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MODELING ELEVEN MILLENNIA OF SEASONAL TRANSHUMANCE AND SUBSISTENCE IN COLORADO'S PREHISTORIC ROCKIES, USA

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Abstract

Three decades of archaeological field studies in Colorado's Southern Rocky Mountains have documented thousands of prehistoric sites and site components occupied from the Late Pleistocene to Early Historic times. Comparative archaeological and Geographic Information System (GIS) modeling studies have reconstructed long-term prehistoric subsistence and paleoclimate/paleoecosystem change in North Central Colorado's mountains resulting in a thirteen millennia model of cultural landscape history. That model proposes establishment, within a millennium and a half of arrival of the region's earliest Clovis hunter-gatherers, of systematic, often logistically-organized, seasonal transhumance strategies between mountain-interior basin valleys, Front Range foothills and high altitude mountain forests and alpine tundra by indigenous native populations, strategies only occasionally modified by periodic introduction of new technologies and cycles of climatic change. The model also incorporates historic environmental data which document past paleoclimate and paleoecological changes that affected regional mountain environments, tempered migratory game species behaviors, and adaptive strategies of four hundred generations of Native American hunter-gatherers.

Keywords: Southern Rocky Mountains, Rocky Mountain National Park, paleoclimate, seasonal transhumance, game drives, base camps, Geographic Information Systems, lithic sourcing, hunter-gatherers, Foraging Theory.

Resumen

En el curso de tres décadas de investigación arqueológica de campo desarrollada en las Montañas Rocosas Meridionales de Colorado se han documentado miles de yacimientos prehistóricos y componentes de yacimientos habitados desde el Pleistoceno Superior hasta los Tiempos Históricos Tempranos. Mediante los estudios de modelado basados en la arqueología comparada y el sistema de información geográfica (GIS) se ha llegado a reconstruir la subsistencia prehistórica de larga duración y el cambio del paleoclima/paleoecosistema en la montaña del norte de la parte central de Colorado elaborándose, como resultado, un modelo de trece mil años de historia del paisaje cultural. Dicho modelo permite distinguir, en un horizonte de mil quinientos años desde la llegada a esa zona de los primeros cazadores-recolectores de la cultura clovis, estrategias sistemáticas y a menudo logísticamente organizadas de la trashumancia estacional entre los valles de cuenca del interior de la montaña, el piedemonte de la Cordillera Front, y los bosques de montaña y la tundra alpina de altas altitudes, desarrolladas por las poblaciones indígenas, estrategias que solo de vez en cuando fueron modificadas por la introducción de nuevas tecnologías y los ciclos del cambio climático. El modelo incluye, también, los datos medioambientales históricos que documentan los cambios paleoclimáticos y paleoecológicos que en el pasado afectaron el medio natural de montaña de esta región y mitigaron los comportamientos de las especies migratorias de animales de caza, y, por otro lado, las estrategias de adaptación de cuatrocientas generaciones de cazadores-recolectores nativos americanos.

Palabras clave: Montañas Rocosas Meridionales, Parque nacional de las Montañas Rocosas, paleoclima, trashumancia estacional, excursiones de caza, campos base, Sistema de información geográfica (GIS), abastecimiento lítico, cazadores-recolectores, teoría de la búsqueda de alimento

INTRODUCTION

Rocky Mountain National Park (RMNP), in Colorado's Southern Rocky Mountains, was created in 1915 and today is one of the most often visited national parks in the western United States. Archeological evidence from hundreds of prehistoric sites in the Park and its adjacent region attests to millennia of well-organized exploitation of its varied landscapes and their economic resources (Fig. 1). In a very real sense, the Park constitutes a complex palimpsest, or over-layered accumulations, of ancient through modern natural and cultural landscapes. It is now apparent those landscapes evolved and changed through more than eleven millennia of adaptive Native American subsistence and socio-cultural strategies designed to accommodate dozens of natural cycles of climatic-environmental change from Late Ice Age to early historic times. It is the purpose of the following article to describe and present evidence for a model of early prehistoric through historic era seasonal transhumance that, subject to broad periods of climatic and ecological change, was established and persisted with modest cultural alterations since the end of the Pleistocene.

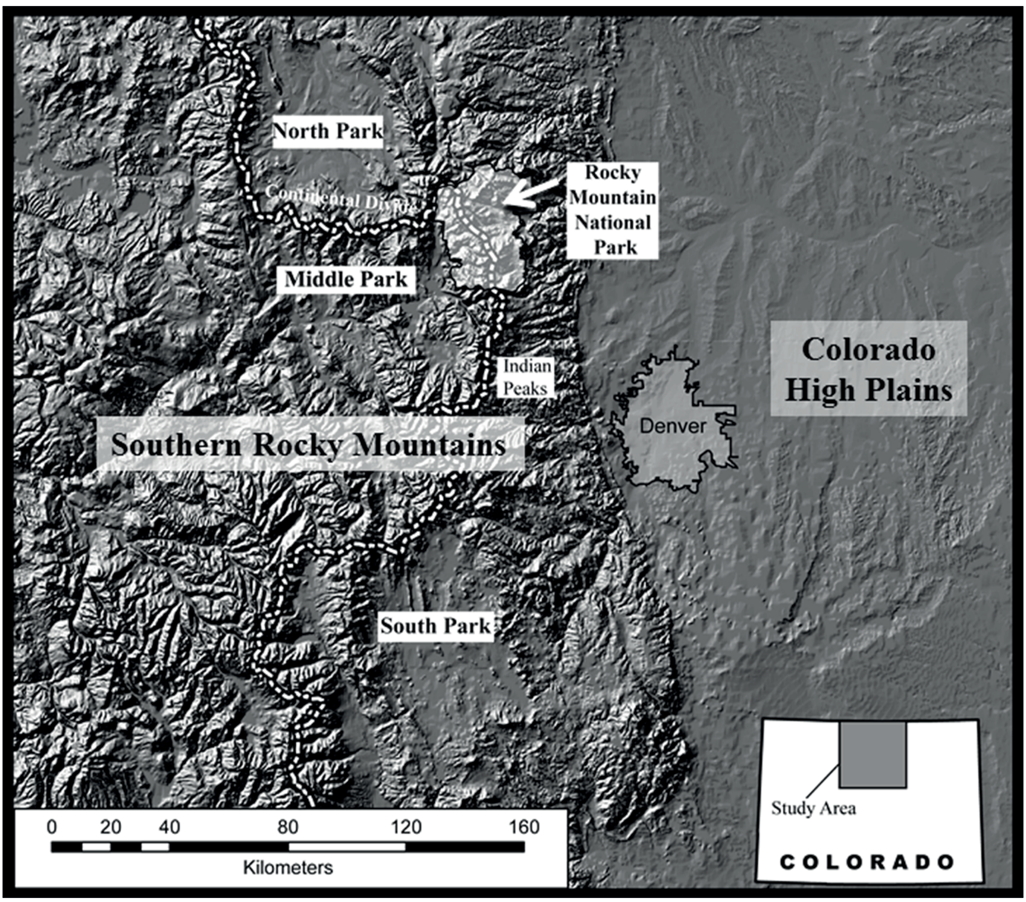

Figure 1. Geographic Information System (GIS) location map of Rocky Mountain National Park and its adjacent interior parkland valleys, North Park and Middle Park.

EVOLUTIONARY PATTERNS OF CULTURAL AND NATURAL LANDSCAPES: HUNTER-GATHERER ECONOMIC AND COGNITIVE SYSTEMS THROUGH THE MILLENNIA

Park environmental zones rise from lowest elevation (~2 226-2 368 m) montane forests dominated by ponderosa pine (*Pinus ponderosa*) which, as elevations increase, transition to Douglas Fir (*Pseudotsuga menziesii*) and interspersed stands of aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta*). The next and highest subalpine forest zone (~2 744-3 507 m) is dominated by Englemann spruce (*Picea engelmanni*). Interspersed throughout the park's forest zones are open grass and forb meadows, frequently located within or near stream and rivers corridors and run-off drainages. Subalpine forest is succeeded in most areas by a transitional (ecotone) zone of krummholz (scattered islands of stunted, dwarf spruce and fir bushes and trees) interspersed with open spaces of alpine grasses and forbs. Finally, the park's highest environmental zone (~3 507-4 345 m) is alpine tundra, consisting of exposed tree-less alpine grass and sedge meadows with occasional low shrubs (e.g., willow-*Salix arctica*) in wind-sheltered areas. Alpine tundra is the most significant environmental zone for past Native American hunter-gatherers since it has almost continuously provided rich summer forage for migratory game animals for millennia.

Rocky Mountain National Park's Native American cultural landscape, once established in the Late Pleistocene, accumulated and evolved as its climates and ecosystems cycled through subtle and, at times, substantial, environmental changes as regional human populations adapted, invented, modified, and adopted new internally developed and externally introduced technologies and subsistence strategies. Once in place, those strategies were maintained for millennia with evolving cultural adaptations and occasional infusions of new technologies and in-migration of native groups from outside the region. Almost without exception, Native American adaptive strategies involved variations of annual spring through fall migrations of hunter-gatherer bands into the Park from adjacent wintering territories of bordering eastern foothills and western mountain valley parklands to exploit its rich warm season resources of game and edible plants and late summer-early fall outmigration from the Park with onset of winter. Over-wintering in the current Park's own valleys, particularly the milder Estes Park valley on its eastern border, undoubtedly occurred at times, particularly in milder and warmer periods such as the broadly warmer-than-present climatic episode often termed the Altithermal or Hypsithermal in North America (ca. 8,300-5,700 14C cal yr b.p.) (cf., Benedict and Olson 1978; Brunswig 2014b; Doerner 2007:24-25, 29; Meltzer 1999), but its summer inhabitants, based on present archeological record and historic ethnographic evidence, more frequently wintered in lower elevation, more sheltered mountain basin sagebrush park steppe-land valleys, or less commonly, in eastern Front Range foothills outside its modern boundaries. These same interior mountain valleys and eastern Front Range foothills in historic times are documented as containing resident bison herds and pronghorn antelope populations as well as having served as winter ranges for other major game species (elk, deer, and rarely bison) which migrated to the Park's high tundra pasturelands in summer and early fall.

ARCHAEOLOGICAL, HISTORIC AND PALEOCLIMATE/ PALEOECOLOGICAL RECORDS OF ROCKY MOUNTAIN NATIONAL PARK AND ITS REGION

Systemwide Archaeological Inventory Program (SAIP) surveys and test excavations in Rocky Mountain National conducted by the University of Northern Colorado (1998 to 2002) were one of the most extensive research programs ever donein the Southern Rocky Mountains (cf., Brunswig 2005a, 2005b). The university's park research program, which employed Colorado university students and was highly interdisciplinary in nature, involved several years of large-scale archaeological surface surveys, test excavations, and extensive paleoclimate and paleoecology research. Despite intensive survey of 12,140 hectares (30,000 acres), one of the project's central research questions, whether evidence of extended winter encampments existed within Park boundaries, remained unanswered. However, project researchers did document significant evidence, in the form of thousands of projectile points, stone tools, pottery, and site radiocarbon dates, a thirteen thousand year presence of Native American hunter-gatherers in the Park, dating from Colorado's earliest known inhabitants (Clovis culture) to the late 19th century when regional historic tribes were restricted to reservations far outside modern Park boundaries. Table 1 summarizes the sequence of Park cultural occupations from the Late Pleistocene to the historic era within the framework of currently recognized archaeological traditions whose chronology is well-established by radiocarbon-dating throughout the western U.S. Summary details of that framework and its absolute chronology are presented in Table 1, its radiocarbon-chronology shown as both conventional date and calendar-age (calibrated) date ranges. The calendar-age date ranges, which account for past variations in earth's atomospheric radiocarbon reservoir (cf., Bronk Ramsey et al 2010; Reimer et al. 2013), were corrected using Oxcal 4.2 correction software available at the Oxford University Radiocarbon Laboratory web site https://c14.arch.ox.ac.uk).

Modeling Cultural-Ecological Adaptations of Past Native Americans

Archeological and environmental-ecological evidence indicate that, by the start of the Early Holocene, ca. 11,000 14C cal yr b.p. (calendar-age radiocarbon chronology) (Brunswig 2014b; Brunswig, Doerner and Diggs 2014a, 2014b: 62-66, 2015b), alpine hunting systems employing sophisticated procurement strategies were evolving to harvest seasonally-migrating elk, Bighorn sheep, and wandering individuals or small groups of mountain bison who grazed the Park's rich, short-season tundra grasses, shrubs, and herbaceous vegetation. Once established, those hunting systems appear to have been consistently in operation until late historic (Euro-American) times (cf., Brunswig 2014c; Brunswig, Doerner, and Diggs 2014a, 2014b, 2015b).

Current evidence suggests no significant gaps in high mountain environmental zone occupations since the Folsom cultural period and its accompanying intensively cold Younger Dryas climatic episode (Brunswig 2007: 274-277, 2014c; Brunswig, Doerner, and Diggs 2014b: 52-55) although scope and intensity of Park land-use likely varied through time, depending on changing climatic-ecological and cultural variables. Alpine hunting may have reached its height as an annually persistent seasonal activity in the warmer-than-present early Late Paleoindian and subsequent Early Archaic periods, during the early mid Holocene (Brunswig 2014b; Brunswig, Doerner, and Diggs 2014b: 67-71), but paleoclimate data, high elevation settlement patterns, and recently modeled tree-line elevation histories indicate summer alpine hunting persisted even when climate was cooler than today, when small glaciers (Neo-glacial episodes) were activated, and more seasonally persistent high altitude snowfields limited access and animal grazing in some Park areas (Brunswig 2014b; Brunswig, Doerner, and Diggs 2014b: 50-62). The Park's prehistoric record supports existence of the following synthesized succession of hunter-gatherer techno-economic systems which evolved over nearly thirteen millennia (calendar-age radiocarbon chronology) (Brunswig 2004a, 2004b, 2005a, 2007, 2014b; Brunswig, Doerner, and Diggs 2014a, 2014b; Doerner and Brunswig 2008; Table 1 above).

The Park's earliest human occupations, ca. 13,185-12,851 14 C cal yr b.p., are evident in the limited presence of Clovis hunting bands in lower mountain valleys, some passes, and high-elevation subalpine and tundra areas (cf., Brunswig 2001b, 2001c, 2003b, 2004a, 2004b, 2007: 269-272). The presence of an earliest Paleoindian culture Clovis point in the Park's La Poudre Pass show that previously glaciated pass was effectively "ice-free" and open to human transit by the terminal Pleistocene (Brunswig 2003a, 2004a, 2007:270-272). To date, there is no evidence of more than simple

Regional Cultural Periods[1]	Conventional Radiocarbon-Date Range[2]	Calendar-Age (Calibrated Age) Range[3]
Early Paleoindian/EP (CL)=Clovis; (FSM)=Folsom; (GO)=Goshen	Clovis-11,300-10,900 BP; Goshen-10,450-10,153 BP; Folsom-10,950-10,250 BP	Clovis-13,185-12,851 BP; Goshen-12,500-11,800 BP; Folsom-12,871-12,007 BP
late Early Paleoindian/EP (AB)=Agate Basin	Agate Basin-10,430-9,350 BP	Agate Basin-12,212-10,590 BP
Late (Mountain) Paleoindian/LP	9,400-7,700 BP	10,689-7,835 BP
Early Archaic/EA	7,500-5000 BP	8,287-5,738 BP
Middle Archaic/MA	5,000-3,000 BP	5,738-3,165 BP
Late Archaic/LA	3,000-1,900 BP	3,165-1,735 BP
Early Ceramic/EA	1,900-900 BP	1,735-856 BP
Late Prehistoric (Middle & Late Ceramic/Lpreh-MLC	900-650 BP	856-642 BP
Terminal Late Prehistoric-Protohistoric-Early Historic/Lpreh-EH	650-85 BP	642-85 BP

1. Primary cultural period definitions and sources are Benedict and Olson 1978; Brunswig 2007, 2012; Chenault 1999; Gilmore 1999; Kornfeld et al. 2010; Pitblado 2003; Tate 1999.
2. Broadly accepted standard (conventional) and non-radiocarbon reservoir corrected cultural period time ranges.
3. Calendar-age (corrected) radiocarbon date ranges. Corrections for past radiocarbon fluctuations used Oxford University's on-line Oxcal 4.2 software (cf., Reimer et al. 2013).

Table 1. Southern Rocky Mountain cultural periods represented by diagnostic projectile points and radiocarbon-dated camp occupations within Rocky Mountain National Park boundaries. Capital letter codes for each period and associated archaeological cultures/technological complexes and cultural period names, used in following text map figures, are shown in the table's left column.

hunting (tracking/ambush) strategies for Clovis bands, but Clovis projectile point materials come from both local (mainly from adjacent Middle Park and North Park valleys to the west and northwest) and non-local (exotic non-mountain) sources, suggesting good local terrain and resource awareness and incipient development of what later became an indigenous "mountain-based" adaptive tradition, sometimes termed the Mountain or Mountain-Foothills Tradition (cf., Black 1991; Brunswig 2007: 277-283; Frison 1992, 1997; Pitblado 2003, 2007).

In waning Late Pleistocene centuries, ca. 12,851-11,750 14C cal yr b.p., human visitation to and exploitation of Park landscapes were restricted by renewed cooling and modest re-glaciation of high altitude passes, cirques and col valleys during a period of world-wide climatic change known as the Younger Dryas Episode, or, regionally, as the Santanta Peak (neo-glacial) Advance (Brunswig 2005a: 46-51, 2007: 298-299, 2014c; Brunswig, Doerner, and Diggs 2014a, 2014b: 20-21, 2015b; Doerner 2007). Even after several years of systematic archeological survey throughout the Park's diverse environmental zones, only two sites were found with evidence of human occupation during the Younger Dryas time span; a single, possibly curated, Folsom point at Forest Canyon Pass (5LR2) and a short-term Goshen-Plainview camp (5GA2537) in nearby Milner Pass. During this time, it is considered likely seasonally-persistent snowfields prevented even warm-season use of the region's highest alpine and alpine-subalpine ecotone zones by human and game populations (cf., Brunswig 2007: 275-276; LaBelle 2012: 147-148).

With easing of Younger Dryas (Santanta Peak [Neo-Glacial] Advance) cold after ca. 11,750 14C cal yr b.p., paleoenvironmental studies (cf., Brunswig 2007: 299, 2014b; Brunswig, Doerner, and Diggs 2014a, 2014b; Doerner 2007) document onset of pronounced Early Holocene warm- wet climate associated with longer alpine summer growing seasons and greater accessibility of high altitude summer range to migratory game herds. Climate change research by the author and his colleagues recently utilized radiocarbon-dated subalpine forest tree remains in an alpine pond and a long-preserved ice patch in Park alpine tundra to model prehistoric tree-lines (and warmer than present-day) at ~130 m above modern-day boundaries at ca. 10,600 14C cal yr b.p. (Early Holocene) and ~75 m above modern-day tree-line at ca. 4,300 14C cal yr b.p. (Mid-Holocene) (Brunswig 2014b: 103-104; Brunswig, Doerner, and Diggs 2014a, 2014b: 30-33, 39-41). The latter tree-line reconstruction at +70 m represents a period of actively descending tree-lines and regional cooling from earlier higher Mid-Holocene levels when tree-lines were even higher in the preceding two to three millennia.

Our (and others') climate research (see above citations) suggests that, between ca. 8,500 and 7,500 14C cal yr, Park tree-lines began to descend in response to cooler summer temperatures due to a minor regional re-glaciation event (associated with a yet unnamed neo-glaciation advance). That still poorly defined neoglacial event signaled the end of the Early Holocene climatic sub-epoch and start of the Mid-Holocene, the latter characterized by an extended period of alternating warmer-than-present-day and slightly cooler-than-modern-day climate cycles referred to as the Altithermal Episode, dating between 7,500 and 4,500 14C cal yr b.p. After ca. 4,500 14C cal yr b.p. and beginning of the current Late Holocene sub-epoch, renewed neo-glaciation (the Triple Lakes Advance) and its cooler climate lowered tree-lines to modern or slightly below-modern levels. At that time, alpine summer growing seasons were shortened and access to tundra pasturelands was periodically restricted to game and human populations by more persistent summer snowfield cover and less abundant tundra forage grass and forb growth (cf., Benedict 1999; Brunswig 2014b: 104; Brunswig, Doerner, and Diggs 2014b: 55-59). Neo-glaciation waned after ca. 2,700 14C cal yr b.p. with brief interruptions and relatively low impact cooling by short neo-glacial cycles at 1,850-900 14C cal yr b.p. (Audubon Advance) and 300-150 at 14C cal yr b.p. (Arapaho Peak Advance). During the past three millennia, modern-era climate and tree-line conditions were well-established, with periodic cycles of upward /downward tree-line shifts of only a few meters, e.g., +5 to -10 m.

Archeological evidence suggests that, between ca. 10,600-7,800 14C cal yr b.p. and possibly earlier, indigenous mountain-adapted Late Paleoindian populations emerged and developed the region's earliest sustained, seasonally transhumant, high altitude hunting systems. Tool material source analyses of Park lithic assemblages (Brunswig 2005a: 177-186; Wunderlich and Brunswig 2004) indicate those transhumance patterns, as discussed below, were strongly biased toward late fall-early spring residence in interior mountain parkland valleys (mainly Middle Park and North Park to the west and northwest) and, possibly less frequently, winter-based in the eastern Front Range foothills and adjacent plain piedmont, with hunting-gathering bands seasonally migrating into Rocky Mountain National Park in mid-late spring through early summer, moving to high subalpine forest and tundra from mid-summer through early fall, and exiting the Park for winter territories by late fall-early winter.

Recent (2003-2014) UNC surveys and excavations in the adjacent interior basin North Park valley support a pattern of mainly (70-80%) interior montane utilization of local (within 75 km) lithic tools materials (primarily chert, quartzite, rhyolite, and petrified wood), closely matching lithic source patterns for Rocky Mountain National Park, described in detail below (cf., Brunswig 2014b, 2015a; Brunswig and Diggs 2014:77-80). At times, as an alternative to cold season residence in large interior montane parkland valleys west and northwest of the Park, it is possible some groups chose to winter within current Park boundaries, particularly during periodic warming climatic cycles, while other groups seasonally migrated into the Park from eastern Front Range foothills and plains although lithic sourcing evidence indicates this latter pattern may not have been particularly common through time (cf., Brunswig 2005a: 186 and discussion below).

Seasonally Scheduled Subsistence Patterns of Past RMNP Native Peoples: Elaboration of the RMNP Model and Evidence for its Presence

As described in earlier publications (e.g., Brunswig 1999, 2000a, 2001a, 2002b, 2004a, 2004b, 2005d, 2007, 2013b, 2014c), by early Late Paleoindian (10,689-9,258 14C cal yr b.p.) through Early Archaic times (ca. 8,287-6,000 14C cal yr b.p.), a well-developed seasonally transhumant, lower-higher elevation hunter-gatherer subsistence pattern emerged and persisted with technological changes (and improvements) associated with evolving socio-cultural adaptations and responses to natural climate-ecosystem cycles down to Early Historic times. Archeological research in the Park and its surrounding mountain region indicates persistent seasonally scheduled subsistence activities of Native American groups.

Seasonal subsistence systems are believed to have involved annual transhumance rounds within three seasonally-defined stages: 1) Late Spring-Mid Summer; 2) Mid-Summer to Late Summer/ Mid Fall; and 3) Late Fall-Early Spring. Fig. 2 shows a graphic representation of the most likely mountain subsistence model. It should be emphasized that earlier archeologists, particularly James Benedict (1990: 68-71; 1992; Cassells 1997: 200-202), have proposed broadly similar models. One of his models, his Up-Down model (1992: 1-14), preconfigures and closely parallels the model for Rocky Mountain National Park described in this article.

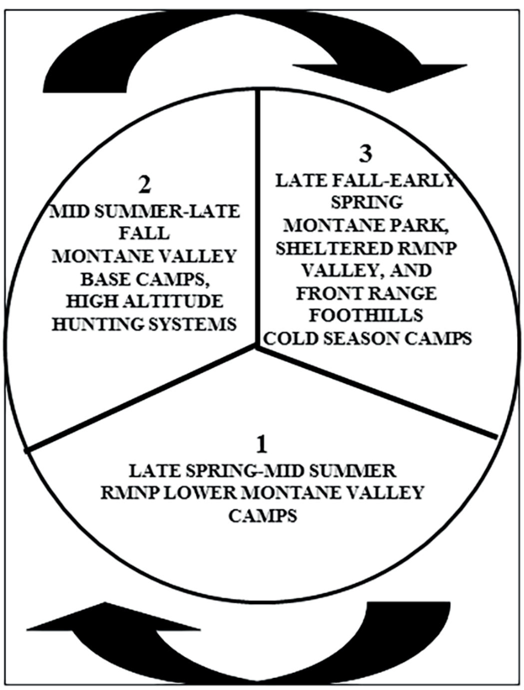

Figure 2. Transhumance migration model for prehistoric subsistence strategies in Rocky Mountain National Park and its surrounding region.

Evidence supporting the RMNP subsistence model is provided in subsequent sub-sections which describe primary elements of annual seasonal lowland-highland subsistence rounds and presents archeological evidence documenting that model's "fossilized" imprint on the contemporary Park landscape. It is important to note that evidence presented here represents only a *selective* sampling of data assembled by SAIP and earlier and subsequent Park investigations. In fact, the full body of evidence supporting the model is extremely extensive and any full treatment would have unduly expanded this article's length, an unnecessary task since other lines of evidence and detailed analyses have been, and will continue to be, presented through Park and other UNC mountain research project reports and formal publications (cf., Brunswig 2001a, 2001b, 2001c, 2003a, 2003b, 2004a, 2004b, 2005a, 2005b, 2005c, 2007, 2012, 2014b; Brunswig et al. 2009; Brunswig and Lux 2014; Doerner and Brunswig 2008; Doerner 2004, 2007). Rocky Mountain National Park's prehistoric subsistence patterning, in its broadest sense, is viewed by this author to have included three annual phases of migration, residence, and subsistence activities (see Fig. 2). These are:

Phase 1-Late Spring-Mid Summer Transhumance Pattern

From late spring to mid-summer (depending on the degree of warmer or colder climatic patterns through time), bands from areas outside the current park boundaries would have established, or re-occupied previously utilized lower elevation mountain base camps while high altitude tundra grazing territories were still under snow cover and subject to persistent high elevation cold and wind chill conditions. It is also considered likely some Park areas, particularly lower elevation valleys east of the Continental Divide such as Estes Park, would have provided sheltered localities for winter camps during milder climatic periods. In some locations where high altitude tundra was accessible in relatively short travel times (a few hours at most), low elevation camps may have been re-occupied periodically during the summer after short forays to high altitude (tundra-subalpine forest) hunting areas. In the latter case, some band members too young or infirm (from age or illness) may have been left behind in low elevation base camps while more physically capable men and women would have made short-term visits to high altitude hunting camps and kill areas. It is possible some members of larger hunter-gatherer bands, particularly more elderly and younger members, could have remained in cool-season camp locales during the summer in adjacent intermountain, e.g., North Park, Middle Park…) areas while more physically capable members pursued seasonal summer procurement rounds in adjacent, more physically challenging high montane terrains.

Phase 2-Mid Summer-Early Fall Transhumance

From mid-summer to late summer, some or all members of hunter-gatherer bands periodically visited or re-located to longer-term base camps in the Park for several weeks, camps with easy access to high altitude hunting territories, moving up well-established trail systems following seasonal game migrations of primarily elk (*Cervus Canadensis*, also referred to as *Cervus elephaus*) and bighorn sheep (*Ovis Canadensis*), but also smaller numbers of bison (*Bison bison*) and mule deer (*Odocoileus hemionus*), to upper subalpine, alpine-subalpine ecotone and tundra areas. There is no evidence that bison or deer prehistorically regularly ventured beyond subalpine forest into alpine-subalpine ecotone or tundra which were normal summer range grazing territories of elk and Bighorn sheep. In the present day, elk begin migrations from winter ranges in lower elevation interior mountain valleys to summer ranges in upper subalpine forest to alpine tundra zones from mid-May through June (Green and Bear 1990: 273; Zeigenfuss 2006). Establishment of regular daily use of tundra grassland summer ranges by elk and Bighorn sheep would have occurred in the past when winter tundra snowfields largely melted away and opened grasslands started new growth with the short summer growing season between early and mid- July. Each year, hunting bands would have returned to previously known and utilized kill localities, areas topographically suited for hunting game animals and often enhanced by the construction of ambush "blinds", rock wall-lined "drive" corridors, and modifications natural cover and trap features, e.g., boulders, ridge scarps, and confining terrain such as narrow erosion draws on steep mountain slopes. It is likely major hunting locations (e.g., game drives) were not used in successive years but their use was alternated over time, allowing game herd "memories" of past hunts to fade from the collective herd and individual herd members which survived and escaped from past hunts (cf., Benhaiem et al. 2008; Festa-Bianchet 1988; Kie 1999).

Archeological research has shown, based on the presence of chronologically diagnostic projectile point types and occasional radiocarbon dates, that many kill sites remained in periodic use for several millennia and sites we refer to as "game drives" represent complex palimpsests (overlays of multiple occupations on individual sites) of construction and re-modeling by many, in some cases more than three hundred, Native American generations. Most game drive systems in the Park and its region, part of more complex hunting systems often involving numerous staging and processing (butchering) camps, exhibit extremely long histories of adaptive technological change and development (cf., Benedict 1975, 1985, 1992: 4-9, 1996; Brunswig 2004b; Doerner and Brunswig 2008; LaBelle 2012; LaBelle and Pelton 2013).

Geographically aggregated warm season kill localities (game drives or natural ambush localities) which make up the Park's hunting territories were often logistically supported by: 1) very short-term game processing camps, usually situated in close proximity to the individual kill sites, often on tundra or alpine-subalpine ecotone benches and knolls, and 2) more substantial, longer-term secondary staging, i.e., base, camps, the latter frequently situated in more protected alpine-subalpine ecotone or upper subalpine knolls and benches, generally within easy travel distance of kill areas (cf., Benedict 1992: 4-9).

Phase 3-Late Fall-Early Spring Transhumance Pattern

By late fall-early winter, cold weather and snow would have driven both humans and animals from the high tundra into lower mountain valleys, either within current Park boundaries, or more likely, into two large parkland valleys, Middle Park and North Park, immediately to the west and northwest. Alternatively, some hunter-gatherer bands would have descended the eastern side of the Continental Divide and wintered in mountain valleys (such as around Estes Park), or moved down stream corridors to the east and southeast into the Front Range foothills or more sheltered river floodplains and hills of the Colorado Piedmont. Except in periods of unusual mildness (warmer climate intervals), historic ethnographic accounts suggest limited appeal for winter occupations in the Park's lower montane valleys although today's Estes Park area has relatively mild winters compared to other Park areas, particularly the wetter, snowier Kawuneeche Valley west of the Continental Divide (Brunswig and Lux 2014; Toll 1962: 18). The large intermontane valleys to the west, specifically Middle Park and North Park, would have provided abundant shelter, water, fuel, and over-wintering game herds of bison, elk, deer, and pronghorn to support small populations of hunter-gatherers who hunted the Park from spring through fall.

An emerging body of evidence from archeological surveys and excavations by the University of Northern Colorado in the adjacent North Park valley shows that numerous high ridge line saddles and adjacent, lower drainage swales were employed to maneuver game animals such as elk (*Cervus Canadensis*), pronghorn antelope (*Antilocapra Americana*), and occasionally, bison (*Bison bison*) into kill zones, utilizing complex systems of rock walls and game blinds in game drive systems closely resembling those, subject to terrain differences, documented in Rocky Mountain National Park's alpine areas (cf., Brunswig 2003c, 2004c, 2005c, 2013a, 2013c, 2014a, 2014b; Brunswig and Diggs 2014; Brunswig, Doerner, and Diggs 2015a). Early and later cool season (winter-spring and fall-winter) use of North Park valley ridge line game drives is suggested by the fact that one of the two probable drive species, elk, would have largely migrated from the valley into upper elevation environmental zones by early to mid-summer. It is considered likely that, except during the most extreme winter conditions (and perhaps even then), ridge-line drives could have operated during late fall, winter, and early spring months as long as game herds of bison, pronghorn antelope, and elk had not retreated to protected areas around the valley margins (cf., Brunswig 2003b, 2013, 2014a).

Archeological Evidence for the RMNP Subsistence Model

Supporting evidence for the RMNP subsistence model is assembled from several decades of archeological investigations in the Park and its surrounding region. It is substantially supported by 1998-2002 SAIP survey and testing project results and subsequent smaller field project results in both the Park and adjacent parkland valleys of North Park and Middle Park to the west and northwest. Data from more than four hundred prehistoric sites throughout the Park, encompassing multiple environmental zones from montane forest to alpine tundra, provide substantive evidence of development, time depth, and nature of the model's broad validity. That evidence is highlighted below in the detailed descriptions of individual sites and site clusters which document archeological evidence for flexible and often well-planned and *logistically organized* subsistence systems designed to systematically extract seasonally available natural (animal and plant) resources for generations of hunter-gatherers.

Fig. 3 (below) shows a location map showing selected individual sites and site clusters believed to represent contributing components of hunting territories once existing as part of prehistoric through early historic subsistence systems present in the Park since the Late Pleistocene. Three map locations, 1-3, designate individual foraging and seasonal transit sites in low elevation montane zones with archeological assemblages consistent with early and late season (early-mid spring to late fall-early winter) occupations designed to exploit available plant and animal resources during those seasons and serve as staging camps for relocation to higher altitude environmental zones when winter snow cover melted from the tundra, signaling the start of the summer pastureland grazing season.

Lower elevation, montane through subalpine forest zone, staging camps within reasonable travel time of highland tundra grasslands were likely used during high summer months as longer-term bases for residence by infant, toddler, and more elderly (physically less capable) band members and places of residence for more physically capable (young and mature adult) band members periodically returning from high altitude hunting territories with hides, dried or smoked meat, and food and medicinal plants gathered in those areas. Numbers 4-6 in the figure represent site clusters believed to represent artifact and feature palimpsests of overlaid hunting systems from different cultural periods designed to integrate different site types, e.g., hunting base camps, kill localities, and secondary animal and plant processing stations, for logistically organized game and food plant procurement in the highly productive summer game pastures at and above the Park's tree line. Two of this article's three archaeological reconstructed hunting territories, Flattop Mountain and Mount Ida Ridge, have kill and primary processing sites, the former known as game drives, with constructed rock walls, blinds, and rock cairn lines designed to channel game into kill zones, each tailored to take advantage of local terrain characteristics such as steep slopes, cliffs, boulder fields, etc. A third territory, Bighorn Flats, is the single largest expanse of tundra in the Park which, while having no identified constructed hunting features (e.g., sites with game drive components) does contain an abundance of *natural* trap and ambush localities, including areas of large boulders and mountain slopes with concealing knolls and erosion swales, associated with alpine and alpine-subalpine margin (ecotone) hunting camps. All three hunting territories have secondary game and plant food processing sites situated on or near kill areas and hunt staging camps in tundra-subalpine ecotone and upper margins of subalpine forest.

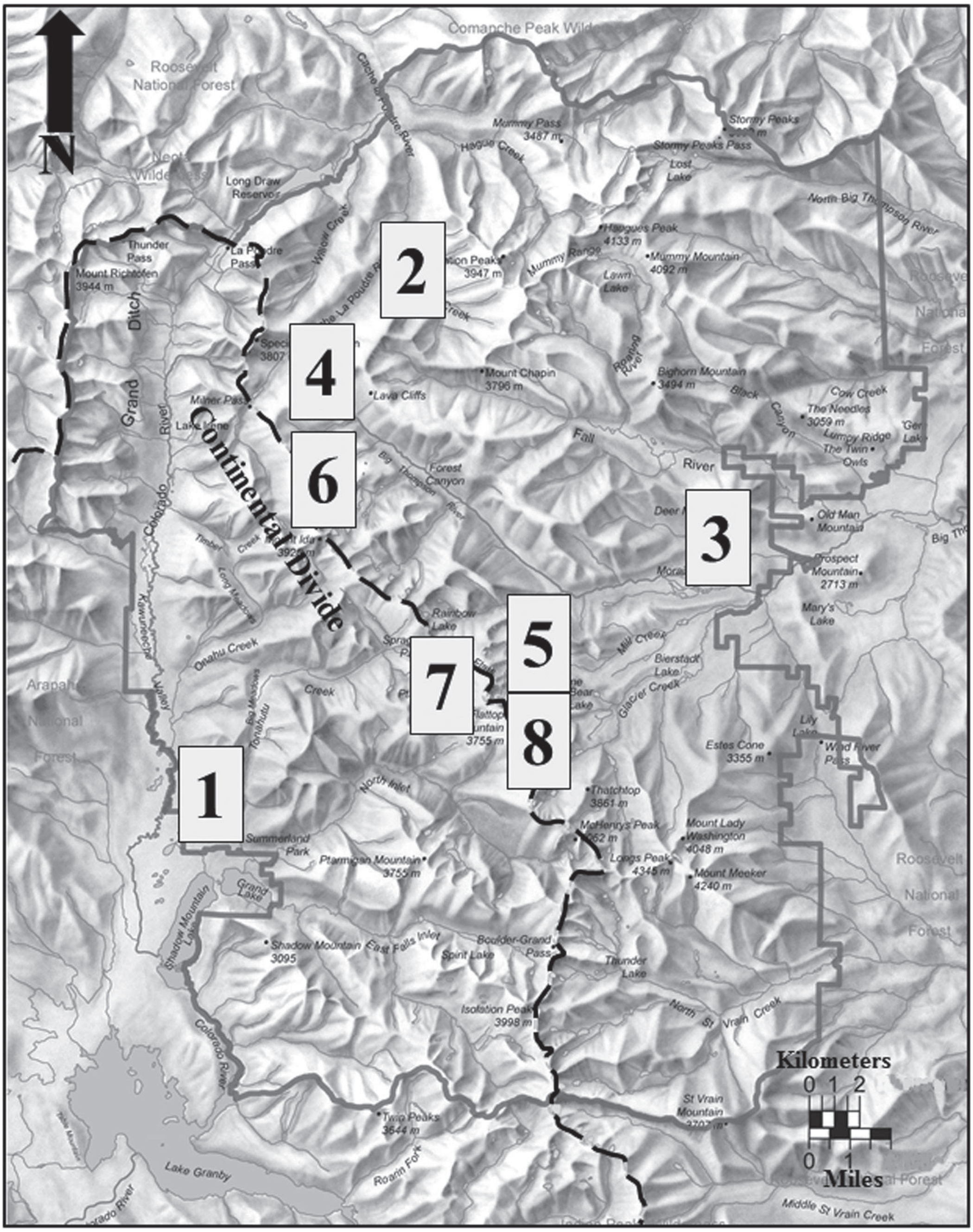

Figure 3. Location of lower elevation base camps: 1-Pontiac Pit site; 2-Cache la Poudre-Chapin Creek Confluence Camp; 3-Beaver Meadow sites; 4- Forest Canyon Pass sites; 5-Lake Helene Trail sites; and high altitude tundra hunting territories: 6-Mount Ida Ridge, 7-Bighorn Flats, and 8-Flattop Game Drive) representing components of Rocky Mountain National Park's prehistoric subsistence systems.

Early and Late Season "Base" and Trail Transit Camps in Lower Elevation Montane Valleys

Two multi-component prehistoric sites and a small cluster of sites along an eastern branch of the ancient Ute Trail, all located in lower elevation montane Park valleys, one in the western Kawuneeche (Fig. 3, No. 1), a second in the northwest, the upper headwaters valley of the Cache la Poudre River (Fig. 3, no. 2), and multiple sites in the east central area of the Park (Beaver Meadows) (Fig. 3, no.3) illustrate what are interpreted as spring and fall base camps, largely occupied by migratory hunter-gatherer bands believed to have entered and left the Park during those seasons.

Pontiac Pit (5GA218)

The Pontiac Pit site (5GA218) is located immediately on the east side of Trail Ridge Road (U.S. Highway 34), 9.5 km north of Grand Lake, on a gently sloping glacial kame terrace (see Fig. 3, no. 1 above). The North Fork of the Colorado River is situated 100 m to the west, only 20 m from the site's edge. A small stream on its north side drains into the Colorado floodplain from upslope lower mountane forest, providing a permanent and close source of water. Pontiac Pit is embedded in a Pinedale Age (Late Pleistocene) Colorado River terrace, consisting of glacio-fluvial drift with a thin (3-5 cm) mantle of eolian silt and fine sand (Madole 1984: 1-2). Figure 4 shows a mapping grade (sub-meter) Global Positioning System (GPS) generated wire frame map of the site and its immediate environs, illustrating its topographically sheltered location within contemporary lower montane forest margins.

Pontiac Pit was discovered during a National Park Service road corridor survey (Lincoln 1978) and extensive excavations (56 m2) were conducted in 1982 and 1983 (Liestman 1986; Madole 1984). Those excavations remain the most complete yet undertaken in the Park and uncovered a buried, multi-component series of shallow camp occupations beginning no later than the Early Archaic Period (7,300-5,200 14C cal yr b.p.) and continuing through subsequent Middle Archaic (5,200-3,125 14C cal yr b.p.), Late Archaic (3,125-1,735 14C cal yr b.p.), Early Ceramic (1,735- 856 14C cal yr b.p.) and Middle/Late Ceramic to early Historic (856-150 14C cal yr b.p.) cultural periods. A possible Late Paleoindian component is indicated by a biface tool fragment with parallel-oblique flaking patterns (Liestman 1986: Figure 11-1a).

UNC re-surveyed Pontiac Pit site in 2000, discovering a second concentration of lithic flakes 75 m south of the earlier recorded site area. That concentration consisted of more than a dozen Windy Ridge Dakota orthoquartzite and Kremmling chert flakes, originating from adjacent western Middle Park and North Park valleys, along with a chert preform and biface tool.

During 1982/83 excavations, Pontiac Pit cultural materials and features were found confined to two upper stratigraphic units (1 and 2). Cultural material was recovered no deeper than 20 cm below the modern surface, although some pit features had been dug into lower culturally sterile glacial kame deposits to a depth of 35 cm. Twenty-seven features, classified into three classes, hearths, roasting pits, and discrete ash and charcoal lenses, were identified. Fifteen were radiocarbon-dated, providing absolute dates for the features and their associated artifacts. The oldest feature (11/15) was dated at 5,282±120 14C cal yr b.p.), and appeared associated with a late Early Archaic (Mount Albion Complex) projectile point. Other late Early Archaic, or, more likely, Middle Archaic, radiocarbon-dated features were 19 (4,564±170 14C cal yr b.p.) and 24 (4,726±120 14C cal yr b.p.). An inferred roasting pit (17) produced a 4,399±160 14C cal yr b.p. date, consistent with the age of two associated Middle Archaic (Duncan and Mallory types) points. The 4,39914C cal yr b.p. date, if part of a Middle Archaic camp component, would be one of that cultural complex's earliest Colorado dates. Two other features: 9 (3,070±50 14C cal yr b.p.) and 13 (3,468±5014C cal yr b.p.) were also within the Middle Archaic time span. Another roasting pit feature (12) was dated at 823±50 14C cal yr b.p. and

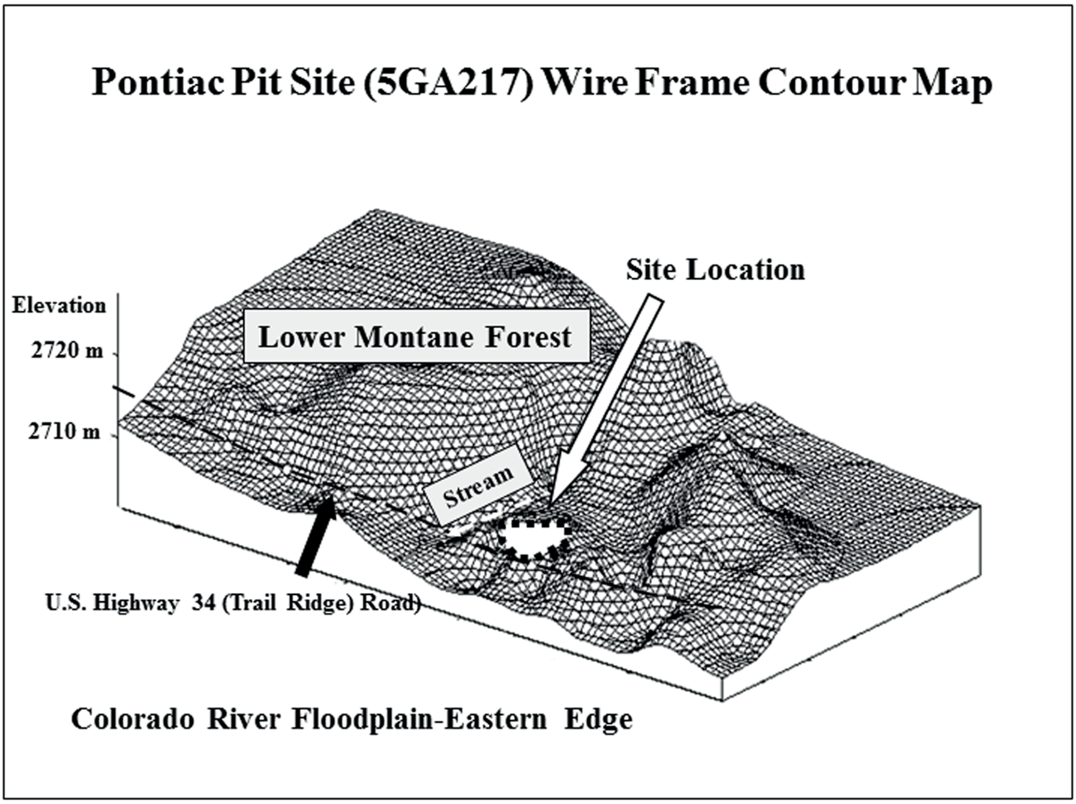

Figure 4. Survey-grade (>.5 m) GPS-logged wire frame contour map of the Pontiac Pit site showing its protective location on an inset terrace bench at the eastern margins of the Colorado River floodplain. The western boundary of montane forest follows the dashed line labeled U.S. Highway 34 in the figure.

physically associated with an Early Ceramic Period corner-notched projectile point. Another roasting pit feature (1) produced a date of 724±50 14C cal yr b.p., consistent with a Late Prehistoric Middle Ceramic Period date while a final roasting pit (feature 16) was dated to 860±180 14C cal yr b.p., associated with an unnotched projectile point type common to Colorado Late Prehistoric Middle or Late Ceramic components. In some cases, projectile point types recovered from later radiocarbon-dated site components were found in association with earlier dated features, showing evidence of stratigraphic mixing in some site areas.

Along with projectile points, the site's lithic assemblage included formal and informal flaked tools such as side and end scrapers, biface knives, a bone-working graver, an edge-retouched blade knife, and one-hundred sixty utilized flakes (informal tools) and nearly six thousand waste flakes, the latter almost exclusively secondary and tertiary stage manufacturing flakes. Although lithic source analysis of flaked tools and debitage was not done by the original excavators, they did note that 95% of Pontiac Pit's projectile points and formal tools were made of a red-brown jasper (56%) and a gray-white chert (39%), descriptions which correspond to Table Mountain jasper and Kremmling chert found within 15 km of the site at Middle Park quarries to the west (cf., Kornfeld et al. 2001; Metcalf et al. 1991; White 1999; Wunderlich and Brunswig 2004). The third most common material type (4-5%), making up most remaining projectile points and tools, was a gray to white orthoquartzite, known regionally as Windy Ridge (Dakota) orthoquartzite and occurring in the adjacent Middle Park valley (Bamforth 1994, 2006).

Both the original site report's lithic source material assessment and the author's analysis of Pontiac Pit artifacts curated in the RMNP Museum confirmed its jasper artifacts were made of Table Mountain (or Grouse Mountain) jasper from Middle Park, its chert artifacts made of local Kremmling (Troublesome Formation) chert, and its quartzite artifacts manufactured from Windy Ridge Dakota orthoquartzite, all from local geologic sources within 75 km of Park boundaries to the west and northwest. Most the remaining (1-2%) flaked tools were made of quartz and rhyolite/andesite from the Park itself. One non-local tool material artifact, the earlier noted biface with Late Paleoindian-age parallel-oblique flaking patterns, was made of Hartville quartzite from south central Wyoming, 150 km to the north. No lithic tool materials from sources east of the Rockies in Colorado's Front Range foothills or plains were identified.

The original Pontiac Pit report noted a "conspicuous absence of ground stone" at the site (Liestman 1986: 48). This author's examination of its artifact assemblage in the Park museum, however, produced three grinding stone fragments, all made of light red Lyons sandstone originating from the eastern Front Range foothills. The presence of basal grinding slabs (referred to as metates or netherstones) suggests plant or dried meat processing occurred during one or more occupation periods. If plant foods, such as dried berries, seeds, or roots, were being processed, then late summer-early fall residence when such plant products were available was a probable season of occupation when grinding stones were in use.

Due to Pontiac Pit's shallow deposits, its acidic soil, and locally severe winter freeze-thaw conditions which limit bone preservation, very little faunal material (eleven fragmented bones) was recovered. Recovered faunal bone was classified as representing small to large mammals, with only a single bone having sufficient diagnostic traits for provisional identification as elk (*Cervus canadensis*). An unusual discovery was recovery of six burnt clay fragments, two pieces which had "impressions of vegetal matter" (Liestman 1986: 102-103; Litaor 1986). Mineralogical analysis of the clay indicated it had been transported from the nearby Colorado River. The presence and nature of the clay, particularly fragments with plant impressions, suggests existence of a formal but simple shelter, probably made of local tree trunks interwoven with branches and sealed against the elements with wet clay, a technique known as "wattle and daub". The lack of soil depth and post-holes indicates the structure (or structures), if it existed, was ephemeral and rested on the then-occupied terrace surface. Construction of a "weather-resistant" shelter may represent an occupation phase at the site when some cool-season residence in the Park occurred although it may also represent early spring in-migration or late fall out-migration rounds rather than winter residence.

Archeological evidence shows Pontiac Pit was a favored camp location over several thousand years. It was located in a sheltered spot with water, game and plant resources associated with the local rich Colorado River riparian environment. The site is also situated near a historically and archaeologically documented Native American travel corridor, the Ute Trail, and near one of the access trails of the ancient Big Trail which crosses the Continental Divide to the east (see Brunswig and Lux 2014; Lux 2004, 2005). Big Trail provides a direct route to the nearby Bighorn Flats hunting system (described below). Its closeness to known high elevation alpine hunting territories, only 2.5 km (1.4 miles) to the east, supports its use as a possible montane zone base camp for hunting parties who ascended and descended the mountain-side to adjacent hunting territories times during the summer and early fall. The site also likely served, at times, as a temporary stopover for hunting bands entering the Kawuneeche valley from winter camps in Middle Park (the overwhelming source of its lithic materials) which traveled north along the Ute Trail to Milner and Forest Canyon passes or turn east and ascended the modern day Green Mountain and Tonahutu trails to Bighorn Flats or traveled further eastward along the Big Trail to the Flattop Mountain Game Drive (described below). When not occupied in the summer as a montane zone base camp, Pontiac Pit would have served as a valley spring-early summer entry and late summer-fall exit camp for brief stop-overs during seasonal in-and-out migrations to and from the Park from Middle Park (or North Park, although it is fairly far south for North Park fall-winter-early spring residents) to provide access to over-wintering camps outside the Park.

The Cache La Poudre Confluence Site

The Cache La Poudre Confluence site, 5LR9826, is located in the upper montane environmental zone just above (north) of a tributary creek confluence with the upper Cache la Poudre River in the northwestern corner of the Park (Fig. 3, no. 2). It is a large (3429 m2) site with six distinct lithic, ground stone, and ceramic concentrations, representing seasonal camps over several thousand years involving cultural groups from late Paleoindian to early historic times (Brunswig 2001: 26-27; 2002c: 49). Fig. 5 shows a map of the site's artifact concentrations and locations of selected projectile point, pottery, metate (grinding stone) fragments, and features (hearths).

Culturally diagnostic artifacts recovered from 5LR9826 included both projectile points and pottery. Projectile point types and associated cultural periods included a Late Paleoindian Frederick/ Lusk/ Angostura point (11,002-8,341 14C cal yr b.p.), two Early Ceramic corner-notched (1735-856 14C cal yr b.p.) points, and a Middle-Late Ceramic side-notched (ca. 900-250 14C cal yr b.p.) projectile point. 5LR9826 produced the Park's only documented example of Middle Ceramic (Upper Republican) pottery (900-650 14C cal yr b.p.). An early historic Ute occupation is documented by Uncompahgre Brownware pottery sherd organic residue which was radiocarbon-dated to 391±50 14C cal yr b.p./ca. AD 1560.

Formal flaked tools, aside from the four projectile points, included two biface knife fragments and a flake core chopper/scraper. The site's only informal tools were three utilized flakes with limited edge wear (edge polish). The majority of formal and informal tools were made of local (within a 75 km radius) mountain-sourced materials, primarily Kremmling chert and Windy Ridge Dakota orthoquartzite. One example each was found of Hartville chert (from south central Wyoming to the north) and a yellow-banded petrified wood from the plains east of the Front Range mountains and a tool made of a white chert believed to have originated in the eastern plains. One hundred-nineteen waste flakes (debitage) were collected, nearly all from mid-lithic reduction stages (2 and 3). Latest stage (4) retouch flakes were rare, but due to their lightness and small size may have eroded away and are less frequently represented than larger flakes (cf., Andrefsky 2005, 2009; Brunswig and Diggs 2014: 77-78; Cotterel and Kamminga 1987; Shott 1994). Material source analysis of the waste flake (debitage) sub-assemblage showed overwhelming source provenance from Middle Park and North Park west of the Continental Divide. Local interior mountain-sourced materials made up 85.09% of all debitage. Non-local or exotic (at a minimum radius distance of 75 km) flake debris came from eastern plains sourced petrified wood (2.63%) and an unknown source chert (12.28%) which *may* have derived from eastern Front Range foothills or plains. However, a caveat on the eastern (non-mountain) source identifications is based on the fact that initial tool source material identification by the author for the site occurred prior to 2002. Subsequent lithic source studies in the mountain region, particularly in the current North Park research program, suggest that many tool materials identified before 2002 as non-local (e.g., Colorado Front Range foothills and plains or beyond) are now considered likely to have come from now better known North Park and Middle Park valley sources to the west (cf., Brunswig, Doerner, and Diggs 2015a).

The Cache La Poudre Confluence site is a low montane forest camp occupied repeatedly over several thousand years. Its adjacent upper Cache La Poudre river and a small tributary of the river are prehistoric Native American trail route corridors into and from the Park, both ascending to major passes with access to hunting territories and camps on high mountain slopes and high tundra grasslands on the Continental Divide. It represents both a short-term hunting camp for the local river valley and a travel access stop-over point for hunter-gatherer bands entering the Park from the North Park valley to the west and ascent within the Poudre River valley which connects to northern Front Range foothills in the east.

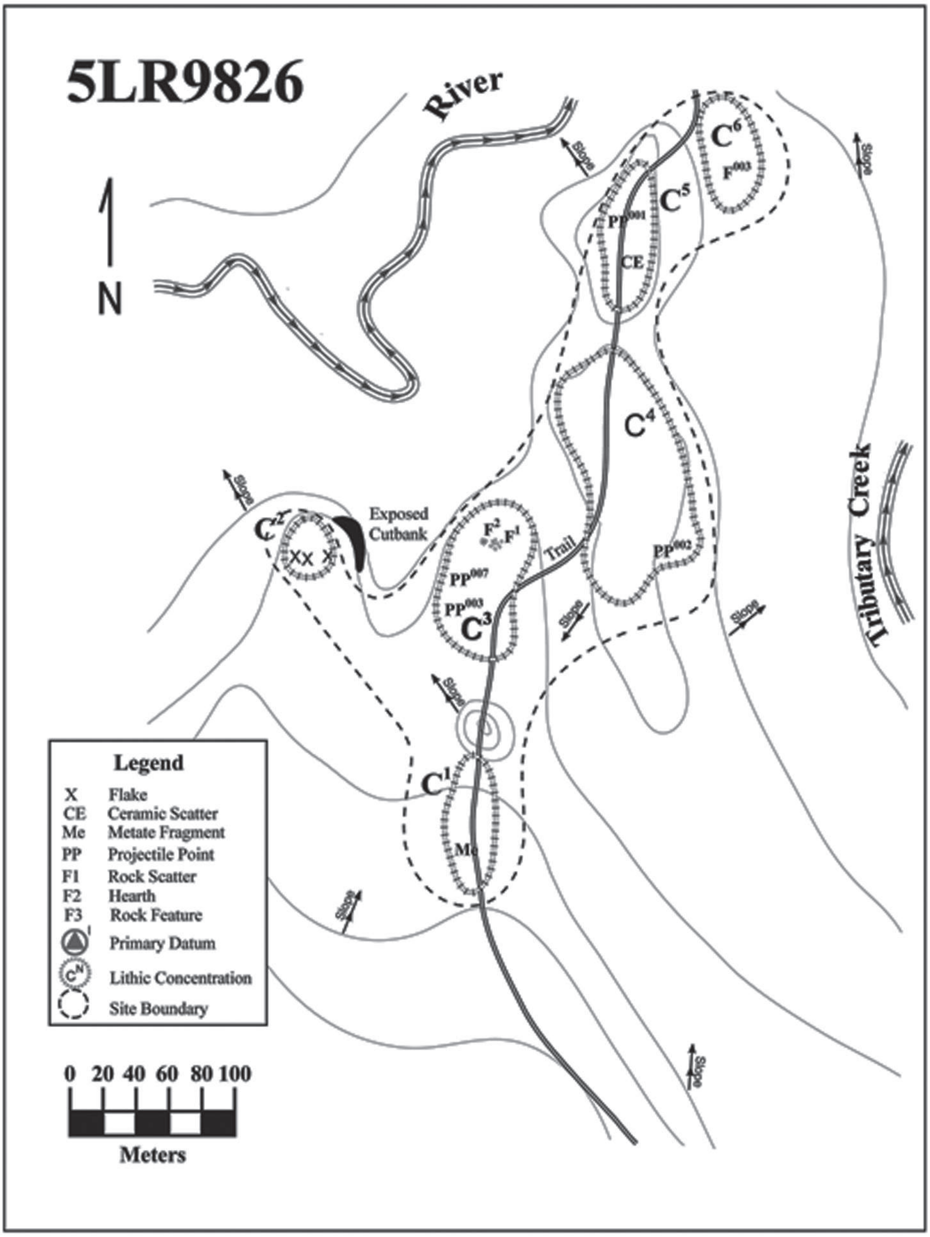

Figure 5. Site map of 5LR9826 at the Cache La Poudre River-Chapin Creek site.

Beaver Meadows Lower Montane Camps

SAIP surveys in 1999 and 2000 documented several prehistoric sites along an eastern extension of the Ute Trail in Beaver Meadows, a small wet meadow valley in east central Rocky Mountain National Park (Brunswig 2005a; Brunswig and Lux 2014; Lux 2005, see Fig. 3, no. 3 above). Beaver Meadow campsites are concentrated along the lower northern slope of a local landscape feature, the North Lateral (glacial) Moraine, which forms a ridge-line divide between Beaver Meadows and the adjoining valley to the south, Moraine Park (Fig. 6). All sites were situated on grassy meadow or lightly forested benches overlooking the meadow and the moraine's lower ponderosa pine forest slopes. While some sites lacked diagnostic artifacts, they provided rich evidence of short-term hunting camps containing lithic tools associated with game processing, plant or dried meat grinding (grinding stones, metates) and tool refurbishment. Other sites, whose locations are also shown in Fig. 6, contained diagnostic artifacts as well as evidence of a range of short-term camp activities consistent with hunting, gathering, and plant and game animal processing.

Two more archeologically significant Beaver Meadows sites are 5LR3891 and 5LR3899. Brief descriptions of both are presented in order to provide the reader a sense of their role and cultural affiliation as lower elevation montane camps used by seasonally migrating hunter-gatherers.

5LR3891 is an extensive prehistoric multi-component camp and historic artifact scatter (Fig. 7) situated in a small protected alluvial fan along a narrow swale draining the North Lateral Moraine

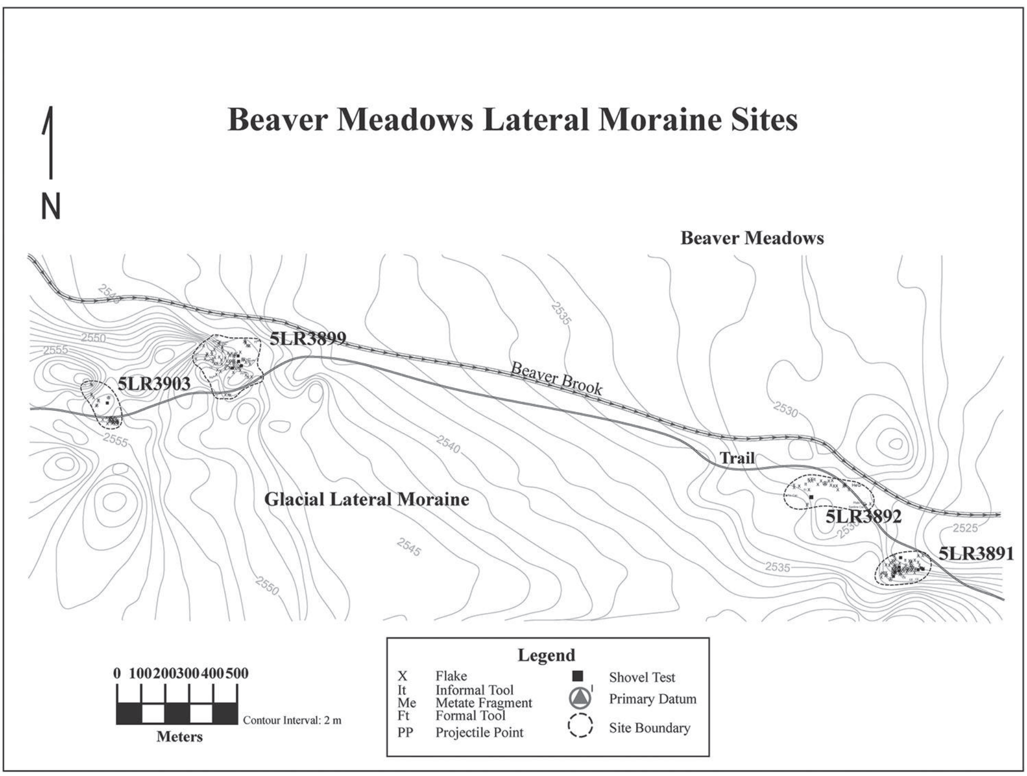

Figure 6. Area map showing locations of North Lateral Moraine sites along the modern trail (and branch of the ancient Ute Trail) in Beaver Meadows.

into Beaver Meadows. Its main area is immediately south of a modern-day riding and hiking trail on the southern margins of Upper Beaver Meadows. The modern trail was also an important branch of the prehistoric and early historic era Ute Trail (Brunswig and Lux 2014; Lux 2004, 2005). Site dimensions are 30 x 30 meters (~900 m2). Its prehistoric components contain numerous lithic flakes, stone tools and projectile points (hafted bifaces). Identified projectile point types from surface finds and one recovered from a test excavation unit suggest at least two cultural period occupations: the Middle Archaic (McKean Complex Duncan projectile point]-ca. 5,738-3,165 14C cal yr b.p.) and Early Ceramic periods (Plains Woodland culture-[various corner notched projectile points] ca. 1735-856 b14C cal yr b.p.). Charcoal from one test unit produced a mid-late Early Ceramic cultural period radiocarbon date of 1,175±40 14C cal yr b.p.

The presence of numerous prehistoric flakes, points, and tools reflect lithic tool manufacture/refurbishment and animal product processing activities. Plant processing is evident in the presence of metate fragments. Two seasons of test excavation recovered numerous lithic materials, mainly secondary and tertiary manufacturing and edge retouch (sharpening) flakes, from four stratified cultural levels which extended to a depth of 40 cm before a boulder-dense glacial till layer was encountered. An undated rock-lined hearth was discovered in one test unit from the site's lowest stratigraphic unit (4).

The site's artifact assemblage represents a full range of game and plant processing tools, including formal flaked tools such as projectile points, scrapers, and biface knives and informal

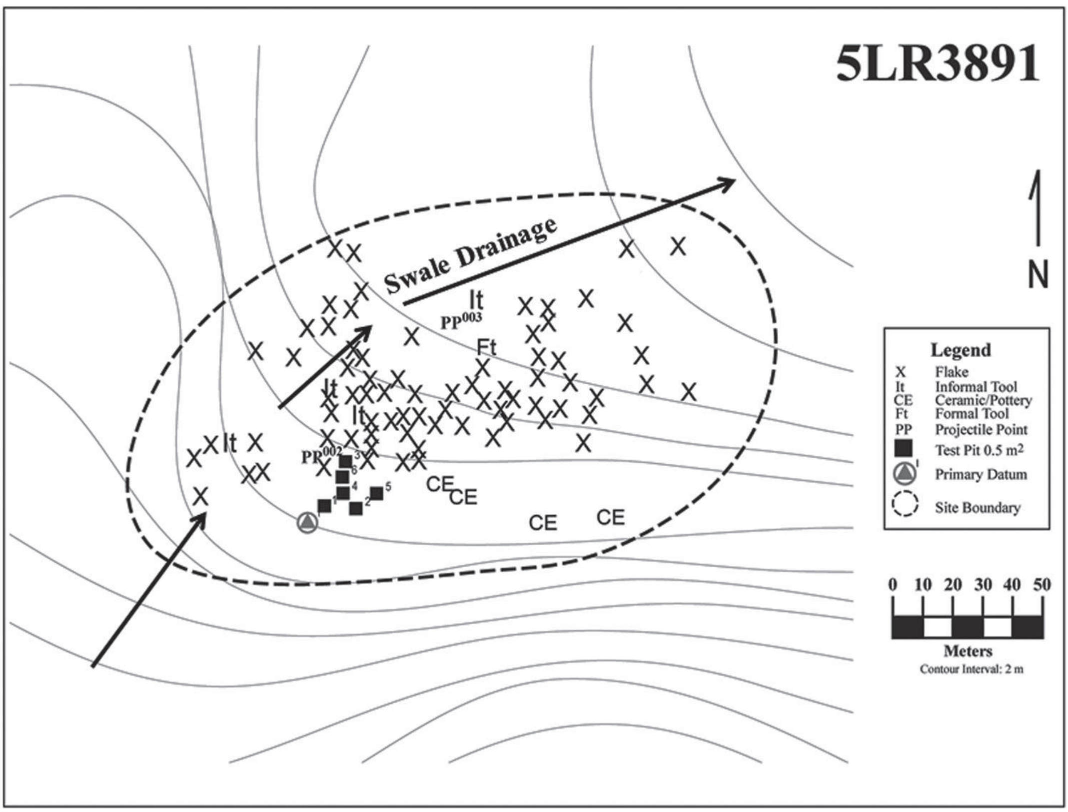

Figure 7. Site map of 5LR3891 showing artifact distributions and local topography.

flake and core knives, and scrapers. The ratio of formal to informal tools was higher for informal tools (informal-59.26%: formal-40.74%). Lithic debitage was heavily inclined toward late stage tool manufacturing/retouch flakes. Material source data, surprisingly, given the site's east of the Continental Divide location, showed strong preference toward interior mountain, western slope parkland valley sources for formal tools (83.33%) and lithic debitage (84.95%). Informal tools were less well represented by local (interior montane) sources at 53.33%.

All projectile points were made of three types of Middle Park or North Park sourced material: Troublesome Formation (Kremmling) chert, Table Mountain jasper, or Windy Ridge (Dakota) orthoquartzite. A similar trend isreflected in the site's lithic debitage sub-assemblage where Kremmling chert made up more than half (57.84%) its total inventory, followed by Table Mountain jasper (25.42%) and Windy Ridge Dakota orthoquartzite (8.05%). Again, Eastern Front Range foothills and plains materials were virtually absent. However, one caveat concerning the source of Kremmling chert, recently discovered by the author and noted earlier is new information from analysis of Kremmling chert debitage in Early Ceramic Period winter camp deposits at the Valley View site (5LR1085) in the eastern Front Range foothills (Brunswig 2015a, *in press*). That analysis concluded that Kremmling chert, previously attributed only to interior montane valley sources, also occurred in eastern plains paleovalley gravels as nodules of Kremmling (Troublesome Formation) chert transported to the plains as stream outwash from uplifted interior mountain deposits during the Miocene Era. This suggests that not all inferred evidence associated with presence of that chert type, particularly in eastern Park sites, are *necessarily* derived from west of the Continental Divide. Ground stone 5LR3891was relatively abundant, providing evidence of plant and dried meat processing. Although Lyons sandstone metate fragments from the eastern Front Range foothills were recovered, the presence of local Park-sourced biotite schist metate fragments showed extensive use of that less desirable but locally obtained material for processing of plants and dried meat (cf., Benedict 1993 for the use of local Park biotite-schist for local grinding stone material).

A second Beaver Meadows site, 5LR3899, is located on a low lightly wooded knoll at the lower moraine edge, overlooking Beaver Brook and its meadow (Fig. 8). Test excavations at the site uncovered shallow cultural deposits (-40 cm) along with a moderately light surface scatter of flakes and tools, the latter including six complete or partial projectile points and eight metate fragments. Several cultural surface features were identified, including three rock-lined hearths, two stone habitation (tipi) foundation rings and a possible rock cairn. Culturally and chronologically diagnostic projectile points documented Early Archaic (7,416-5,738 14C cal yr b.p.), Late Archaic (3,165-1735 14C cal yr b.p.) and Early Ceramic period (1,735-856 14C cal yr b.p.) occupations.

It is believed the site represents a short to medium term camp where tool manufacture, tool refurbishment, and economic processing took place over several millennia of seasonal visits. It is a large site (18,450 m2) (Fig. 8) and its artifact inventory closely resembles that of 5LR3891. Formal and informal tools were roughly equal in number, represented by a preponderance of western, interior parkland valley lithic source materials as was the lithic debitage (waste-flake) sub-assemblage. Projectile point material sources were evenly divided, with two each from mountain interior and eastern Front Range foothills/plains sources.

Although the above sites are good examples of short-term summer hunting camps in Braver Meadow's lower montane environmental zone, they represent only two of four recorded prehistoric sites distributed along the moraine's lower slope (Fig. 6). All are interpreted as representing short-term early-late warm season (late spring-summer-early fall) camps occupied prior to, during, or after seasonal migrations to higher elevation hunting territories along an eastern branch of the Native American Ute Trail (cf., Brunswig and Lux 2014; Lux 2004, 2005).

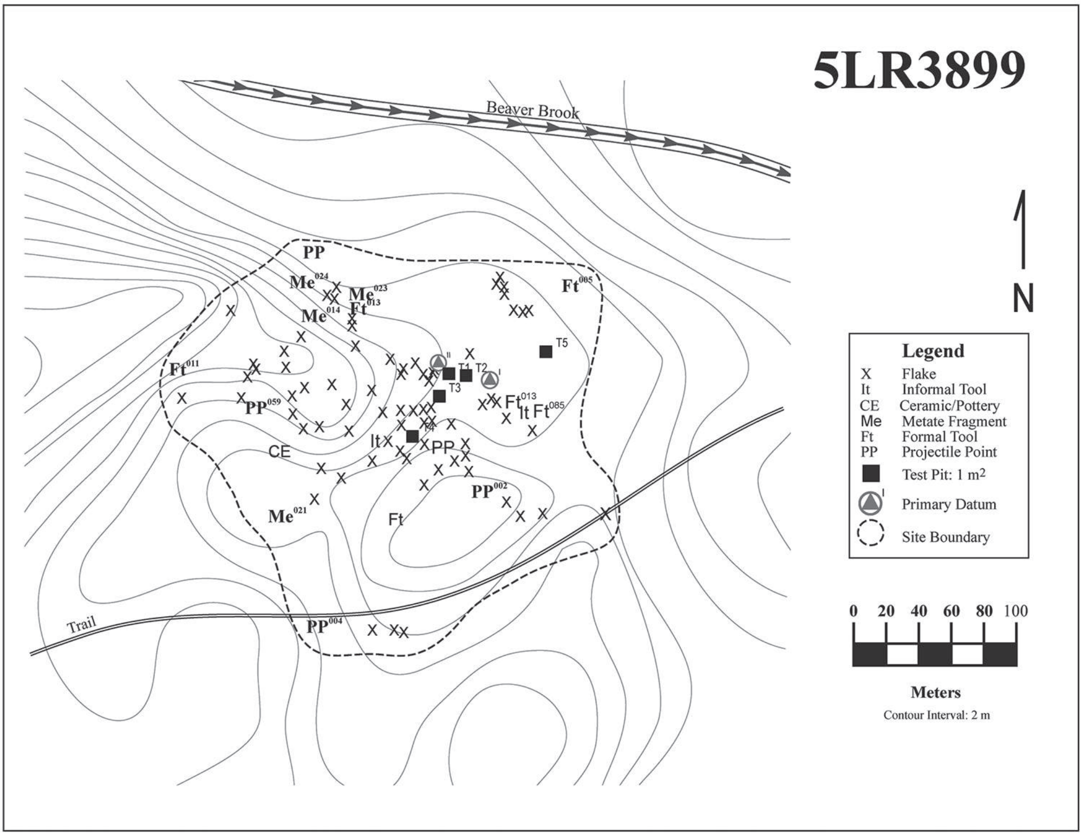

Figure 8. Site map of 5LR3899.

High Altitude Base Camps and Hunting Territories: a Sampling of Park Sites

By mid- to late- summer, hunting bands migrating into the Park ascended to higher elevations, following migrating game herds of elk (*Cervus canadensis*) and Bighorn sheep (*Ovis canadensis*) to upper subalpine and alpine tundra grazing ranges. While more than dozen such ranges were identified during UNC Park surveys, this sub-section describes only four of the more prominent grazing ranges which served as prime hunting territories for Native American hunter-gatherer bands: Forest Canyon Pass, Mt Ida Ridge, Bighorn Flats, and Flattop Mountain.

Forest Canyon Pass

Forest Canyon Pass contains one of the densest concentrations of prehistoric archeological sites in Rocky Mountain National Park, ~24 sites per square kilometer (Brunswig et al. 2009: 63; Fig. 3, no. 4 above and Fig. 9). Its largest site, the Forest Canyon Pass site (5LR2), is a series of closely spaced camp and special use activity areas representing all known regional cultural traditions from Late Paleoindian (ca. 10,670 14C cal yr b.p.) through early historic (ca. 150 14C cal yr b.p.) times (cf., Brunswig 2005a, 2014b; Brunswig et al. 2009; Mayer 1989). Archaeological and historic evidence show the area has been a crossroads for migrating Native Americans throughout that time. Historic documentation, supplemented by 75 years of archaeological research, provides evidence that the Deer Trail branch of the Park's well-known Native American Ute Trail passed directly through the top of Forest Canyon Pass (Brunswig and Lux 2014; Lux 2004, 2005; Toll 1962: 32-33). The Pass is strategically located adjacent (north and west) to several major game drives along Mount Ida Ridge and Trail Ridge (see below) and its archaeological evidence shows it almost certainly served as a base camp locality, particularly for the nearby Mount Ida Ridge game drives (see below), for summer and fall hunting parties who ascended to those drives throughout prehistoric and early historic times.

Several archaeological surveys were conducted in the Pass over the past half century. Most were limited within 30 meters on either side of the ancient Ute Trail which crosses the pass from northeast to southwest (Brunswig 2001; Husted 1962, 1965; Mayer 1989; Yelm 1935) until two UNC research programs, the earlier discussed Systemwide Archaeological Inventory Program (SAIP) and the Forest Canyon Pass Cultural-Natural Landscapes and Ecological Patch Islands Project, took place in 2000 and 2008 (Brunswig et al. 2009). The pass' Ute Trail corridor was intensively surveyed by the SAIP Project in 2000, but that and earlier projects failed to explore the adjacent Big Thompson pass headwaters section or upper slope benches and basins of the main pass. In 2008, a UNC field crew surveyed 67 hectares in the main pass area, re-documenting its largest site, 5LR2 (the Forest Canyon

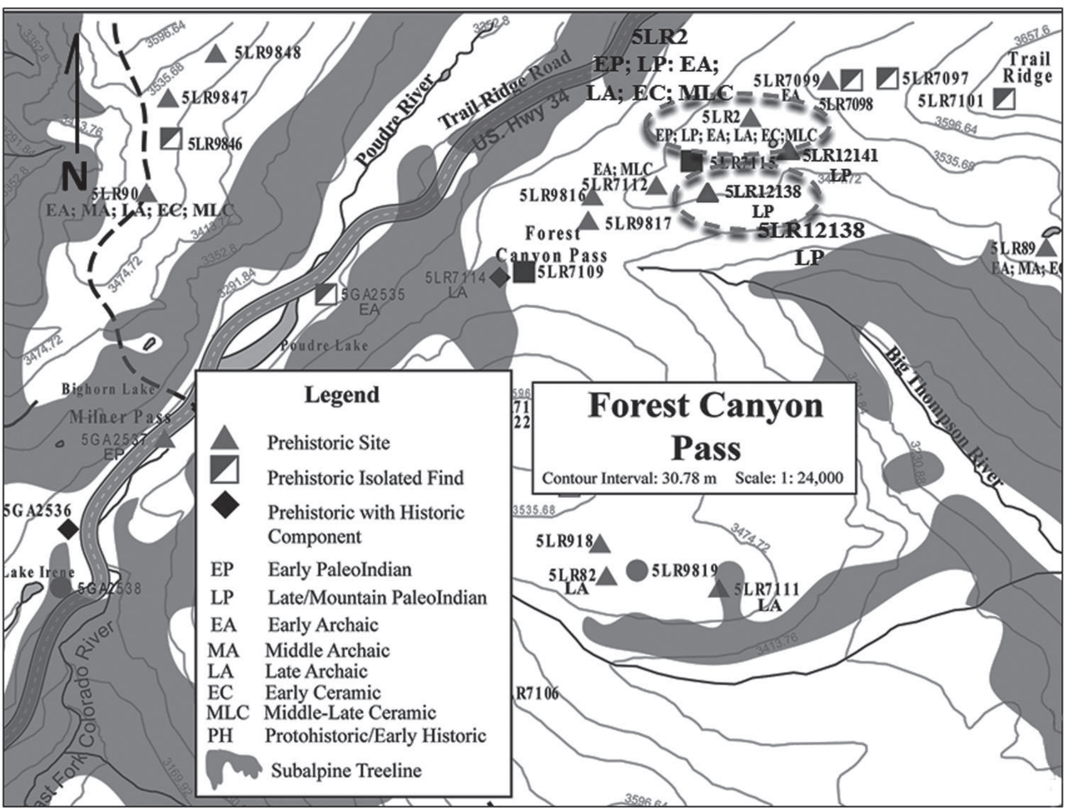

Figure 9. Map overview of Forest Canyon Pass sites. Locations of two sites described in the text, 5LR2 and 5JA12138, are highlighted inside dashed lines.

Pass site), and recording new sites in previously unexplored areas to its east and south (Brunswig et al. 2009; Fig. 9). Plant surveys of the Pass' Big Thompson River headwaters documented rich botanical diversity and high potential for productive archaeological and paleoenvironmental field studies. In particular, its sheltering alpine-subalpine ecotone krummholz (tree island) stands and open terrace benches closely reflected environmental contexts known elsewhere in the Park where prehistoric high altitude seasonal hunting base camps have been identified (cf., Brunswig 2004a, 2004b, 2005a, 2007: 283-295). The surveys identified twenty-seven plant species with food or medicinal uses, including such edible or medicinally-valuable products as berries, plant roots, leaves, and nuts (Brunswig et al. 2009: 11-13, Tables 1 and 2, Appendix D). This diversity of edible and otherwise economically and medicinally useful plants, occurring on grass meadows, in sheltered wetland, and krummholz tree-island stands reflects an unusually rich concentration of plant resources for supporting past Native American populations who traveled through the pass or established base camps for local tundra hunting expeditions. A 2008 resurvey of the Forest Canyon Pass site (5LR2) provided detailed mapping data and identification of new diagnostic projectile points, stone tools, and waste flake scatters, confirming that the site was a dense palimpsest of multiple trailside camps with rock-lined hearth features and discrete concentrations (camp areas) of lithic tools, debitage, and, occasionally, prehistoric pottery. Culturally diagnostic projectile points and ceramics documented an unbroken series of short-term occupations ranging from the Paleoindian Folsom Complex (12,871-12,007 14C cal yr b.p.), Late Paleoindian Period (Frederick, James Allen, and Great Basin Stemmed types) (10,689- 8,287 14C cal yr b.p.); Early Archaic Period (Mount Albion (ca.7,416-5,738 14C cal yr b.p.); the Late Archaic Period (3,165-1735 14C cal yr b.p.), the Early Ceramic Period (1735-856 14C cal yr b.p.) and the latter Late Prehistoric/Early Historic periods (856-85 14C cal yr b.p.) periods (cf., Brunswig et al. 2009: 37-42). Other sites in the pass, situated on eroded benches and free-standing knolls with associated subalpine krummholz tree stands east of 5LR2 and the Ute Trail, included a plant-processing activity area (with a large biotite-schist grinding stone metate), two small hunting camps, one with a Late Paleoindian Cody Complex projectile point fragment (ca. 10,689-9,258 14C cal yr b.p.; cf., Kornfeld, Frison, and Larson 2010: 86-88; Pitblado 2003: 81-87, Table 5.1), another with a Late Paleoindian Angostura projectile point (ca. ca.11,002-8,341 14C cal yr b.p.), and a storage "cache" of Troublesome, or Kremmling, chert, cores and flakes, the latter from sources in the nearby Middle Park and North Park valleys.

Southeast of 5LR2, one campsite which produced a Late Paleoindian projectile point, 5LR12138, provided an excellent example of a travel corridor (trail) and hypothesized game drive base camp, possibly used to support hunting on adjacent tundra areas on Trail Ridge to the northeast and the Mount Ida Ridge hunting territory to the south (Brunswig et al. 2009: 30-35). Archaeologically, the site produced two prehistoric lithic concentrations (camp or activity areas) at southern and central areas of "finger" ridge bench of a south-facing mountain slope overlooking upper Forest Canyon Pass (Fig. 10). It is situated in alpine-subalpine ecotone and its resident bench has a thin cover of dwarf spruce-fir krummholz with intervening open areas. Its southern section has a moderately heavy concentration of stone tool manufacturing-retooling flakes (secondary and tertiary stage) and seventeen lithic tools, including a projectile point and butchering, hide processing, and bone-wood working tools. The projectile point was classified as a Late Paleoindian Angostura base. It had been manufactured of yellow-brown to red quartzite, material originating from interior montane valleys (e.g., North Park) immediately to the west and northwest of the Park. It exhibited impact fracture scars on both blade faces, resulting from impact with a solid object, either a game animal or the ground surface. The point has a lenticular cross-section and evidence of parallel-oblique flake-thinning, a common Late Paleoindian trait. Both characteristics, combined with its tapering lower part and flat to convex base, led to its classification as a Late Paleoindian Period Angostura type (cf., Brunswig 2005a: 74-77; 2007: 278-283, Table 9.3; Pitblado 2003: 112-116, Table 5.11, 2007: 315-318) dated ca.11,002-8,341 14C cal yr b.p.

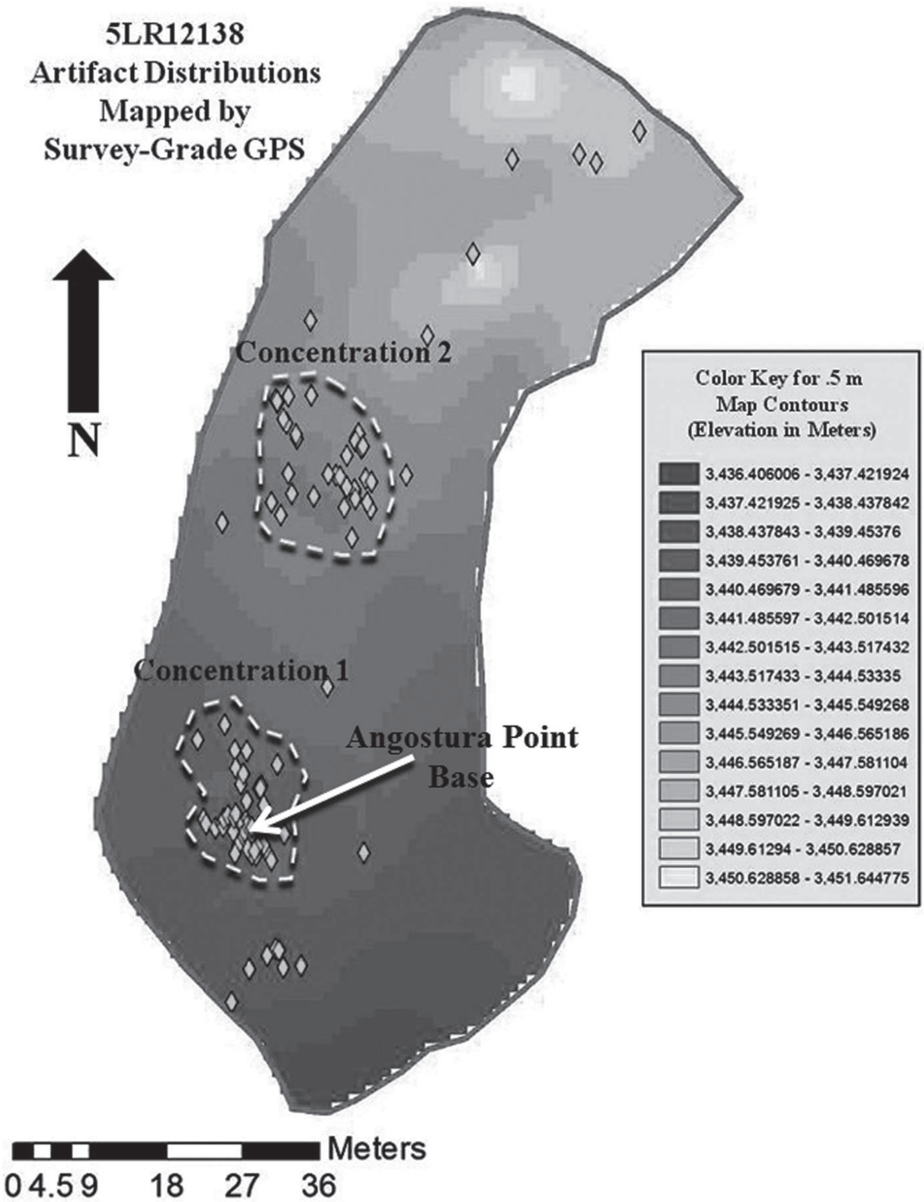

Figure 10. Forest Canyon Pass site, 5LR12138, map showing artifact clusters and location of the Late Paleoindian projectile point base.

Several of the site's lithic tools, including scrapers and knives, were well-made and one, an ovate, fully-worked artifact, is interpreted as a multi-purpose tool (scraper, knife, and spokeshave). The northern lithic concentration had a lighter artifact scatter which produced more than a dozen flakes and an informal blade knife. Both concentrations contained fire-cracked rock from dispersed surface hearths, but concentration 2 also had three discrete fire-cracked rock clusters (granite and quartz) with larger perimeter rocks defining as still relatively intact surface hearths. Raw material sources of site lithic tools were primarily, ~83%, from local park and local regional (North Park and Middle Park) sources, although two tools were made of stone from more distant non-local sources in South Central Wyoming (Hartville chert) or the Northeastern Colorado plains.

A high ratio of formal to informal tools, particularly in 5LR12138's southern lithic concentration (1), was interpreted as indicating the site served as a medium-stay camp. Its location overlooking Forest Canyon Pass made it an ideal place to observe game movements in the Pass and across the pass to a north-facing mountain slope which forms the northern termination of Mount Ida Ridge, home to several large multi-component game drives (see below). Presence of a Late Paleoindian projectile point base (Angostura type) provided evidence of at least one occupation phase dating as early as 11,002 14C cal yr b.p. while its tool types (mainly scrapers and knives) are those commonly occurring in camps used for local hunting or secondary staging and processing activities associated with nearby high altitude alpine hunting areas, e.g., game butchering and meat-processing, hide preparation, and bone- wood working. One multi-purpose formal tool with inferred knife, scraper and spoke-shave (bone and wood-shaping) functions suggest it was used not only for meat and hide processing, but in preparation of spear shafts using its spoke-shave (shaft-cutting/smoothing) notch.

Forest Canyon Pass represents an unusually rich concentration of economic plant foods, firewood and shelter (Krummholz tree stands and bordering subalpine forest), trail access, game animal for localized hunting, and easy access as a base camp for hunting large herbivore game on Mount Ida Ridge's tundra to the south (see below). As discussed in a later section, the pass likely represents a resource-rich location known as a patch island embedded within a larger landscape of less dense natural resources.

Recent modeling of climate change and tree-line boundary changes in the Forest Canyon Pass area and along the tundra and alpine-subalpine ecotone zones of Mount Ida Ridge to the south (described below) and briefly summarized above has shown a significant rise of subalpine tree-line in the pass during the Early Holocene (+130 m) and Mid-Holocene (assuming a *minimum* tree-line rise of +70 m) (Brunswig 2014b; Brunswig, Doerner, and Diggs 2014a, 2014b, 2015b). Both sites described here (5LR2 and 5LR12138), now situated within the alpine-subalpine ecotone environmental zone, were, based on recent paleoclimate studies (see above), located inside subalpine forest tree-line from early Late Paleoindian through Early Archaic times (10,600 14C cal yr b.p.-~3,500 14C cal yr b.p.).

The Mount Ida Ridge Hunting Territory

While earlier described lower elevation camps were designed to access tundra hunting areas and support warm-season hunting expeditions, most Native American hunter-gatherers focused on high altitude (tundra) game foraging pastures. This article describes three such hunting territories beginning with the Mount Ida Ridge, which several kilometers directly along the Park's Continental Divide (Fig. 3, no. 6; Fig. 11).

Mount Ida Ridge extends southeastward along the divide from Milner Pass (elevation-3,474 m) for 6.4 km to Mount Ida in western central Rocky Mountain National Park (Fig. 12). Its northwestern segment descends to the east and west from the Continental Divide onto moderately steep (5-30º) alpine slopes while its southeastern section has moderately steep alpine slopes (10-30º) west of the divide but drops precipitously into steep talus slope at its eastern edge. The ridge's topography consists of varied elevations and directional aspects, consisting of open flat to barrel-vaulted continuous ridgeline, ridge slope benches, knolls, boulder fields, and ascending mountain slopes that provided numerous topographically-enhanced micro-terrains for prehistoric hunters to maneuver game animals, primarily elk and bighorn sheep, into kill zones or wait in ambush along game foraging trails. In many

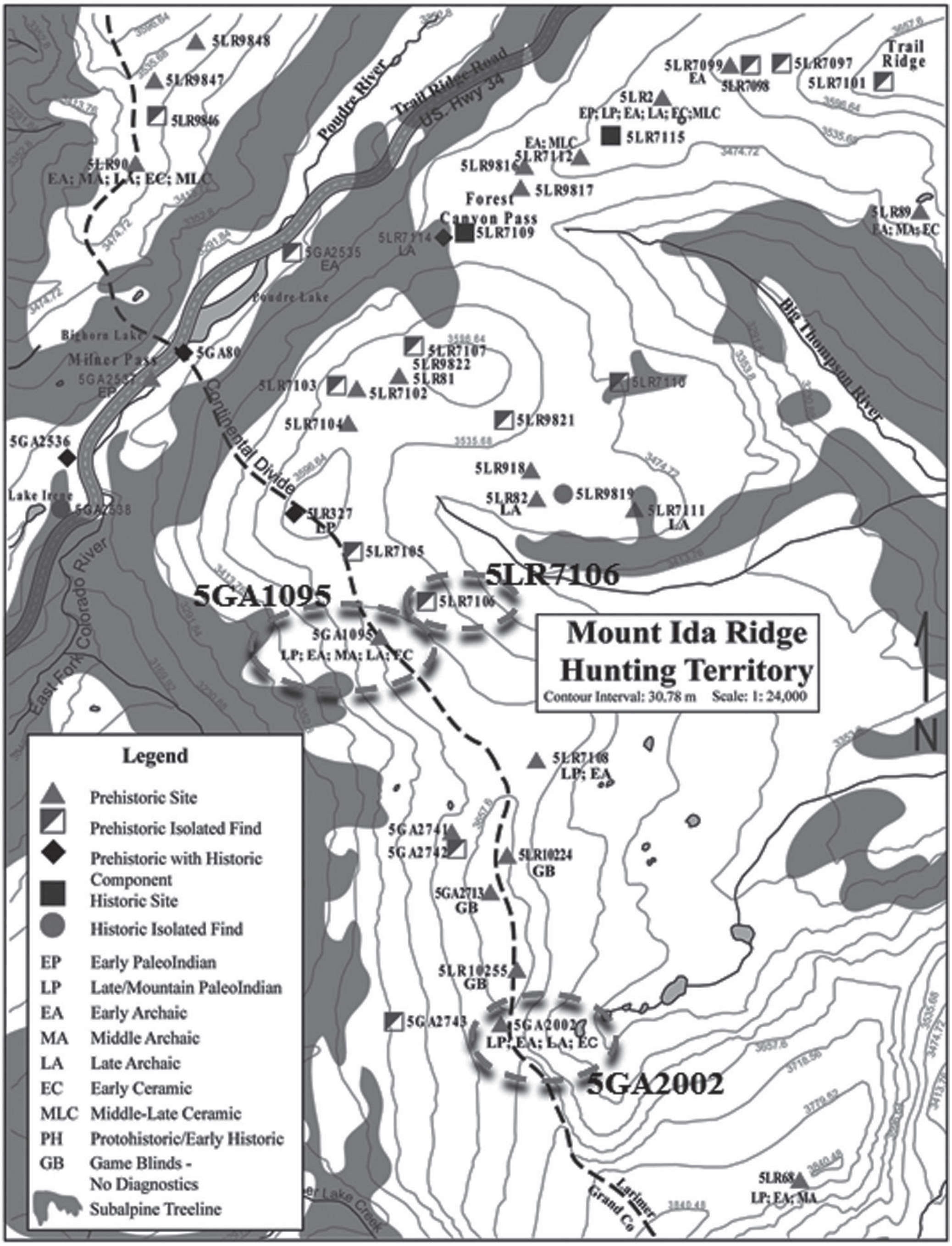

Figure 11. Map of the Mount Ida Ridge hunting territory with its associated prehistoric sites. Locations of the territory's two game drives (5GA1095 and 5GA2002) and game processing camp (5GA7108) are outlined with dashed lines.

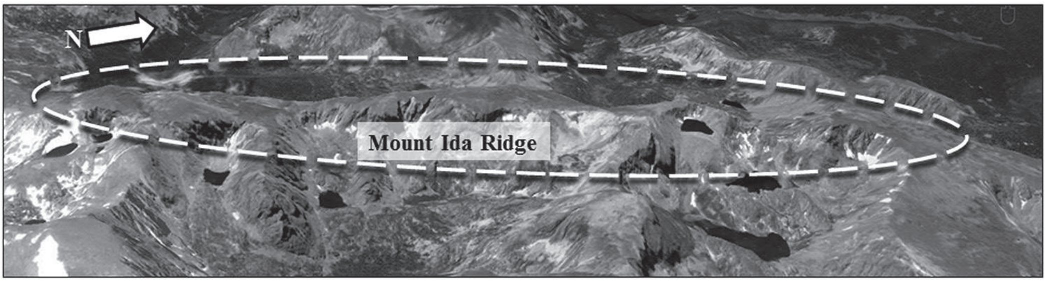

Figure 12. GoogleEarth™ Satellite Image of Mount Ida Ridge facing west-northwest. The continental divide follows the ridge-line from north-northeast to south-southwest.

cases, ambush localities provided hunters with naturally concealing features; boulders, rock outcrops, or terrain rises, while in other instances, hunters architecturally enhanced natural features for better concealment by piling small boulders, excavating shallow pits, or building more substantial boulder walls and excavating pit blinds with low concealing walls. In the latter case, some high altitude hunting systems, including at least four sites along Mount Ida Ridge (5GA1095, 5GA2713, 5GA2002, 5LR10255), were formally "constructed" with artificial game maneuvering (drive) features such as rock cairn lines, rock-walled observation pits, rock wall alignments, and rock-walled hunting blinds.

One of the most prominent Mount Ida Ridge sites is 5GA2002, a multi-component game drive first recorded by James Benedict (1995). Benedict described the site as situated "in a saddle on the Continental Divide and on the slope leading southward toward Mount Ida." He designated the site the Mount Ida Game Drive and described it as consisting of two groups of "structures", with: "The northern group… (4 blinds)" [occurring] "in an area of sackung features (tension-crack faults) and scarps, taking advantage of the natural concealment that they provide. The southern group of structures (2 blinds, 1 wall) complete the local hunting system represented by 5GA2002. The wall parallels the cirque headwall, 2-4 m from its edge. It is a subtle system, in places unconvincing." (Benedict 1995).

University of Northern Colorado surveys of the site and its surrounding area produced substantial numbers of artifacts and a detailed map of Benedict's original seven blind and wall features (Fig. 13). According to Benedict, the site's northern feature group consisted of a circular rock wall blind (feature 1-1.8 to 1.4 m diameter), a west facing semi-circular blind (feature 2-maximum length of 2 m), a short (2.6 m) rock "wall" line (feature 3), and another, also short (2.7 m) rock "wall" line (feature 4). The latter features, 3 and 4, were situated at the southeast end of a linear northwest to southeast oriented depression. A major artifact scatter (concentration 1), located a few meters northwest west of those features, yielded two dozen secondary and tertiary lithic jasper and chert flakes, five sandstone metate fragments, a dozen informal flake tools (scrapers, knives…), a single rhyolite (local volcanic material) tool core, and most importantly, two Early Archaic Mount Albion Complex corner- notched projectile points (ca. 7,416-5,738 14C cal yr b.p.). A third complete Mount Albion projectile point was recovered by UNC archaeologists during a site re-visit in 2005.

Plant or, in addition, dried meat, grinding is shown by the presence of sandstone metate fragments located inside a small lithic flake concentration north-northwest of the site's largest artifact and feature concentration (1) (Fig. 13). Three other sandstone metate fragments along with several secondary and tertiary flakes, informal flake tools and three projectile point fragments were found scattered down-slope west of concentration 1. Broken projectile point fragments from Late Paleoindian (James Allen-Frederick) (10,590-8,747 14C cal yr b.p.) and Late Archaic (3,165-1,735 14C cal yr b.p.) periods were also recovered in the northern feature group in association with game blind pits and walls.

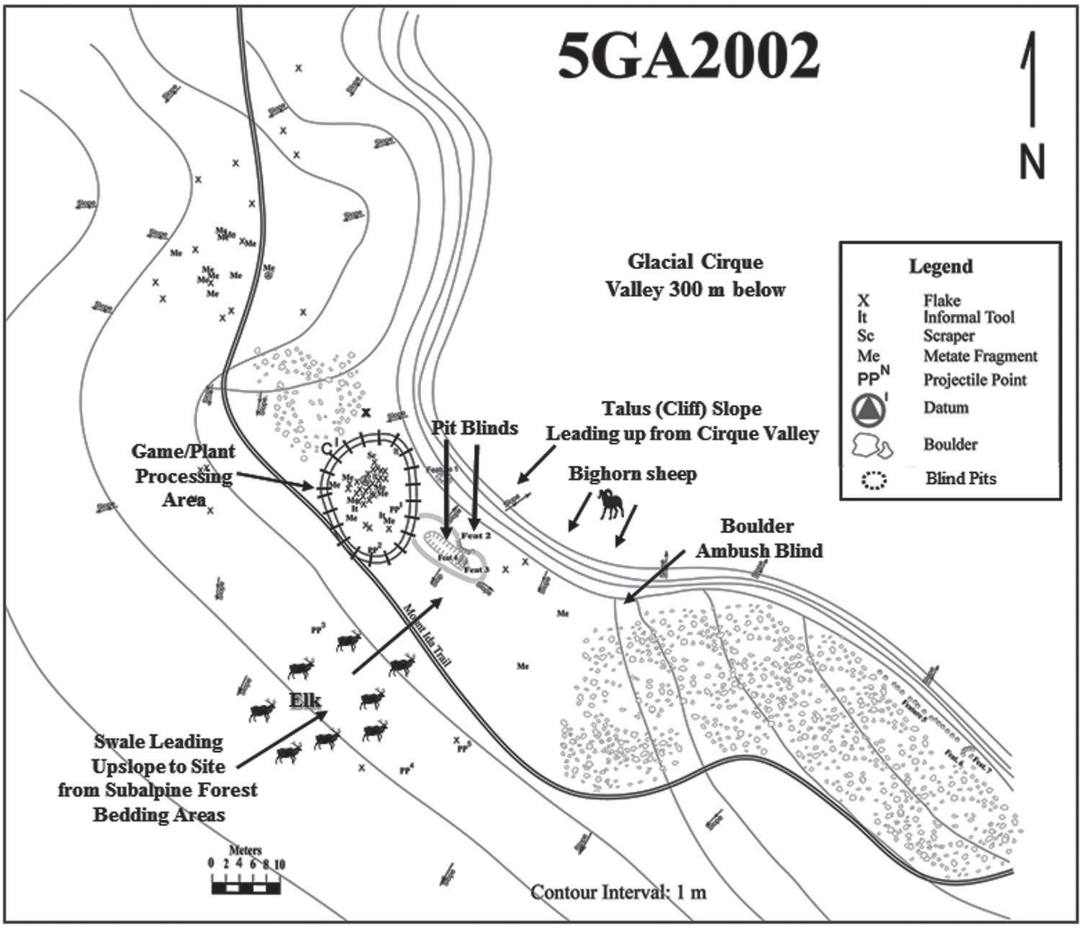

Figure 13. Site map of 5GA2002 showing features, artifact concentrations, and illustrating its hypothesized "dual-game (elk and Bighorn sheep) hunting system".

The site's southern feature group consisted of a 60 m long rock "wall" (feature 5) paralleling the ridgeline crest and 3-5 m west of a steep northeast facing scarp that drops off down a talus slope cliff into the adjacent glacial cirque valley, a semi-circular, 2.7 m long, northwest facing wall or blind (feature 6) in line and at the southeastern end of feature 5, and a nearly complete, 1.7 by 2.1 m, oval rock wall blind (feature 7) located ca. 2 m southeast of feature 6 just over the crest of the cliff edge. Large boulders at the southeast corner of the southern feature group forms a protected shelter area with concealment from game crossing the saddle crest from the southwest (from upslope) and up the steep talus slope from the northeast. Southern group features were arranged to ambush game animals arriving (driven) from two directions; up the long mountain slope saddle on the southwest and up the steep cliff talus slope from the northeast (see Fig. 13). No artifacts were found at the southern feature group.

The archaeological inventory represented by 5GA2002 features, artifact distributions, and artifact classes suggests it served as a frequently utilized game procurement locality where two distinct hunting strategies were employed over the past ten thousand years. Its northern feature group, located near the main processing and tool refurbishment area, includes rock-wall and shallow pit game blinds largely oriented toward ambushing game being maneuvered up (north to northeast) a relatively gentle west-southwest facing mountain-slope swale ascending from the subalpine tree line below. It is hypothesized that the primary hunted game species on that site area and along the saddle crest was elk (*Cervus Canadensis*), given that specie's habit of grazing up gentle to moderately sloping tundra slopes in pre-dawn and early morning periods after leaving night-time bedding areas in nearby lower elevation sub-alpine ecotone krummholz tree-islands or upper sub-alpine spruce-fir forest (Brunswig et al. 2009: 15-17; Green and Bear 1990: 275-276).

Artifacts recovered from the site's northern part, including several fragmented diagnostic projectile points broken during ambushes, suggest its kill area was in use during the Late Paleoindian period, the subsequent Early Archaic Period (10,689-5,738 14C cal yr b.p.), and during the Late Archaic and Early Ceramic periods 3,165-856 14C cal yr b.p.). It is also possible the drive was used in other cultural periods, but diagnostic artifacts from those periods remain undetected or have been collected by visitors and not reported to Park staff.

The southern feature group at 5GA2002 is less easy to interpret since it lacked artifacts and given the fact that one of its features, the long "wall" (feature 5) is difficult to identify and indistinct within its boulder-littered landscape. However, given overall orientation and placement of features in the up-hill southern site section, it is possible those features do, as remarked by Benedict, represent hunter concealment "blinds" and "visual pause" lines on the ridgeline horizon for game such as Bighorn sheep being driven up the eastern scarp's lower talus slope from below to emerge at a ridgeline kill locality (cf., Fig. 13 above and Fig. 14 below).

The position of a game blind pit immediately west (inside) of the cliff edge and 20 m northwest of the boulder concentration is hypothesized to have been integral for use of a long net to snare sheep fleeing up the cliff talus slope from hunters in the valley below (cf., Frison 1991: 246-258; Frison, Reher, and Walker 1990; Fig. 14b). The use of nets to trap animals such as Bighorn sheep (*Ovis Canadensis*), whose natural instinct is to flee up steep talus slopes, such as occurs at 5GA2002, is supported by discovery of a Late Paleoindian period (9,915 14C cal yr b.p.) fully intact net measuring 50-65 m in length in Wyoming's Absaroka Mountains (Frison 1991: 258; Frison et al. 1986; Kornfeld, Frison, and Larson 2010: 312-313).

At this point, comment should be made on the frequent presence of ground stone tools found at both this site and others recorded on the Park's alpine tundra. Ground stones are composite tools, consisting of a base slab, referred to as a metate and a mano which are used to reduce seeds, dried roots, or dried meat to a flour or a coarse to fine powder for storage and later use for stews or making pemmican (a mixed animal fat, ground dried meat and ground plant food product) (cf., Ewers 1958: 74-76; Liboiron and St-Cyr 1988; Morris et al. 1981: 214). Meat from tundra hunting could have been quickly dried by being cut into thin strips and laid out on rocks in the dry, thin alpine air. By later summer and early fall when the hunts took place, a number of edible tundra and subalpine-alpine ecotone plant species would have been available for harvesting and processing. Most were root bulbs that would have been dried, ground, and transported to lower elevation base camps for mixing with stone-boiled (or pottery vessel heated after arrival of ceramics around ca. 1,600 b.p.) reduced meat fats and bone and marrow grease to make light and protein-concentrated pemmican. Benedict (2007: 13-32) identified at least seven alpine and alpine-subalpine ecotone plant species with edible bulb roots suitable for drying, grinding, and mixing with meat and grease for pemmican. They include wild onion (*Allium geyeri*), two varieties of Bistort (*Bistorta bistortoides* and *Viviporous bistorta*), Indian potato (*Claytonia lanceolata*), Alpine Spring Beauty (*Claytonia megrhiza*), Cottongrass (*Eriophorum angusti folrum*), Avalanche lilies (*Erythronium gradiforium*) and Alp lily (*Lloydia serotine*). An ethnobotanical survey of alpine plants at an another Park game drive, Trail Ridge Game Drive (5LR15), documented several

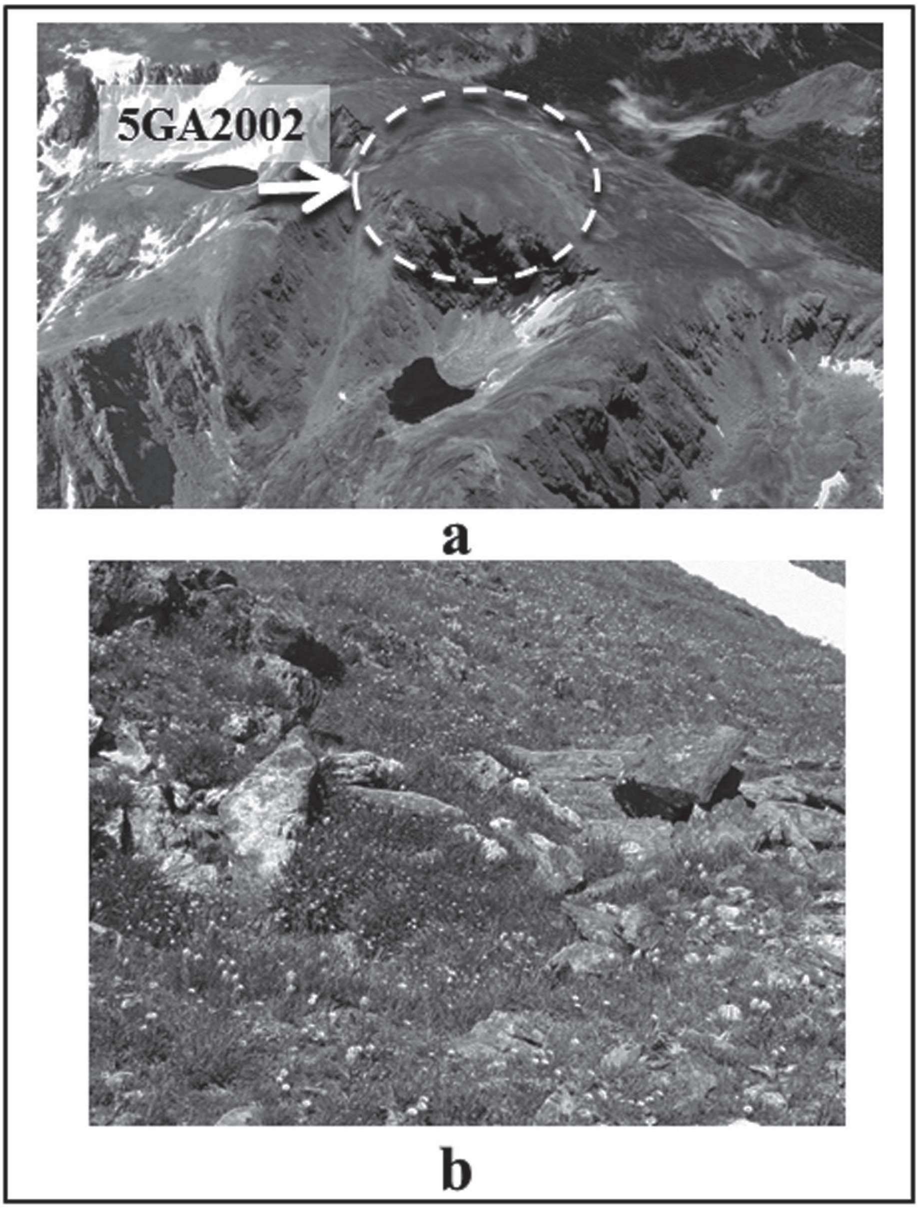

Figure 14. a: GoogleEarth™ satellite image of the 5GA2002 ridge-top saddle and **b**: a rock-walled game blind (feature 1) immediately west of the ridge crest believed to have been used in Bighorn sheep net trapping and weapon ambush for game fleeing up the steep talus slope from the cirque valley below.

on-site edible plants, with strong representation (46% of identified plants) of the two Bistort species (Werner 1999: 2-3, Table 1). Along with edible root plant bulbs, tundra hunting territory areas would have provided small shrub berries in the form of Soapberry (*Shepherdia Canadensis*) and edible seeds from alpine sunflowers (*Helianthella quinquenervis*). Other berry and seed species would have been available in lower elevation base camp areas such as that of the earlier described Forest Canyon Pass.

5GA2002 is the most organizationally complex multi-component game drive with associated early-stage game processing activity areas on Mount Ida Ridge. However, other secondary processing camps were recorded along the site's lower western slope and on a ridge-spur east of the Continental Divide a short distance to the north (see Fig. 11for locations). One ridge-spur site (5LR7108) produced Late Paleoindian (Pryor Stem, 9,418-8,694 14C cal yr b.p.) and Early Archaic (Mount Albion Complex, 7,416-5,738 14C cal yr b.p.) projectile points along with butchering and hide-processing tools.

Finally, a small "constructed" game drive (5GA1095) with cairns and natural and human-built ambush blinds is located near the north-central end of the Mount Ida ridgeline. 5GA1095 is associated with artifact concentrations related to early stage game processing areas with diagnostic projectile point types spanning at least nine thousand years (Late Paleoindian to Early Ceramic period, ca. 10,088-91014C cal yr b.p.).

5GA1095 (the Mount Ida Ridge Game Drive) was also recorded by James Benedict (1987: 1-27, Appendices A, B, and C). Officially, the site has two Colorado State site identifier numbers, 5GA1095 and 5LR1089, because the Continental Divide, which transects through the site, is also the boundary between two Colorado counties, Grand (GA) and Larimer (LR), which make up part of the Colorado site naming system. It is located in alpine tundra a kilometer northwest of 5JA2002. It includes a number of prehistoric cairns, a U-shaped stone walled fasting, or vision quest, bed, and hundreds of lithic artifacts and tool reduction flakes (Fig. 15).

Benedict suggested several cairns and alignments found near a Native American fasting bed (vision quest) feature that directly overlooks Milner Pass and the northeast headwaters branch of the Colorado River were components of an earlier (pre-vision quest) game drive system. In fact, the vision quest feature appears to have been constructed over an earlier rock-walled game blind. An alignment of game diversion rock cairns, designed to channel game animals (mainly elk) toward a ridge-top kill saddle, consists of sixteen irregularly spaced cairns oriented in an east-west direction, and starts downslope and west of the drive kill area and rises up the mountain-slope, crossing a ridge- line knoll into an ambush saddle (see Fig. 15). The cairn diversion wall is 130 m long and interpreted by Benedict (1987: 5) as having served as a drift fence, designed to direct game animals from open alpine grazing areas northwest of the site knoll toward hunters stationed on the knoll's south side next to a low saddle between it and another knoll to the east.

It should be noted that no substantial hunting/ambush blinds or other constructed forms of concealment were identified by Benedict or a later University of Northern Colorado site survey, except possibly the blind "overconstructed" by the vision quest. The general absence of formally constructed blinds suggests game animals were ambushed by hunters concealed mainly behind natural concealment features, including a large boulder, on the knoll at the west side of the saddle kill area (cf., also Benedict 1987: 5). However, a well-constructed stone-walled pit is situated on the continental divide ridge-line 280 m north-northwest of the site's kill area and may have been a look-out blind from which hunts were coordinated. UNC site survey also identified a barely visible and probable blind pit on the knoll crest, enclosed with small boulders that may have formed a low concealing wall. Configuration of the site's cairns, artifact concentrations, and local topography are consistent with the hypothesis that game animals were maneuvered toward and through the ridge-top saddle immediately east of the main knoll and ambushed from a large rock outcrop at its southwest corner (see Fig. 15).

Artifacts recovered from 5GA1095/5LR1089 were clustered in three main concentrations, designated A, B, and C (cf., Fig.15 above), and included 21 projectile points and point fragments, several flaked tools, a quartzite core, more than 200 reduction and retouch flakes, and ten sandstone metate fragments, the latter from at least two individual grinding stones.

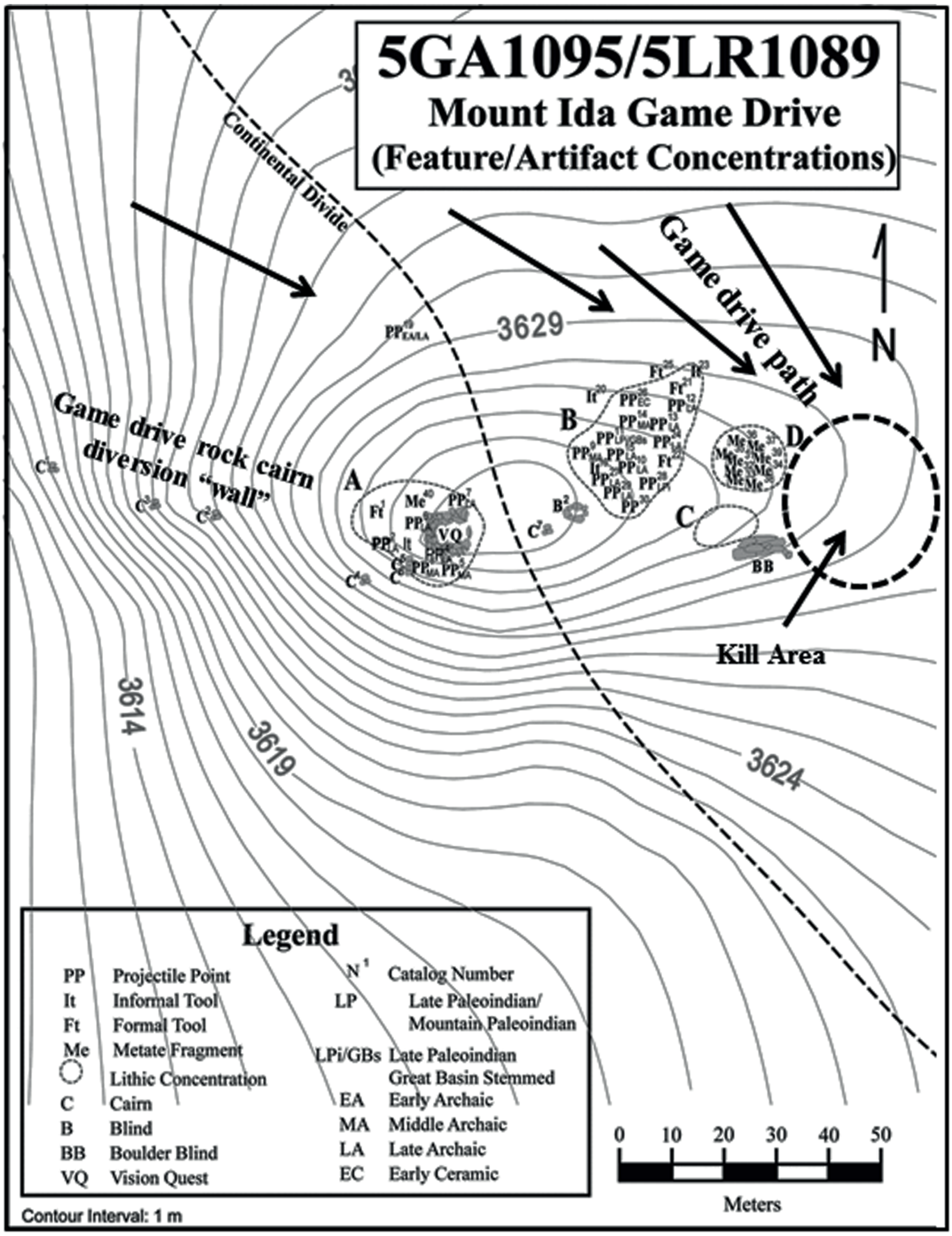

Figure 15. Map of the 5GA1095/5LR1089 game drive site.

Diagnostic projectile point types from the Mount Ida Ridge game drive are from the region's Late Paleoindian, Early Archaic, Middle Archaic (two Mallory bases), Late Archaic, Early Ceramic, and Middle-Late Ceramic cultural periods, ranging from ca. 10, 590 to 64214C cal yr b.p. Its lithic and ground stone tools, like those of the Mount Ida Game Drive (5GA2002), represent butchering, meat processing, and, perhaps, plant food processing activities associated with game animal kills and local tundra plant food collection. The majority of its lithic tool materials (<70%) derive from local sources within 75 km of the site with Troublesome Mountain (Kremmling) chert and Windy Ridge Dakota orthoquartzite being most common.

Due to locations well within the modern alpine tundra environmental zone and significantly above today's subalpine forest tree-line, all the Mount Ida sites described here are believed to have remained above subalpine forest tree-line throughout the Holocene (Brunswig 2014c; Brunswig, Doerner, and Diggs 2014a, 2014b, 2015b).

The Bighorn Flats Hunting Territory

The Bighorn Flats hunting territory is situated in a large (~2,025 hectares/2.024 km2) of west to southwest sloping tundra, alpine-subalpine ecotone (krummholz-dwarf spruce and fir tree-islands) and upper subalpine forest. Its western margins are headwaters for Tonahutu, Ptarmigan, and Hallett creeks, tributaries of the Colorado River to the west. Bighorn Flats is the largest continuous expanse of alpine tundra and alpine-subalpine ecotone in the Park and has one of its highest prehistoric site concentrations. It is one of the region's richest and most extensive alpine grassland areas, summer range for elk (*Cervus Canadensis*) and Bighorn sheep (*Ovis Canadensis*) whose presence drew generations of human hunters to the flats and adjoining Flattop Mountain (see below). Fig. 16 is a composite satellite image showing the extent of the Bighorn Flats subalpine-alpine hunting system territory determined by archeological survey.

Fig. 17 is a map of Bighorn Flats showing its major topographical features and prehistoric site locations.

Bighorn Flats is traversed by a cross-Continental Divide Native American trail known as the Big Trail (cf., Brunswig and Lux 2014; Lux 2004, 2005). The Big Trail, as well as several other trails documented in the Park, served as a major migratory route for past Native American populations since the end of the Pleistocene. Tundra peneplain and mountain slopes of Bighorn Flats were surveyed by UNC archeology teams in 2000 and 2001. Those surveys documented low site densities where the Big Trail (and its modern version, the Flattop Mountain-Bighorn Flats trail) crossed the Flats over the Continental Divide from the west end of Flattop Mountain to the Tonahutu Creek headwaters area (Fig. 17). However, below western margins of the Bighorn Flats "rim" where the Big Trail descends into Tonahutu Creek headwaters alpine-subalpine ecotone, archaeological surveys found site numbers increased dramatically (Brunswig 2007: 292-293; Fig. 17).

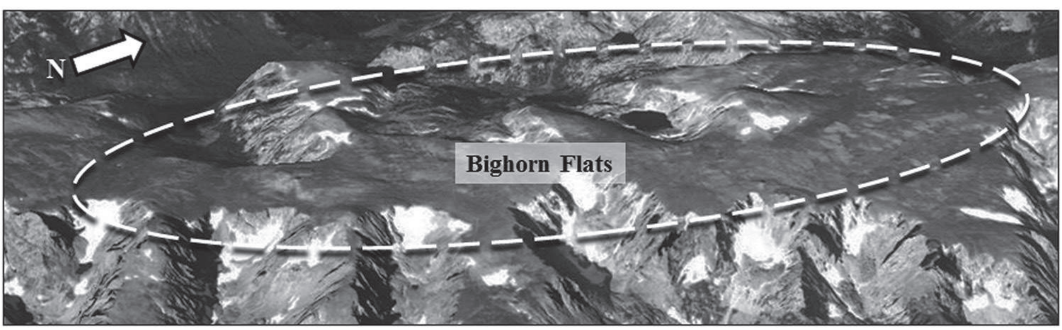

Figure 16. GoogleEarth™ satellite image of Bighorn Flats and its inclusive Continental Divide ridgeline. The area enclosed by the Bighorn Flats hunting territory is shown within the dashed white line.

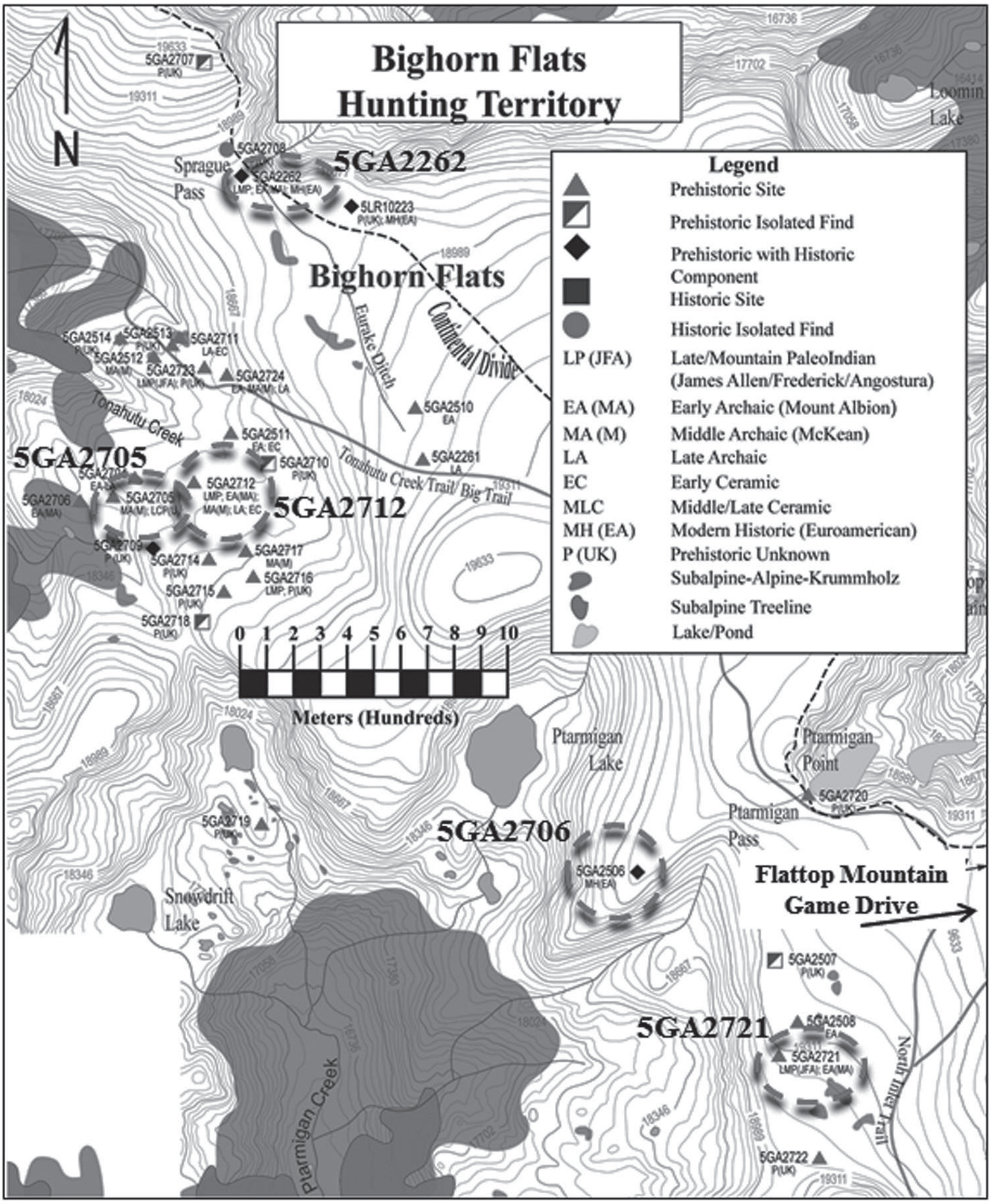

Figure 17. Map of topographic features and prehistoric site locations of Bighorn Flats' northern and central areas. Sites discussed in the text are shown inside dashed lines.

Bighorn Flats' alpine tundra contains several lithic-ground stone scatter sites associated with primary game kills and early stage game processing. UNC surveys found those sites concentrated in the northern sector of Bighorn Flats on the south-facing slope of Sprague Mountain and in its southwest sector within and above the Ptarmigan Creek headwaters.

Sprague Mountain is part of a high narrow Continental Divide ridge-line that steeply descends into Bighorn Flat's northeastern corner (Fig. 17). A pass at the mountain's top, Sprague Pass, provides access east of the Continental Divide by a steep trail that descends into a glacial cirque valley from where headwaters of Spruce Creek flow eastward through Spruce Canyon. A large multi-component prehistoric game processing camp (5GA2262) is situated on an alpine tundra mountain slope bench below (southwest) the pass (Figs. 17 and 18).

Archeological surveys at 5GA2262 documented kill and processing tools in three concentrations, scattered over a 25,200 m2 area. The heaviest concentration (1) is in its northern area while lighter concentrations (2 and 3) occur in its southeast quadrant (Fig. 18). Formal and informal lithic tools from concentration 1 included a petrified wood graver (used in bone processing), chert, jasper, and silicified wood scraper-knives, a jasper notched spoke-shave (wood and bone working), a jasper Early Archaic (Mount Albion-7,416-5,73814C cal yr b.p.) projectile point base, and a chert Late Paleoindian projectile point mid-section (ca. 9,500-7,500 14C cal yr b.p.). Formal and informal tools from the other concentrations were scrapers, unifacial and bifacial knives, a biface knife fragment, and two other Early Archaic corner-notched projectile points. Refurbishment of butchering and hide processing tools at all three lithic concentrations is shown by the presence of secondary and tertiary flakes. More than 70% of flaked tools recovered from the site were formal (fully shaped by flaking) tools while fewer than 30% were unretouched or minimally worked informal and lithic core tools. The majority of site artifacts, more than 80%, were made of locally available materials from Middle Park and North Park (cf., Brunswig 2005a: 181-183, Appendix B; 684-685).

A second, more extensive, processing camp, 5GA2721, is situated in an alpine tundra boulder field in southeastern Bighorn Flats in upper Ptarmigan Creek watershed. It is a palimpsest of lithic and ground stone scatters with diagnostic artifacts representing occupations of different cultural periods over a large 50,000 m2 area. At the site's northern end, a very large granite boulder forms a small protective south-facing shelter (Fig. 19).

The boulder shelter has a five-meter opening, an entrance height of 1.25 meters, and an overhang-to-back-wall depth of 2.5 meters. An open area outside its south-facing entrance produced a Lyons sandstone grinding stone (metate) fragment along with several lithic tool manufacturing and refurbishment flakes. Most of the site's artifacts were widely scattered, although five relatively discrete artifact concentrations were identified. Significant artifacts included the lower section of a Late Paleoindian (James Allen-Frederick type) concave-base projectile point (10,590-8,747 14C cal yr b.p), a corner-notched, Early Archaic Mount Albion (7,416-5,738 14C cal yr b.p) projectile point, and various scrapers, knives, a serrated flake knife, a core graver, core choppers, a petrified wood biface tool fragment, utilized flake tools, several sandstone metate fragments (all of Front Range foothills Lyons sandstone), and nearly two hundred chert, jasper, quartzite, and silicified wood secondary and tertiary flakes. Altogether, 5GA2721's lithic tool assemblage, unlike the above described 5GA2262 site, was dominated by informal rather than formal tools (~65%), possibly reflecting its sheltered nature and longer-term use as an overnight hunting camp rather than a day-time activity locality used for brief early stage processing of locally acquired game as often common for other tundra-situated sites. Its lithic tool materials, like most other Park prehistoric sites, were mainly local (within 75 km) in origin, consisting mainly (+85%) of Troublesome Formation (Kremmling) chert, Table Mountain jasper, and Dakota orthoquartzite. One notable exotic material artifact was a partial, very small, stemmed Late Paleoindian Cody Complex (10,689-9,258 14C cal yr b.p.) projectile point fragment made of Southwest Wyoming ostracod coquina from 200 km northwest of the Park.

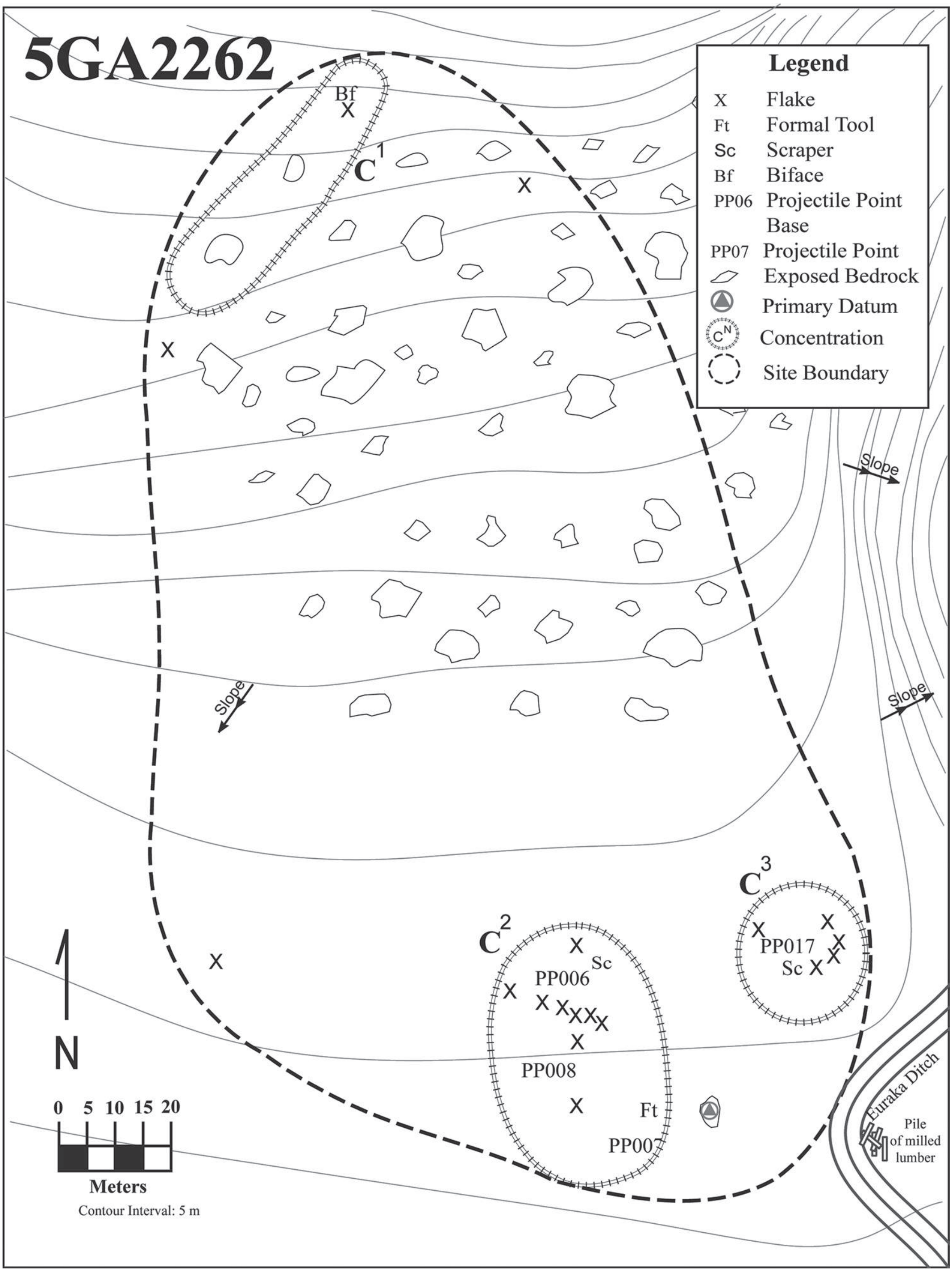

Figure 18. Site map of 5GA2262: a tundra game processing site.

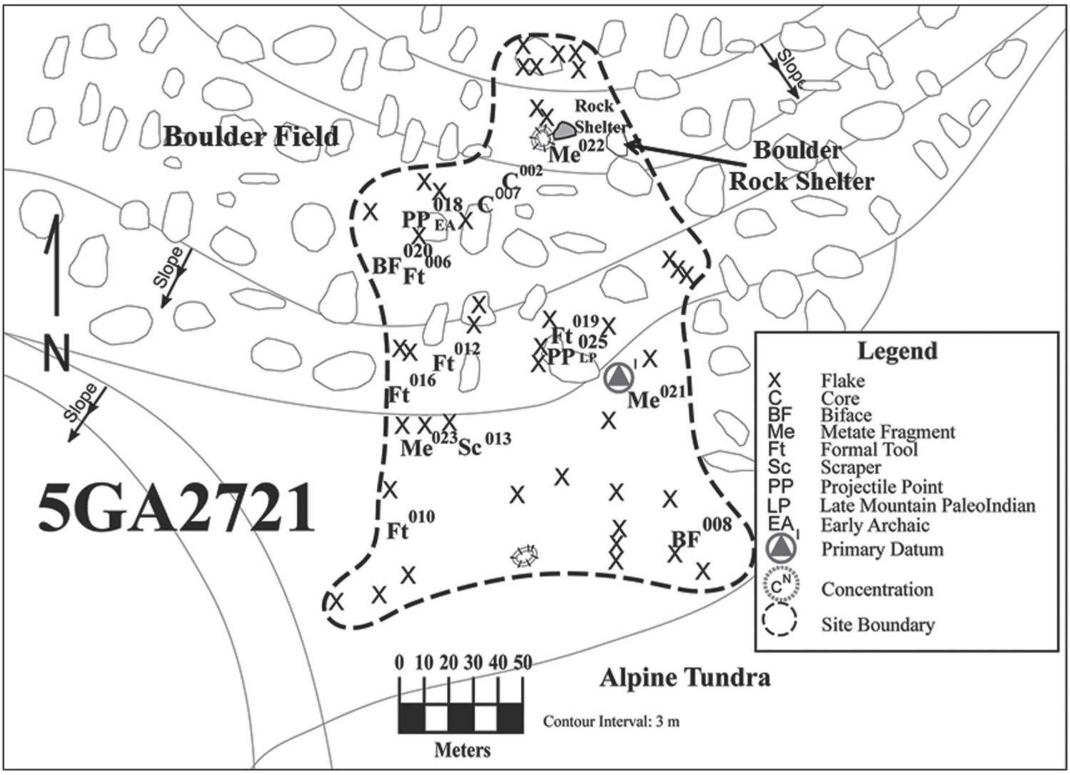

Figure 19. Site plan of 5GA2721, southwestern Bighorn Flats.

Logistical support for Bighorn Flats tundra-based kill areas and early stage game and plant processing camps was provided by a dense concentration of eighteen hunt staging (or base) camps and assorted isolated tool finds recorded within a 103 hectare area of low ridges and benches in the upper Tonahutu Creek headwaters, immediately below the Flats' contemporary northwestern tundra margins. Site density in the camp concentration area is 18 sites per km2, twelve times the average of 1.5 sites per km2 calculated for all Park survey areas documented in the 1998-2002 UNC SAIP project.

Due to the large number of Tonahutu Creek headwater sites, only two are described here as representative examples. All the Tonahutu sites contained diagnostic artifacts and nearly all were multi-component, representing millennia of accumulated short-term summer occupations. Environmental and archeological evidence suggest the camps served two main functions: 1) providing short- to medium- term base camps with immediate access to tundra game hunting ranges on Bighorn Flats and the adjacent Sprague Mountain ridge-line and as 2) rest or overnight camps along the Continental Divide-crossing Big Trail, the latter function being desirable since the ascent/descent to the lower elevation montane forest areas west of the divide is steep and arduous.

One site, 5GA2705, has two main artifact concentrations and a rock feature cluster located on a low mountain-slope bench within a dwarf spruce-fir krummholz tree stand overlooking a Tonahutu Creek tributary swale (Fig. 20). Two other camps are located nearby, up-slope (5GA2704) and down-slope across the swale on another bench knoll (5GA2706).

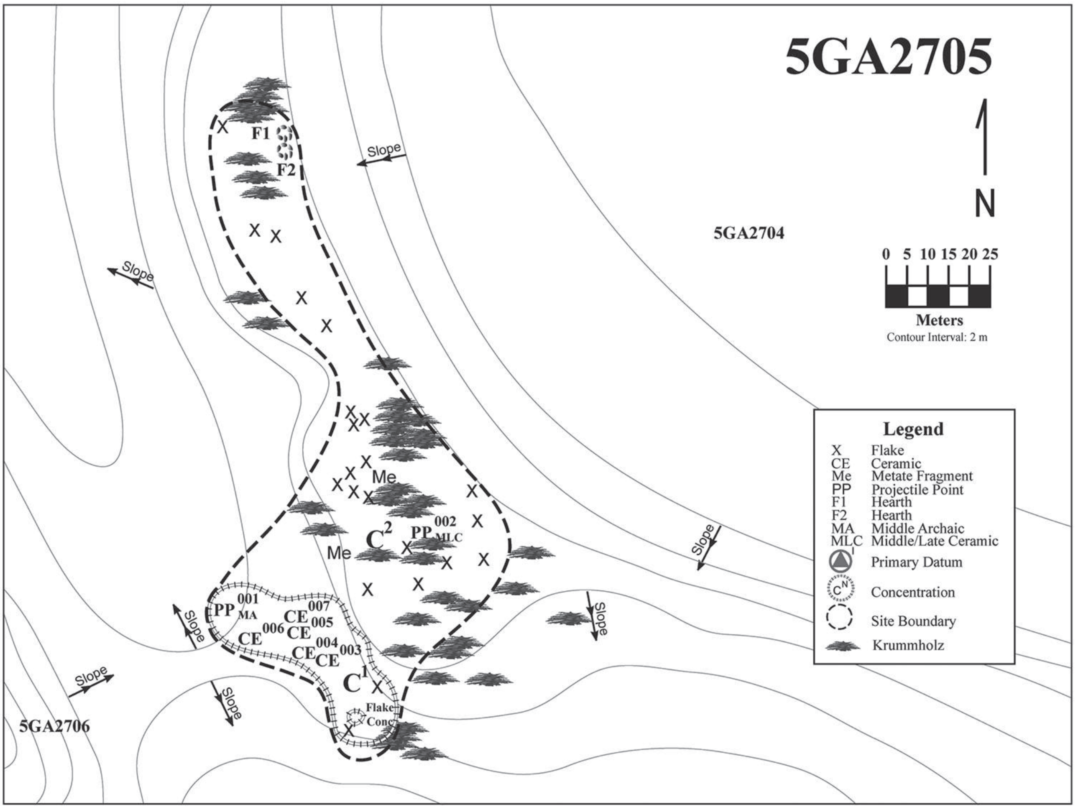

Figure 20. Site plan for 5GA2705. Note the scatter of sixteen Uncompahgre Brownware potsherds (CE) in artifact concentration 1.

5GA2705, along with flaked stone tools, secondary and tertiary waste flakes, and metate fragments, produced evidence of multiple period occupations in the form of a Middle Archaic (McKean Complex, 5,738-3,16514C cal yr b.p.) projectile point, a Late Prehistoric (Mid-Late Ceramic) side-notched projectile point (856-350 14C cal yr b.p.) and sixteen Ute (Uncompahgre Brownware) potsherds. Organic residue from the pottery was radiocarbon-dated at 401+50 14C cal yr b.p./AD 1549. Site features included two rock-ring surface hearths and a partially intact 4 m diameter rock semi-circle, the latter possibly representing foundation stones which once anchored a conical hide-covered tent (tipi).

One of the most impressive Tonahutu Headwaters sites, 5GA2712, is an extensive (9,947 m2) series of five lithic tool and ground stone concentrations interspersed in several dwarf spruce-fir krummholz stands on a northwest-southeast trending ridge between two Tonahutu Creek headwater tributaries. Fig. 21 shows distribution maps of the concentrations which individually may represent different cultural period camp occupations or spatially dispersed camp activity areas of past occupations.

Five different cultural period occupations are represented by fourteen diagnostic projectile points or point fragments: Late Paleoindian (10,689-7,835 14C cal yr b.p.), Early Archaic (8,287-5,738 14C cal yr b.p.), Middle Archaic (5,738-3,165 14C cal yr b.p.), Late Archaic (3,165-1,735 cal yr b.p.), and Early Ceramic (1,735-856 14C cal yr b.p.). Hundreds of flaked stone tools, flakes, and grinding stone fragments, the latter made only from eastern Front Range foothills Lyons sandstone, were recovered.

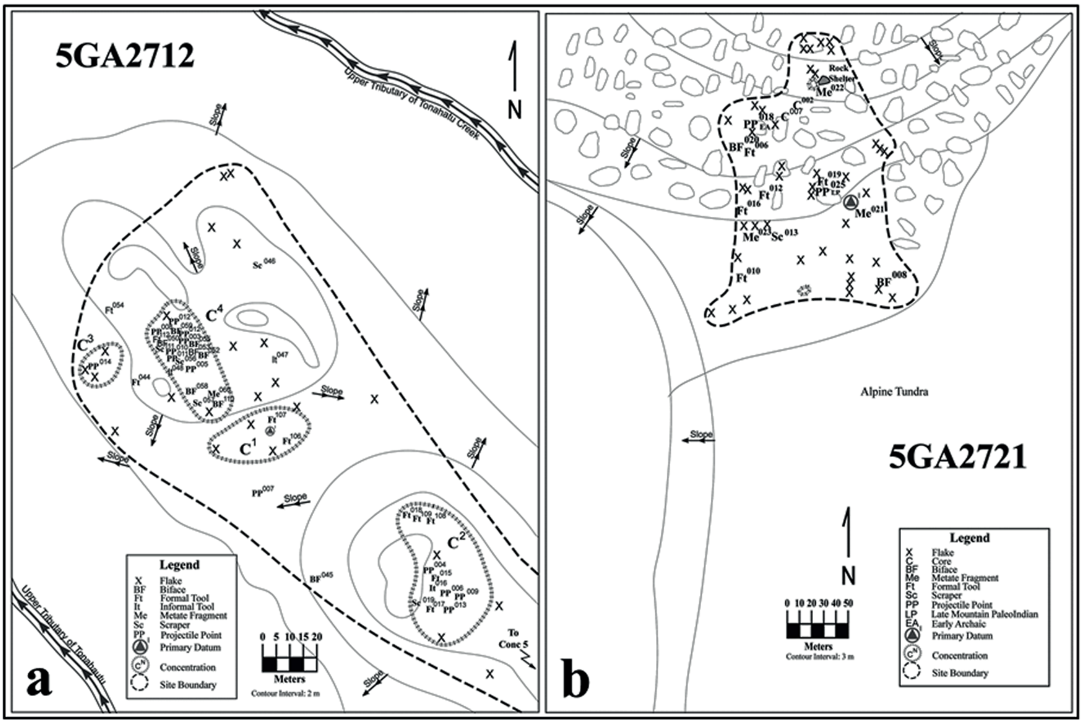

Figure 21. Site plan of 5GA2712. **a:** detail map of artifact concentrations 1, 2, 3 and 4. **b:** detail map of concentration 5. Note positioning of the site on a linear bench knoll between two Tonahutu Creek tributary drainages.

Lithic tool and waste flake concentrations (hypothetically from differing occupations) had differing ratios of formal versus informal tools, ranging from a preponderance of formal tools in concentrations 4 (90.48%) and 5 (57.14%) while more informal tools were found in concentrations 1 (65.22%), 2 (64%), and 3 (77.78%) (Brunswig 2005a: 161-63).

Assigning behavioral or economic strategy interpretations to different formal-informal tool ratios at the site (see the hunter-gatherer subsistence system section below) is problematic since most concentrations had diagnostic artifacts of different types and associated cultural periods showing existence of chronologically-culturally mixed (palimpsest) lithic assemblages. All artifact concentrations (Brunswig 2005a: 175-179) had high representation of secondary manufacturing stage flakes, representing both tool manufacturing (from prepared cores or used tools) and tool rejuvenation activities. Tertiary flakes, commonly associated with tool retouch (sharpening or re-shaping), were rare, although it is likely they are poorly represented due to their small size and greater chance of erosional transport and burial in subalpine and alpine soils prone to freeze-thaw cracking. Source material analysis showed patterns common to most Park prehistoric sites analyzed for lithic tool and waste flake traits. Lithic sources for all the site's formal tools, including projectile points, were found to be mainly local (67.8% coming from within a 75 km radius) while locally sourced informal tool materials were even more common at 84.21%.

Bighorn Flats hunting sites, lacking constructed game drive traps, walls, and blinds, appear designed to support open terrain hunting of grazing game herds and early to secondary stage processing of prey carcasses for meat, hides, and bone products. Drainage swales, ridges, knolls, large rock outcrops, and scattered large-boulder fields provided numerous terrain features for hunter concealment in natural kill areas. While constructed game drive features may be identified in the future, Bighorn Flats itself provides a natural topography conducive for efficient open tundra hunting.

Based on interpolation of data from a recent model of climate change and tree-line boundary changes on Mount Ida Ridge and Forest Canyon Pass to the northwest, two of the above described sites, 5GA2262 and 5GA2721, remained on alpine tundra above subalpine tree-line throughout the Holocene (cf., Brunswig 2014b; Brunswig, Doerner, and Diggs 2014a, 2014b, 2015b). The remaining two sites, along with several others in the Tonahutu headwaters site cluster (see Fig. 17), 5GA2705 and 5GA2712, are located within 55 m elevation of modern subalpine forest tree-line and would have existed within that tree-line boundary from the Early Holocene (Late Paleoindian) through earliest Late Holocene (Early Archaic) sub-epochs, (10,600 14C cal yr b.p.-~3,500 14C cal yr b.p.). An Early Holocene tree-line at +130 m, as indicated in the climate model, would have advanced subalpine forest a kilometer up-slope into what is Bighorn Flats alpine tundra today. A minimal Mid-Holocene tree-line rise of +70 m, documented by subalpine spruce tree remains preserved in an ice patch on the east slope of Mount Ida Ridge to the north, would have placed tree-line ~700 m up-slope at ca. 4,300 14C cal yr b.p., placing all the Tonahutu hunting camps with documented Late Paleoindian and Early Archaic occupations within upper subalpine forest margins.

The Flattop Mountain Game Drive Hunting System

East of the Bighorn Flats hunting territory is one of the Park's best-known game drives, the Flattop Mountain Game Drive (5LR6) (Benedict 1996). The Flattop drive is a large complex of drive walls and ambush pits ranging from Paleoindian times (Cody and James-Allen-Frederick complexes, ca. 10,845-8,747 14C cal yr b.p.) through a major period of use during the Early Archaic Period (7,416-5,738 14C cal yr b.p.) and into the most recent historic period (150 14C cal yr b.p.). The highest western portion of Flattop Mountain extends eastward from its boundary with Bighorn Flats and descends eastward through successive alpine, alpine-subalpine ecotone, subalpine forest and montane forest environmental zones to Bear Lake and the Glacier Creek valley (Fig. 22).

Flattop Mountain Game Drive (5LR6) extends along an east-west ridge-line spur known as Flattop Mountain (Fig. 22). The spur rises west through boulder fell fields and tundra until it crests at the Continental Divide. The site's lower eastern segment begins just within the upper subalpine-alpine ecotone and terminates upslope in alpine tundra, ca. 380 m east of the Continental Divide at an elevation of 3740 m (see Benedict 1996: 21-75). A graduate student in the mid-1930s, Elizabeth Yelm, first formally identified the site as a camp with associated game drive features in her 1935 Master's Thesis (1935: 28, 42, 44, 61, 94, 96-97, 112). She described its main game drive area as a series of rock walled blinds, cairn lines, and a 600 foot long, 2-3 (.6-1.0 m) ft high east-west wall. Yelm also noted numerous "…arrowheads, manos, pottery and two Yuma-like [Late Paleoindian-Cody Complex] points." (1935: 28). In addition to lithic artifacts, Yelm (1935: 94, 96-97, Table 8-D) recovered pottery from the site, now identified as belonging to subsequently named prehistoric Early Ceramic and late prehistoric/early historic Apachean (Dismal River) and Ute (Uncompahgre Brownware) ceramic types (cf., Brunswig 2012: 26-27).

Nearly three decades after Yelm, in 1961, University of Colorado graduate student Will Husted (1962: 26, 31, 105-106) visited the site and collected more than thirty projectile points belonging to the Early Archaic (Mount Albion Complex), Middle Archaic (McKean Complex), and Early Ceramic cultural periods. Another three decades passed before James Benedict (1996: 21) conducted extensive investigations on Flattop Mountain and documented what he described as "one of the most extensive examples of prehistoric game-drive walls, blinds, and cairns in the Colorado high country". Benedict (1996: 66-69) mapped what he interpreted as a series of nine, often "remodeled" and overlapping, drive

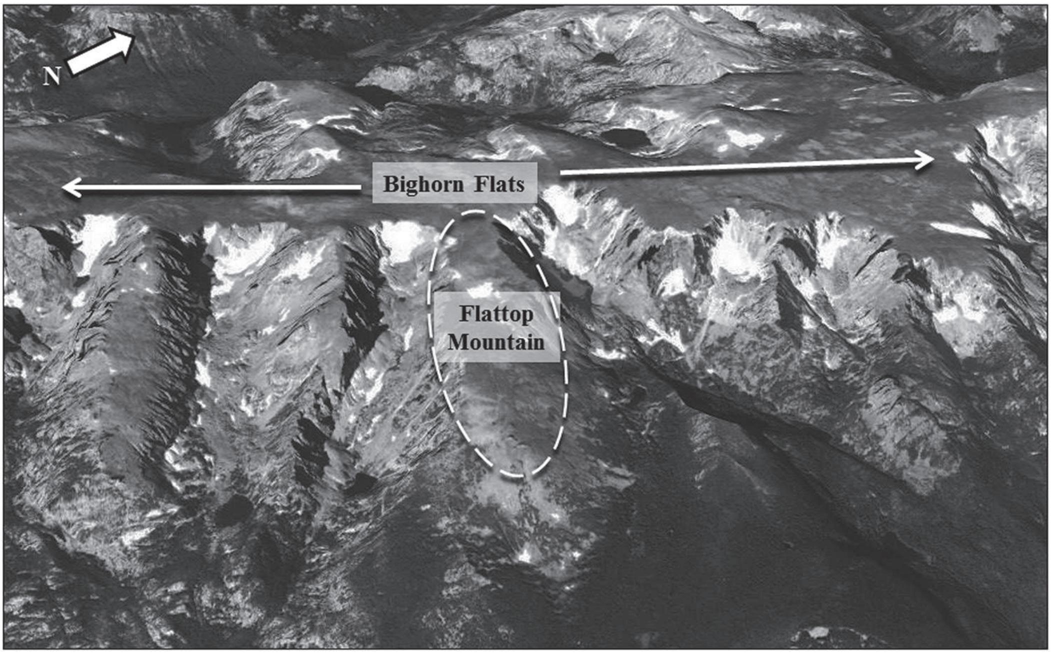

Figure 22. GoogleEarth™ satellite image of Flattop Mountain. The top of the image is oriented to the north-west and the earlier described hunting territory "crosses the T" along the Continental Divide tundra ridge-line

systems (or drive groups) on the mountain, consisting of seventy-eight circular to semi-circular rock wall and depression blinds, several low rock wall alignments, and rock cairn lines. He also investigated a small processing camp at the site's lower (east) subalpine-alpine ecotone end, a locality subsequently re-surveyed by UNC in 2000 (Doerner and Brunswig 2008). Fig. 23 shows a map of the Flattop Mountain Game Drive, its early stage processing (initial butchering) camp at the drive's southeast corner, and logistical-support hunting base camps, the latter located just inside subalpine forest on the mountain's northeastern lower slopes. The figure was created from topographic and archeological data using digitized United States Geological Survey (U.S.G.S.) maps, site maps published by Benedict (1996: Figs. 21, 22, 53, and 60), and mapping information gathered by UNC survey.

The number of diagnostic projectile points recovered from Flattop Mountain is impressive. At least seventy projectile points are stored in the Rocky Mountain National Park Museum along with other projectile points curated in other Colorado private and state institution collections (cf., Benedict 1996: Appendix C; Doerner and Brunswig 2008). Flattop Mountain's projectile point assemblage spans the region's entire culture history from the Late Paleoindian Period (Cody-Eden and James Allen-Frederick projectile point types, 10,590-8,747 14C cal yr b.p.) to protohistoric-early historic (Ute, Arapaho, and Apache) times. The most commonly represented cultural period is the Early

Archaic Mount Albion Complex (7,416-5,738 14C cal yr b.p.). Radiocarbon-dates of charcoal sediment-cored from game blind interiors (Benedict1992: 67, Figures 21, 60) and a UNC test-excavated blind (Doerner and Brunswig 2008: 5-7) provide direct chronological evidence of game drive use as early as 4,900 14C cal yr b.p. and as late as 220 14C cal yr b.p./AD 1730.

Along with the game drive and its associated processing area, archeological surveys documented four nearby hunt staging, or base, camps on the northern slope of Flattop Mountain (Fig. 24).

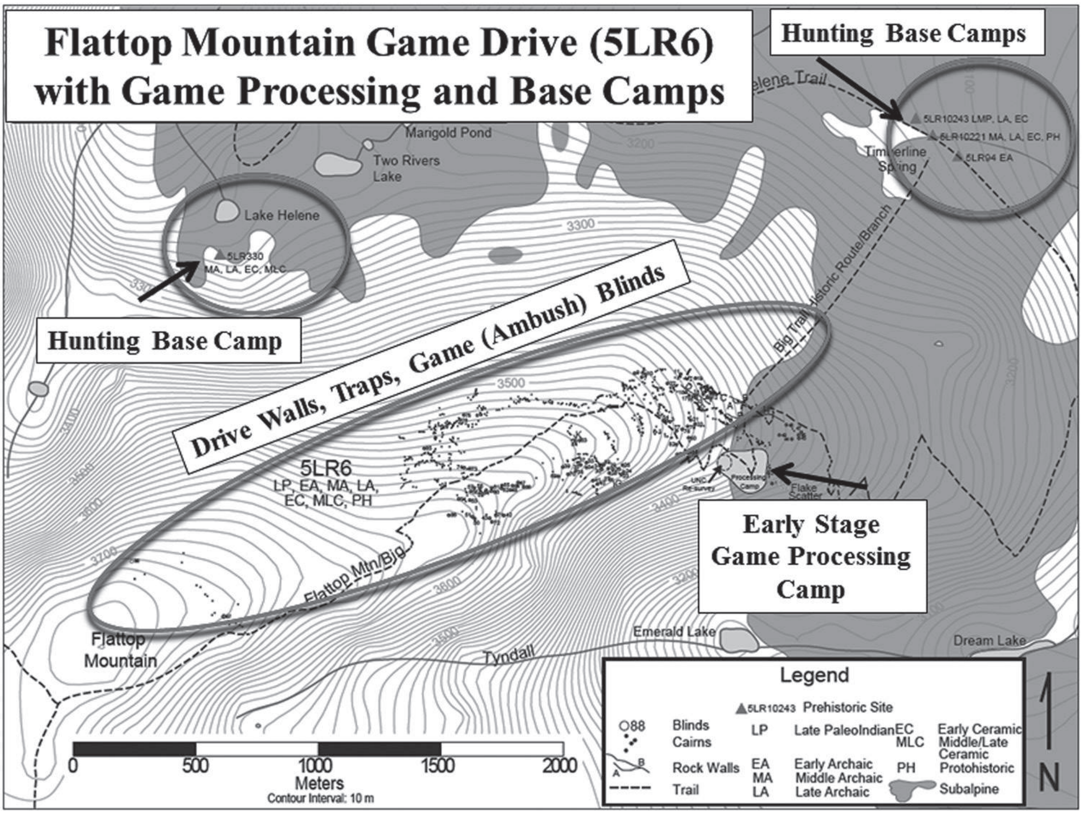

Figure 23. Computer map of the Flattop Mountain Game Drive (5LR6), its main processing camp and four support base camps (downslope and northwest and northeast of the drive).

Three camps, 5LR94, 5LR10221, and 5LR10243, are clustered on a 150 m east-west line along the modern-day (and prehistoric) Lake Helene trail, immediately below a free-flowing natural spring, Timberline Spring, in upper subalpine forest (Fig. 24, upper right corner). A fourth base camp is situated downslope and northwest of the main game drive area above Lake Helene (Fig. 24, upper left corner). Altogether, the base camps represent Late Paleoindian through early historic Native American occupations located on or near the earlier described prehistoric and early historic Big Trail which ascends the northeast slope of Flattop Mountain and crosses the mountain's upper crest-line westward over the Continental Divide into the earlier described Bighorn Flats hunting territory (cf., Brunswig and Lux 2014; Lux 2004, 2005).

One site, 5LR94, was originally recorded by Husted (1962: 30 101, 103) as an open camp with lithic tools but with little detail on its tool types. Later UNC analysis of artifacts that Husted collected from the site identified a Late Archaic projectile point (3,165-1,73514C cal yr b.p.) and a 2001 UNC survey recovered an Early Archaic corner-notched projectile point base (7,416-5,738 14C cal yr b.p.). Another site, 5LR10221, was found to be a substantial camp with lithic tools, lithic debitage, and Lyons sandstone grinding stone fragments. Culturally diagnostic artifacts at 5LR10221 included Late Archaic (3,165-1,73514C cal yr b.p.) and Early Ceramic (1,735-85614C cal yr b.p.) projectile points and two small protohistoric-early historic Ute (Uncompahgre Brown) pot sherds (ca. 350-150 14C cal yr b.p.).

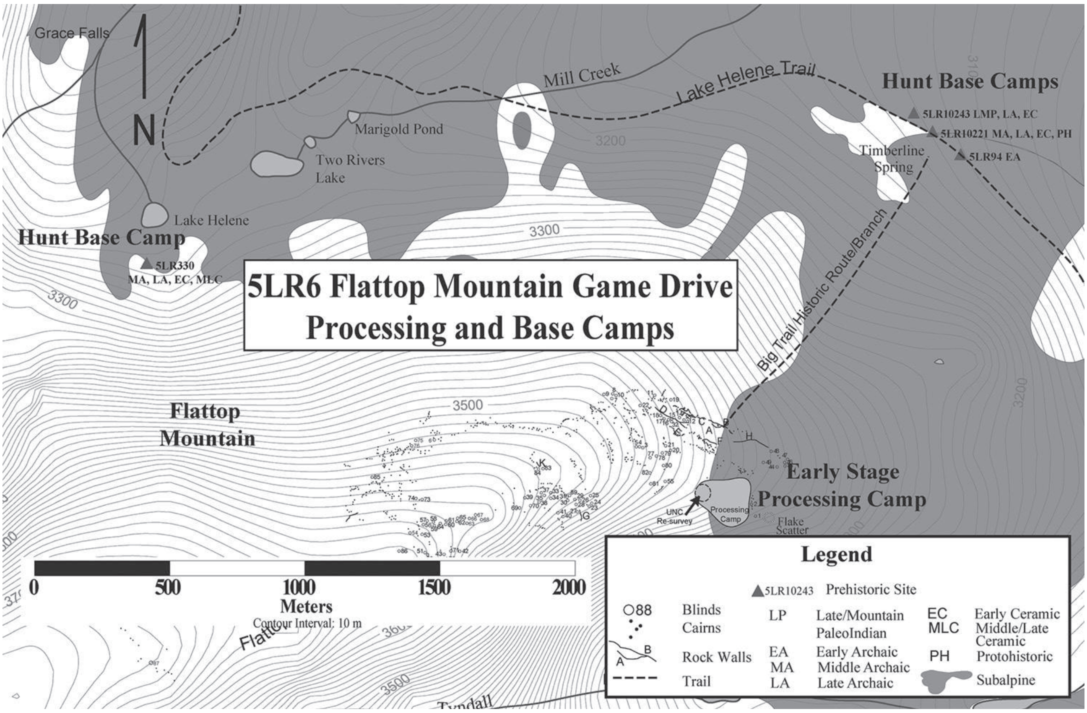

Figure 24. Area detail map of the Flattop Game Drive, early stage processing camp, and subalpine forest zone base camps.

A third base camp site in the Lake Helene Trail cluster, 5LR10243, is a multi-component prehistoric open camp located 15 meters south of the modern and prehistoric trail. Its associated artifacts were found scattered over two shallow drainage swales on the north-facing subalpine forest slope (Fig. 25).

In 2002, UNC archaeologists recovered six projectile points belonging to Late Paleoindian (10,689-7,835 14C cal yr b.p.), Late Archaic (3,165-1,73514C cal yr b.p.), Early Ceramic (1,735-856 14C cal yr b.p.), and Middle/Late Ceramic (856-64214C cal yr b.p.) occupations, along with several lithic tools, Lyons sandstone metate fragments, and seventy tool waste flakes in two lithic concentrations. Four 50 cm2 test pits were excavated in lithic concentration 1, revealing very shallow (4-8 cm deep) deposits containing buried artifacts, mainly small secondary and tertiary flakes, and remnants of a small basin hearth (Brunswig 2005a; Fig. 26 below). Hearth charcoal was radiocarbon-dated to 1007 AD/944±4014C cal yr b.p. (Beta-169189), a terminal Early Ceramic cultural period date.

MODELING SEASONALLY SCHEDULED SUBSISTENCE MIGRATION PATTERNS IN THE NORTH CENTRAL COLORADO ROCKY MOUNTAINS

In 1990, James Benedict (1990: 68-71; 1992: 11-14) proposed two seasonally-scheduled subsistence migration models for the North Central Colorado mountains, interior valleys, and eastern foothills; the Up-Down and Rotary models. Benedict's Up-Down transhumance pattern involved summer seasonal migrations of hunter-gatherer bands from low altitude winter camps in the Colorado

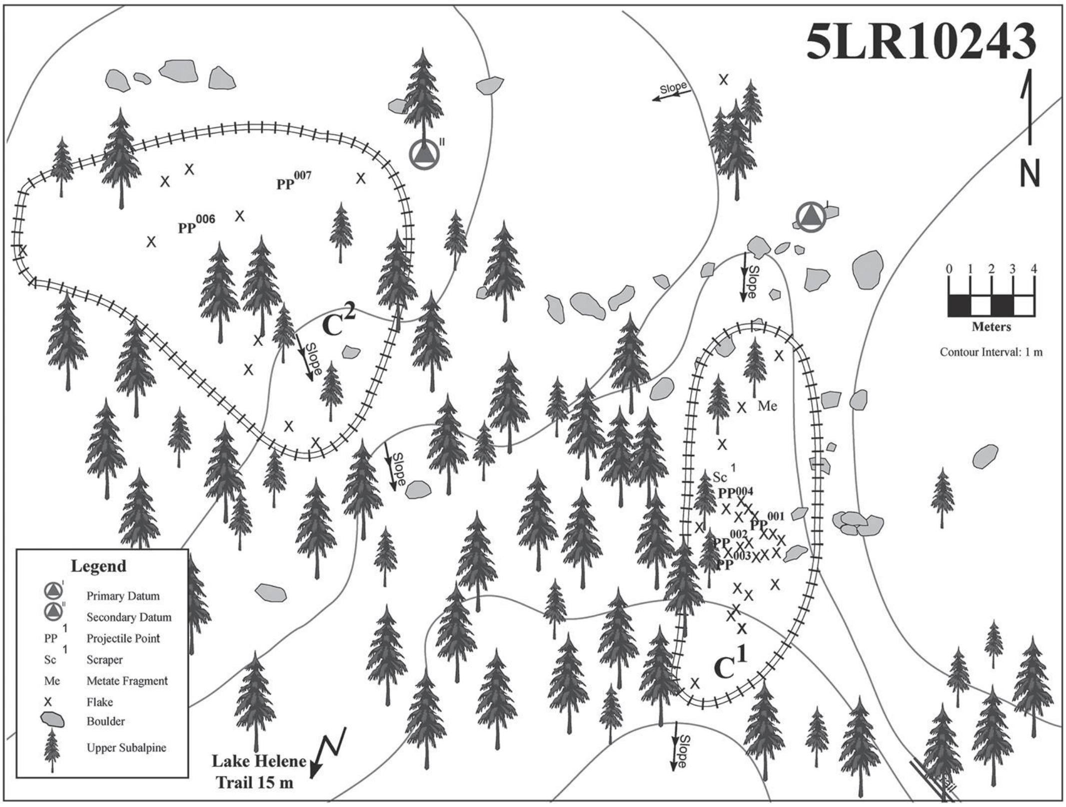

Figure 25. Site Map of 5LR10243. Note the two lithic concentrations and locations of the projectile points (ppN) shown in bold letters and numbers.

Front Range foothills to mountain valley and, ultimately, tundra hunting grounds. He suggested that the Up-Down transhumance pattern was particularly common during the Early Archaic Period when warm, dry conditions limited summer hunting in the eastern plains and increased growing season lengths and bio-mass productivity in the high mountains. Based on then available archeological data, Benedict viewed seasonal migrations as heavily oriented toward hunting groups moving from the eastern foothills to mountains along the Continental Divide and back in their seasonal rounds (Fig. 27).

At the time, Benedict (1992: 12) suggested high-altitude summer hunting was primarily accomplished by hunter-gatherers utilizing the Up-Down migration pattern who wintered in the eastern foothills and nearby high plains margins because: "people of the Mount Albion Complex obtained their toolstone exclusively from Eastern Slope and high altitude sources. No Middle Park cherts or jaspers have been identified."

However, analysis of 149 Early Archaic projectile points from Rocky Mountain National Park found they were overwhelmingly (74.5%) manufactured of locally available tool materials originating *west of the Continental Divide*, e.g., in Middle Park and North Park (Brunswig 2005a: 190-192, Fig. 41). Projectile point material source data from both earliest and later cultural periods point to a very long-term pattern of orientation toward western slope intermontane valley occupations as much or more than ones focused toward the eastern slope foothills and plains.

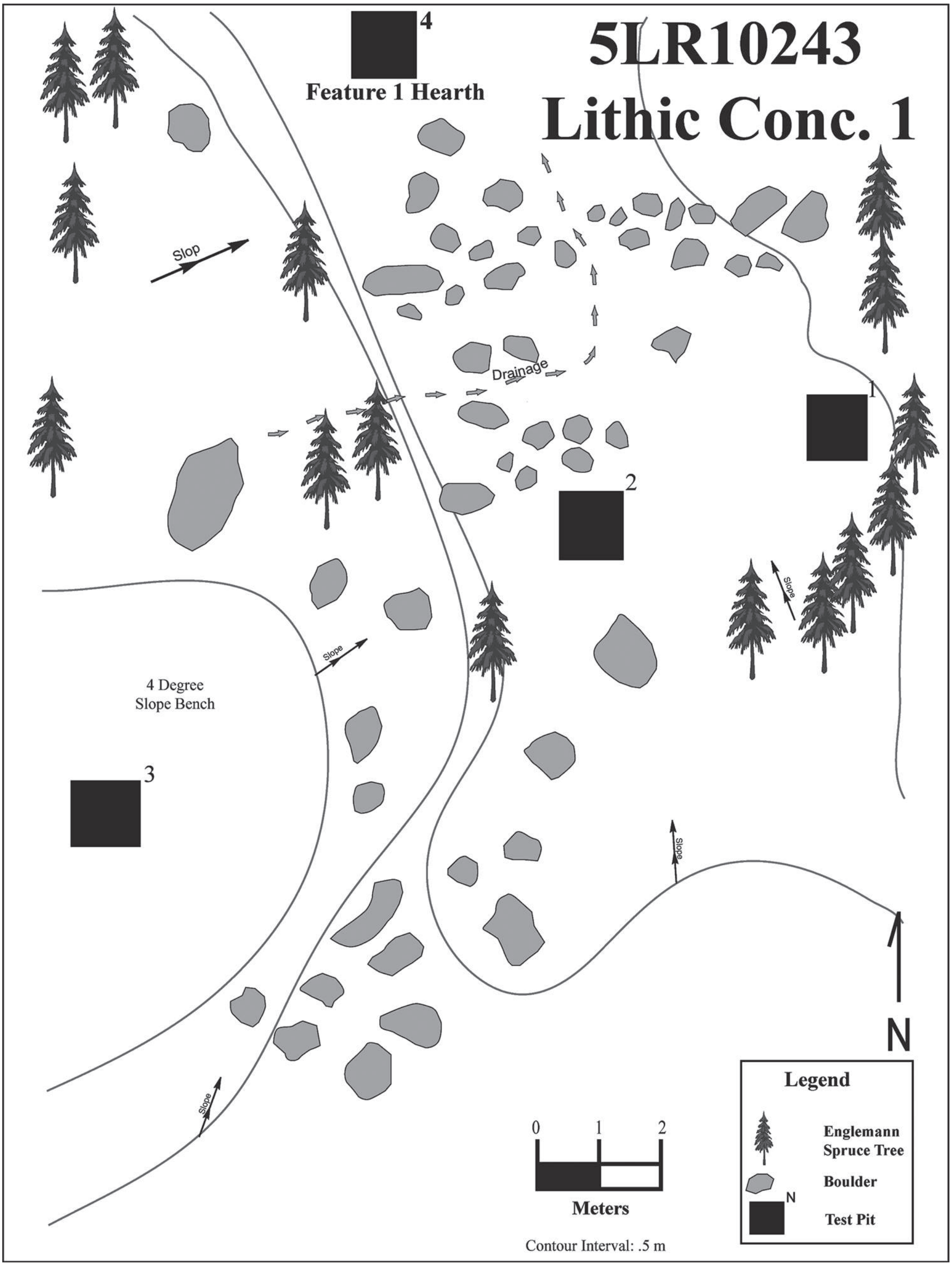

Figure 26. Location of 5LR10243 excavation units in lithic concentration 1. Test unit 4 at the top contained the radiocarbon-dated hearth.

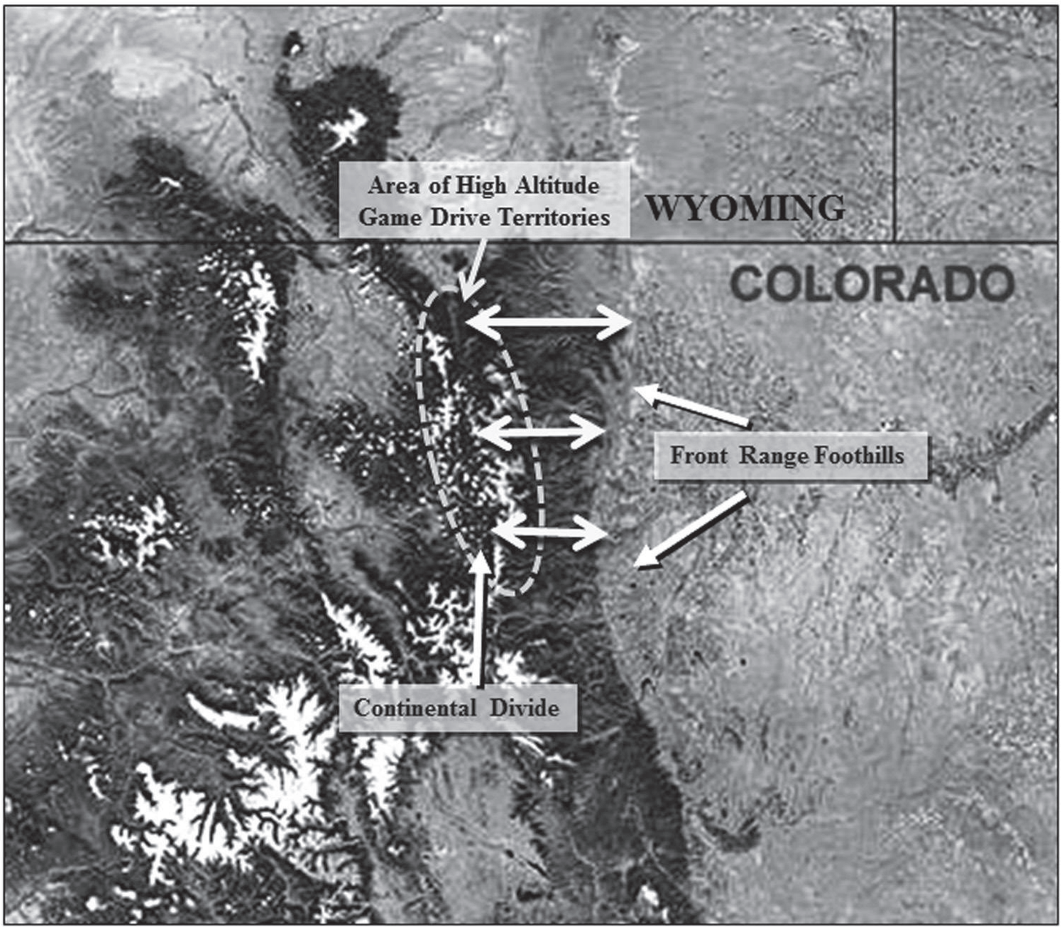

Figure 27. Illustration of Benedict's Up-Down seasonal transhumance system emphasizing eastern foothills-high mountains migration, superimposed on a GoogleEarth™ satellite image of North Central Colorado and South Central Wyoming.

Benedict described his Up-Down system as an early "rudimentary" stage of seasonal transhumance eventually succeeded by an alternate pattern he termed the Rotary or "Grand Circuit" system. In the Rotary model, hunting-gathering bands which primarily wintered in the eastern foothills "departed their winter base camps and [in late spring when mountain passes and tundra were still snow-covered-inserted comment by author] drifted north along the east flank of the Front Range" (Benedict 1996: 12). He viewed their strategy as circling the higher, snow-covered mountain ranges earlier in the spring by crossing lower passes in northern Colorado and southern Wyoming, e.g., Cameron Pass, La Poudre Pass, Kings Canyon, and North Gate Canyon, into North Park and Middle Park. Once eastern-based hunting bands arrived in the interior montane North Park and Middle Park valleys, they remained there until late spring or early summer when high altitude tundra game pastures opened to migrating elk, Bighorn sheep, and, probably, small numbers of mountain bison which, in turn, were followed by those migrating bands (Fig. 28).

In the course of their seasonal circuit north and west of Colorado's Continental Divide, migratory hunting bands are assumed to have carried supplies of flaked stone and ground stone tools from the eastern foothills, replenishing *part* of their flaked stone tool kits in spring and early summer with local Middle Park and North Park chert, jasper, quartzite, and petrified wood. According to Benedict, they chose not to acquire grinding tool materials from interior mountain valleys, but instead carried eastern foothills Lyons sandstone tools into those valleys and transported them back (eastward) to high altitude (mainly alpine) hunting territories along the Continental Divide in mid-late summer and early fall.

Analysis of ground stone artifacts during UNC's Park archaeological inventory project supported Benedict's premise that ground stone material on high mountain sites in the Park was almost exclusively Lyons sandstone, occurring only in Lyons Formation outcrops in the Eastern Front Range foothills (Brunswig 2005a: 188-195; Shropshire 2003). The high percentage (89.8%) of Lyons sandstone (eastern foothills sourced) grinding stone artifacts at Rocky Mountain National Park sites could support either of Benedict's two transhumance models. However, this author believes that

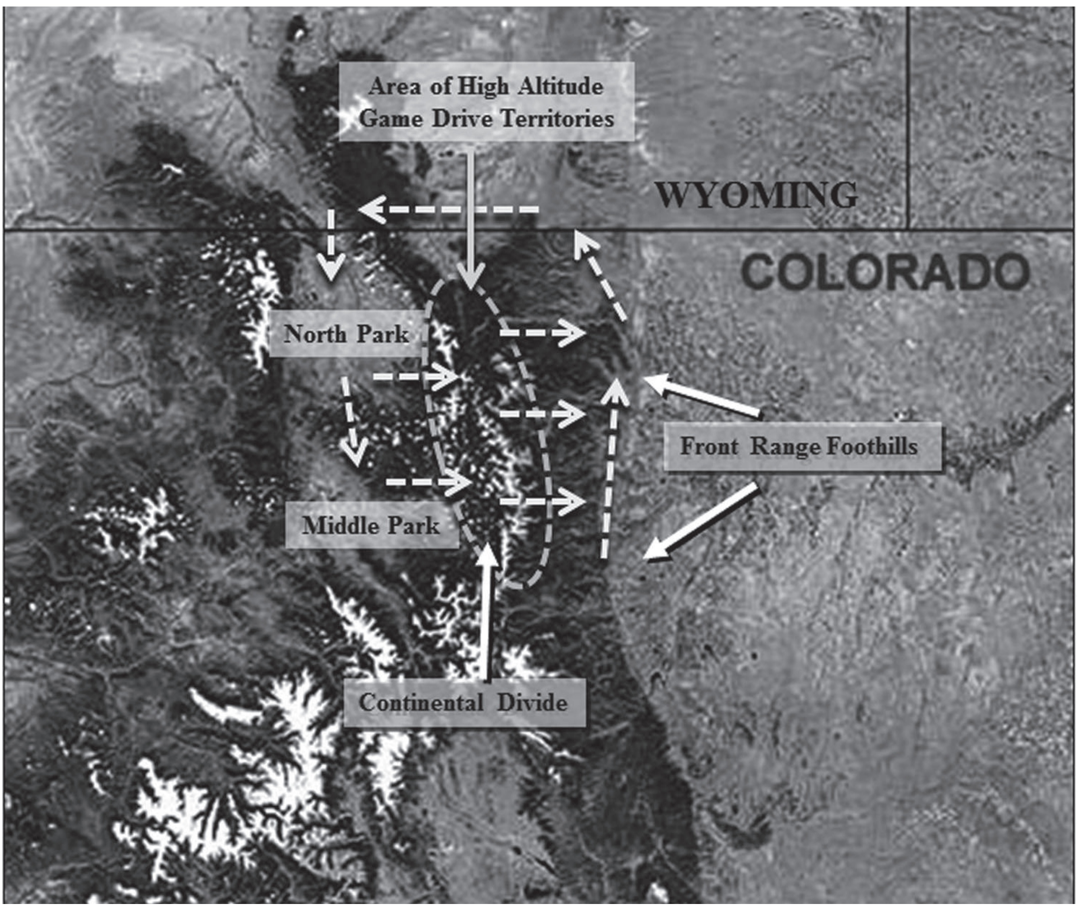

Figure 28. Illustration of Benedict's Rotary/Grand Circuit Seasonal Transhumance System superimposed on a GoogleEarth Satellite Image of North Central Colorado and South Central Wyoming.

validity of the Rotary model is weakened by virtual absence of Middle Park and North Park sandstone artifacts identified (only 2%) at Park sites since it is reasonable to assume that eastern foothills sourced Lyons sandstone tools would have been supplemented by interior mountain valley sandstone (of which there is an abundance) even though Lyons sandstone is functionally superior due to its harder, more durable, and better cemented traits. It is well-established that interior montane (Middle Park and North Park) sandstones do exist in geological formation outcrops and were frequently utilized for ground stone tools at local and regional prehistoric mountain sites (cf., Brunswig 2014a: 17-20; Brunswig, Doerner, and Diggs 2015a: 62-76). However, it must be noted that virtually no North Park and Middle Park sourced sandstone grinding stone artifacts encountered by this author during field research in those valleys are as well-cemented and durable as eastern foothills sourced Lyons sandstone. It is that durable quality that may explain why prehistoric Native Americans went to such great lengths in transporting heavy (8-15 kg) blocks of Lyons sandstone to mountain-top hunting sites. However, rather than necessarily indicating Lyons sandstone grinding stones were carried 250-350 km (155-218 miles) in a Rotary migration circuit from Front Range foothills sources through the North Park-Middle Park valleys to high-altitude RMNP hunting territories, this author suggests their presence may represent specialized procurement expeditions for Lyons sandstone directly to the eastern foothills by indigenous, interior montane resident hunting band members. An occasional alternative would have been active trade for Lyons sandstone with seasonally migratory bands who occupied winter sites in the eastern Front Range foothills or the nearby Colorado Piedmont and traveled westward into the park in late spring and summer.

If the above scenario is correct, its plausibility is supported by the fact that Lyons sandstone is tightly bonded and durable, making it a desirable ground stone material that could be cached and used year after year in the severe freeze-thaw winter conditions found at most high- and mid- altitude mountain kill and processing sites. Less well-cemented and softer Middle Park and North Park sandstones, while serving perfectly well as grinding stone material and situated close to interior montane valley sources where they could be easily replaced, would have worn and broken down more quickly in high tundra freeze-thaw and high wind conditions. This would have significantly reduced their cost-effectiveness, particularly given the physical effort in moving heavy ground stone over horizontal distances of 50 to 65 km (31-40 miles) and vertical elevation rises up to 2,287 m (7,500 ft). Caching and long-term re-use of durable Lyons sandstone grinding tools at high altitude sites would have allowed their continued use for years, even centuries or millennia, without having to regularly return to eastern foothills sources for replacement. Evidence of continued multi-year use, likely spanning decades or even centuries, is evident in the virtually universal trait of bifacial work surfaces and thin cross-sections of Park metate grinding stones made of Lyons sandstone.

Finally, UNC surveys and excavations at North Park Valley sites since 2003 have uncovered extremely limited examples of Lyons sandstone artifacts in an area which would have been a primary transit corridor if the Rotary Model had been common practice. This is despite the fact that Lyons sandstone is relatively accessible through Cameron Pass (east of North Park) and eastward in the lower parts of the Poudre River Valley which allows access to the Front Range foothills. To date, UNC North Park valley surveys, covering dozens of sites and more than 485 hectares, have only recovered only three examples of Lyons sandstone metates (Brunswig and Diggs 2014). The majority of sandstone metates so far documented at North Park sites are from locally abundant, although less erosion and use-wear resistant, sandstone-bearing formations such as those of the Dakota group, Morrison Formation, and Pierre Formation.

A second source of evidence often cited as supporting highland-lowland transhumance systems based in either the Up-Down or Rotary models is the presence of interior montane lithic materials, predominantly Kremmling (Troublesome Formation) chert in Front Range foothill sites (cf., Gleichman, Gleichman, and Karhu 1995: 131-134; Millonig 2011). However, as noted earlier, recent analysis of the Early Ceramic lithic assemblage of the Valley View pit-house site (5LR1085) in the foothills west of Loveland determined that Miocene-age outwash deposits from eastern plains paleovalley ridges include Troublesome Formation Kremmling chert cobbles (Brunswig *in press*; Brunswig, Doerner, and Diggs 2015a; Scott 1982: 10). The author, having collected gravel samples of Kremmling chert from plains surveys in the mid-1990s, confirmed that some plains-sourced cherts were geologically identical to Middle Park and North Park samples and UV light florescence analysis support a common Troublesome Formation origin. This discovery, while not obviating the up-down or rotary transhumance models, does diminish the value of using Kremmling chert in eastern Front Range sites as an indicator of highland-lowland transhumance for either model. And while this fact *does not* invalidate either model, it suggests we will need to look elsewhere for supportive evidence.

In both of Benedict's seasonal transhumance systems, cold-season (winter) residence was viewed as primarily taking place east of the Continental Divide in sheltered hogback ridge-lines of Colorado's Front Range foothills, protected riparian stream terraces, and bluff rock shelters in the adjacent Colorado Piedmont. He suggested that: "people are unlikely to have wintered in Middle Park or North Park, west of the Front Range. These high-altitude basins are snow covered in winter except for the windiest ridges and knolls. They receive cold-air drainage from the surrounding mountains, and often register the lowest temperatures in the United States" (Benedict 1992: 11).

However, many areas of both North Park and Middle Park today are comparatively snow-free during winter months (cf., Surrovell et al. 2003: 4-5) and both prehistoric and historic data show that many game species, including bison, elk, pronghorn, and mule deer, overwintered in both valleys, with preference for sheltered valley bottoms between protective ridge lines and along major river corridors such as the Colorado (Middle Park) and North Platte rivers (North Park) (cf., Carpenter et al. 1979; Fremont 1851; Surovell et al. 2003: 7). Even during the most severe cold episode of post-Pleistocene times, the Younger Dryas, it is believed Folsom bands wintered in nearby Middle Park at Barger Gulch, south of the Colorado River (Surovell and Waguespack 2007). In warmer climatic intervals, such as during Early Holocene warming (initiated at ca. 9,500 14C b.p.) and the subsequent warm Altithermal (Mid Holocene) Episode (ca. 7,500-5,000 14C b.p.) when intermontane valley winters would have been even more conducive to year-round human residence.

While evidence cited here does not fully support or refute either Benedict's Rotary or eastern slope-focused Up-Down transhumance models, it reinforces the hypothesis that indigenous mountain adaptations, with interior montane valley residency, were well established by earlier Late Paleoindian times (ca. 10,600 14C cal yr). At present, there is little evidence to suggest that Rocky Mountain National Park, except possibly during periods of highly beneficial climate optima such as the Early Holocene and Mid-Holocene (e.g., the Altithermal) and their respective Late Paleoindian and Early Archaic cultural periods, was a place of winter residence for prehistoric and early historic Native American populations. There is evidence that the Park, particularly its high altitude tundra grasslands, was integral to warm-season high altitude hunting and gathering and central in its local region to annual cycles of seasonally scheduled subsistence systems established by Early Holocene/Late Paleoindian times. As to the directional (rotary, up-down…) patterns of those seasonal cycles, it is likely they varied through time and space and may have, at times, been contemporaneous in operation. What appears likely, given heavy utilization of interior mountain lithic sources for flaked tools of all known cultural periods, is former existence of a long-term, possibly dominant, presence of mountain-adapted, indigenous hunter-gatherer populations in valleys west of the Continental Divide, populations which seasonally exploited, primarily in a *western slope* focused Up-Down transhumant pattern, summer resources in Rocky Mountain National Park (Fig. 29).

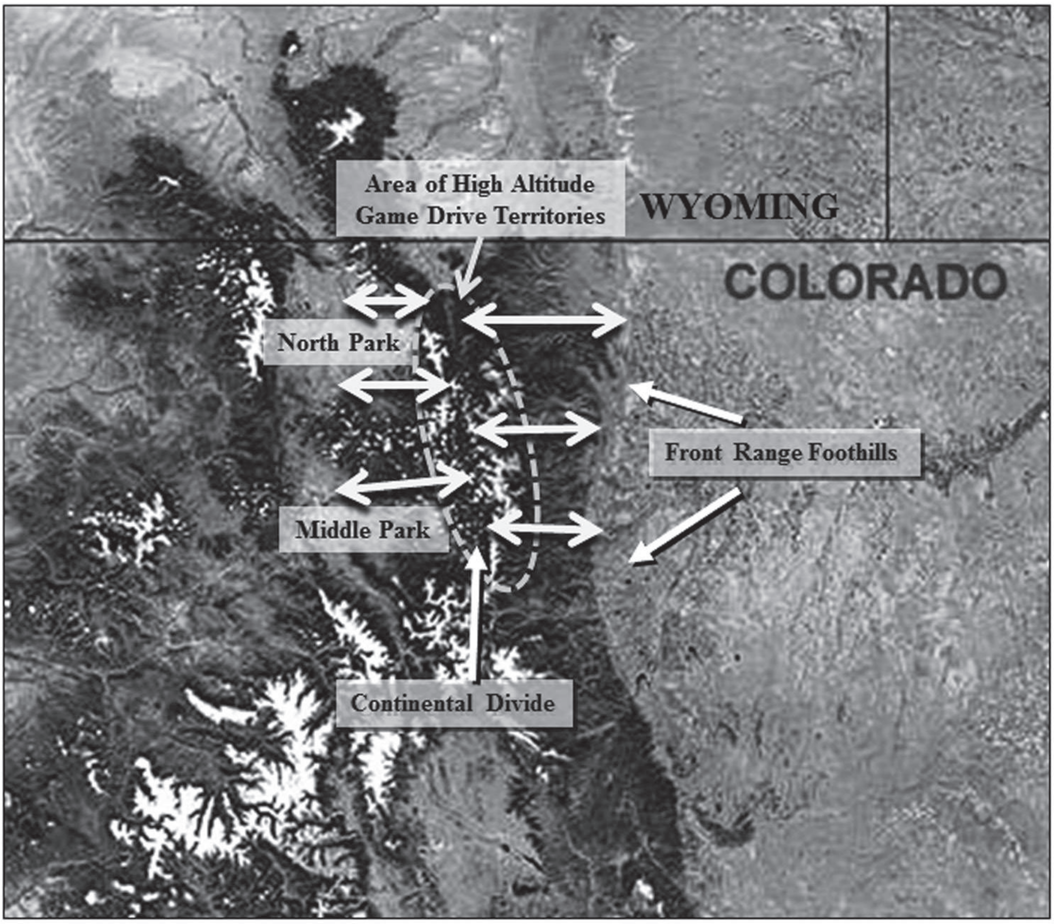

Figure 29. Evidence-supported seasonal migration model which emphasizes both interior-mountain valley to alpine and eastern foothills to alpine transhumance with a long-term bias toward interior montane migratory patterns.

FORAGING, PATCH CHOICE ECOLOGY, AND LOGISTICAL COLLECTING ECONOMIC STRATEGIES OF PREHISTORIC ROCKY MOUNTAIN HUNTER-GATHERERS

Theoretical concepts on hunter-gatherer subsistence strategies, based on analogues with historic and modern populations, have been the subject of archaeological research for well over a century. From the 1970s to the present day, archaeological theorists, Bettinger (1991: 61-82), Binford (1977, 1978, 1980), Cashdan (1992) and Kelly (1992, 1995, 1998, 2013) among others, have extensively formalized method and theory about hunter-gather subsistence strategies focused on what is known as the Foraging Spectrum, involving socioeconomic systems ranging from highly mobile and seasonally based foraging to less mobile, more highly residential and logistically-organized collector behavior. While there have been many permutations and arguments for and against applications of forager-collector theory and concepts, broad-scale use of their fundamental principles as functional Middle-Range theory for explaining prehistoric to historic hunter-gatherer behavior has remained constant (cf., Kelly 2013; Sellet, Greaves, and Yu 2006).

Hunter-gatherers employing forager subsistence practice residentially restricted, high mobility (migratory) strategies although their time-span of occupation site residency and mobility associated with food and other economic resource procurement may vary from one season to season. Their frequency of movement through resource territories depends on the extent (size), richness (ecological productivity), and relative distribution of resources across different landscapes and ecosystems. Forager subsistence systems nearly always involve forays from base hunter-gatherer camps (central places) to procurement sites (resource locations) which contain one or more rich resources in greater abundance than most surrounding areas (cf., Binford 1980). Once "extractive" tasks are carried out, foragers commonly return to base camps where further extraction and processing takes place.

Hunter-gatherer collectors, who are sometimes engaged in food-production activities for part of the subsistence year, are more highly systematic and logistically organized than foragers. Base camps used in subsistence procurement are commonly occupied for longer periods (extended residence). Like foragers, collectors travel outward from base camps to exploit resource-rich patch locations within a variably productive natural landscape. Collecting forays from base camps are designed to logistically-organize hunter-gatherer group (band) members to systematically "harvest" resources (game, food plants, lithic tool materials, etc.) from a large "patchy" resource territory. At times, multiple collector teams (task groups) might be absent from their common base camp at the same time. Along with base camps and resource locations, collectors often systematically employ other activity site types making up the collector procurement system; field camps, "where a task group sleeps, eats and otherwise maintains itself away from the residential base" (Binford 1980: 10), stations, information-gathering and sharing sites where localized resources are evaluated and procurement actions are decided, and caches, temporary storage locations for procured resources (meat, harvested plant products, etc.) prior to their transport to residential base camps for final processing. Finally, collectors are broadly defined as involved in procuring economic resources, with an emphasis on preserved foods for extended storage and later use.

Both foragers and collectors seek resources within natural landscapes and their associated ecosystems that are subject to seasonal climate variations (temperatures, moisture) and geographic variations in types and abundance (richness) of resources, e.g., water, fertile soils, game, economic plants…). Uneven distribution of human economic resources within landscapes is characterized by their concentration (high density areas) in specific locations referred to as ecological patches or patch islands. Ecological patches are defined by physiographic and ecological conditions which are more resource-rich than surrounding terrain (cf., Levin and Paine 1974; White and Pickett 1985; Winterhalder 1981: 26), but having those conditions endow them with what patch ecology theorists refer to as persistence, stability, and resilience (cf., Holling 1973; Winterhalder 1994: 34). Unusually high productivity and natural persistence of that productivity when other areas were adversely stressed by climate or other negative-feedback phenomena, either seasonally or throughout the year, made patch islands desirable procurement localities for hunter-gatherers. Archaeological researchers often utilize the uneven-distribution-of-natural-resources patch concept in patch choice modeling, or PCM, (Kelly 2013: 62-63), a theoretical approach used to explain complex interrelationships of past human subsistence systems with their associated ecosystems (cf., Brunswig 2003c; Burger et al. 2005; Osborn and Kornfeld 2003; Wandsnider and Chung 2003; Vehik 2003).

Interdisciplinary research in one of this article's study areas, Forest Canyon Pass, established that its unusually high site density was likely, at least in part, due to high ecological diversity and productivity based on a variety of topographic, ecological, and hydrologic conditions, qualifying it as a high density patch island embedded in a broadly lower productivity landscape (Brunswig et al. 2009).

Alpine tundra hunting territories discussed here, despite their short summer growing seasons, also qualify as high density patch islands in the Park's mountain landscapes, providing highly nutritious alpine grass and forb forage for herds of large grazing herbivores that, in turn, attracted Native American hunters to its high country for thirteen millennia. As shown by the common occurrence of grinding stones at game drives and food processing sites, harvesting and processing of alpine food plants along with game animal carcasses further enhanced the alpine tundra's role as a short-term but highly rewarding (high density patch) ecosystem (cf., Festa-Bianchet 1988). Overall productivity of alpine rangelands through time would have varied, subject to long-, medium-, and short- term climate conditions and their effect on moisture, temperature and the length of growing seasons. Modeling of such climate change on large herbivores, such as elk, which use alpine tundra as their primary summer range, predicts significant increases in game herd sizes occur during more positive (e.g., warmer and wetter) climate periods (Wang et al. 2002).

Elements of both forager and collector subsistence strategies, but with a strong forager bias, are documented in above descriptions of Park hunting territories and sites. Base camps (central places), from which hunting-gathering forays originated, are characteristic of both forager and collector systems and appear common to all described Park hunting territories. Tundra game drive sites with associated butchering tools, tool refurbishment (flake scatters), and grinding stone concentrations and subsidiary primary and secondary game processing camps, some located away from the drives themselves, represent detailed planning and logistical organization consistent with collector behavior. Medium to short-term camps in sheltered upper subalpine forest and alpine-subalpine ecotone (kummholz) locations provided a secure staging area, or base camps, for pending tundra hunts, including game drive operations, and locations for final stage hunting and gathering foray game and plant processing. Tundra sites were where game was driven, ambushed, and killed and carcasses cut into sections for transport to lower elevation base camps or readily-butchered meat was cut off bone, cut into strips, and dried for lighter-weight transport to those base camps. During initial processing of hunted game, edible tundra plants (mainly those with root bulbs), many useful for mixing with animal fat and grease and dried powdered meat for pemmican, were collected, dried, and ground into flour using durable grinding stones left on site and re-used for decades or centuries until they were worn down and discarded. The construction and re-modeling of game drive walls, blinds, and, in some cases, drive walls and rock cairn lines over millennia and hundreds of human generations suggest significant planning and labor organization, again verging on logistically-planned collector behavior. Base camps, located in more sheltered areas with their own concentrated natural resources (game, food and medicinal plants, fire-wood, trees and branches for hide-covered shelters, and abundant water), provided additional subsistence materials as well as secure, protected locations for final stage processing of meat, bone, hides, plant products, and tool and weapon repair.

Archaeological evidence for open tundra hunting territories such as Bighorn Flats, however, support the existence of a well- planned and organized forager hunting strategy but perhaps not as logistically organized as game drive hunting systems.

With these facts in mind, it can be surmised that human hunting systems in the Park represent a long history (up to thirteen millennia, including the earliest pioneer Clovis hunters) of seasonally transhumant hunting-gathering with elements of both forager and collector behavior with a bias toward shorter residence (forager) hunting and camp site activity but often with elements of long-term planning and collective band task organization (drive construction, coordination of band members for animal drive and kill tasks, and meat and plant processing roles).

CONCLUSION

Recent archaeological research in North Central Colorado's Rocky Mountains points to the existence of an extraordinarily rich cultural landscape exemplified by thousands of sites produced by millennia of hunter-gatherer bands, overlaid and deeply integrated into the Park's diverse natural landscapes. That evidence suggests a complex story of human achievements spanning more than four hundred human generations before the first European explorers entered the American West. Most of that story, as described in the preceding article, deals with evolving, and often highly sophisticated, economic systems, and to a lesser degree, social (hunter-gatherer bands) aspects of long-departed Native American ancestors. While much work remains to further refine our understanding of the nature and extent of past socio-economic systems in the region, past and on-going research has opened the path to more completely understanding and interpreting those systems beyond subsistence and broad social organization.

Over the past decade there has been a sustained research effort by this author and his co-investigators to explore physical (archaeological) and ethnographic evidence which helps explains how past Native Americans integrated spiritual beliefs and spiritually-inspired behavior with socio- economic systems to both define and cope with their often challenging physical worlds through time (Brunswig 2005c; Brunswig, McBeth, and Elinoff 2009; Diggs and Brunswig 2013). Although that research is on-going, it has, over more than a decade, documented that, at least in more recent late prehistoric and early historic times, native peoples such as the Ute viewed their world as inhabited by spirit beings and places of great spiritual power which, at times, needed to appeased, and at others, could be manipulated by ritual and ceremony for their advantage. Their conceptual, or cognitive, worldview, and likely those of earlier native peoples extending back to the Late Ice Age, appears to have envisioned a seamless, interwoven fabric of the mundane, everyday world with that of a supernatural world. In psychological and anthropological, if not religious, terms, those beliefs, and actions associated with them, infused native peoples with a strong sense of community, both with each other and with their natural and supernatural worlds. That sense of community and a conviction that, through spiritual cultural action (ritual and ceremony) united with technology, sophisticated subsistence planning, and social cooperation, they could exert substantial control over the world around them, giving powerful mechanisms for survival in an often unforgiving environment.

LOW ALTITUDE PROSPECTION OF EARLY MISSISSIPPIAN MOUNDS AT THE COLLINS SITE, ELKINS, ARKANSAS

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Abstract

This paper presents the methodology and results of a preliminary survey in which the efficacy of low altitude aerial photogrammetric survey using an unmanned aerial vehicle as the camera platform and the Structure from Motion image processing pipeline are tested for feature identification at a Mississippian mound site in the Southeastern United States. Challenges encountered during the survey are addressed along with suggestions for improvement. Despite the challenges, a digital elevation model (DEM) derived from the photogrammetric data yields an accurate realization of the size and shape of the earthen mound in the survey area. This previously unknown information coupled with magnetic gradiometry data supports the interpretation that the shape of the mound was influenced by the presence of a structure. In addition, the DEM provides measurements that are potentially useful for applications such as topographic correction of ground-penetrating radar data. The results demonstrate the utility of low altitude aerial photography. And, as excavations at the site are not permitted, our survey also highlights the importance of such non-invasive survey methods.

Keywords: digital elevation model, earthen mound, Mississippian, photogrammetry, Southeastern Archaeology, Structure from Motion, UAV

Resumen

El objetivo de este artículo es presentar la metodología y los resultados preliminares del estudio sobre prospección fotogramétrica aérea a baja altitud, mediante el uso de un vehículo aéreo no tripulado (UAV) y tecnología de Structure From Motion (SFM). El área de investigación corresponde a los yacimientos de la cultura Misisipiana localizados en el sudeste de los Estados Unidos. Los autores resaltan las dificultades aparecidas durante el estudio y las propuestas de solución para éstas. De esta manera, a pesar de dichos inconvenientes, se ha conseguido elaborar un Modelo Digital del Terreno (MDT) que refleja con precisión, en una realidad virtual, la microtopografía de los montículos de tierra construidos por la cultura Misisipiana. Los datos obtenidos por el UAV fueron comparados con algunos resultados de una prospección geofísica anterior, lo que aumentó significativamente las posibilidades de interpretación de dichas construcciones en el terreno. Los resultados validan la utilidad que ofrece la investigación mediante fotogrametría aérea a baja altura, especialmente considerando la imposibilidad de realizar excavaciones arqueológicas en dichos yacimientos.

Palabras clave: Modelo Digital del Terreno, montículos de tierra, Misisipiana, fotogrametría, arqueología sudeste, Structure From Motion, UAV

INTRODUCTION AND THE BACKGROUND OF THE COLLINS SITE

The use of non-invasive sensor technology is becoming routine in archaeological investigations. In some situations, especially when excavation is not permitted, such methods may be the only way to document the archaeological record. The Collins site, located in the southeastern United States, is one such example. Excavation is not allowed and the use of geospatial technology is crucial in order to understand the role of the site in the prehistory of the region.

The Collins site is situated in the Ozark Highlands, a large plateau characterized by hills and valleys formed by river and stream erosion. The alluvial valleys of the Ozark Highlands are host to many archaeological sites including the Collins site, which is located along the White River in northwestern Arkansas (Figure 1).

The site is heart-shaped and is bounded by the current river channel to the north and east and a paleochannel along the south and west. Five constructed earthen mounds ranging in size from 21 to 51m in diameter and 0.5 to 3m in height border the present and former channels. Mounds A and E are in the southern section of the site and Mounds B, C, and D are in the northern section (see Figure 2).

In the 1980's, looters dug into the southern mounds with a backhoe. Burned clay, thatch, and charcoal removed by the backhoe were salvaged by a member of the Arkansas Archeological Survey (Fritz 1980). A single sample of the burned thatching sent for radiocarbon dating returned a conventional date of 820±60 B.P. calibrated to cal. A.D. 990-1230 at 2 sigma (Vogel 2005: 303), placing the site in the Early to Middle Mississippian Period.

A barbed wire fence extending east-west divides the site and demarcates land ownership. Both the northern section and the southern section are privately owned and due to landowner permission (or lack thereof), only the northern section of the site is available for archaeological investigation. Although access to the northern section has been granted, excavation on the property is not permitted by the landowners. The landowners are, however, receptive to the use of non-invasive survey methods.

Aside from the radiocarbon date obtained in 2005 (Vogel 2005) and the creation of a map of the layout of the mounds (Kay et. al 1989), formal investigations of the site have only recently begun. A magnetic gradiometric survey was conducted across the entirety of the northern section of

Figure 1. Location of the Collins site within the Ozark Highlands of Northwest Arkansas (after Sullivan and McKinnon 2013:71).

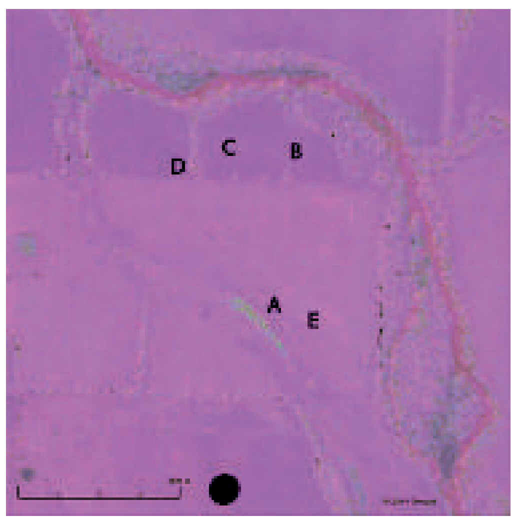

Figure 2. Layout of the Collins site (imagery provided by Google Earth) including locations of the five mou-nds, Mounds A through E

the site encompassing Mounds B, C, and D and yielded excellent results revealing the footprints of structures both on and off mound (Sullivan and McKinnon 2013). A comparison of the magnetic gradiometry data from the Collins site with the results of archaeological excavations conducted at other contemporaneous mound sites in the western Ozark Highlands suggests that the Collins site was used as a ceremonial center where various rituals including mortuary ceremonies took place (Kay et al. 1989, Kay and Sabo 2006, Sullivan and McKinnon 2013).

The success of the magnetic gradiometric survey sparks further surveys employing other methods. This article discusses a preliminary UAV-based aerial imaging survey over the northwestern section of the Collins site including Mound D. The purpose of the survey is to test the efficacy of aerial imaging for creating a digital elevation model of the Collins site. It is hoped that the digital elevation model will yield an accurate realization of the shape and size of the mound, provide data with which to topographically correct the ground-penetrating radar data, and potentially reveal cultural features on the landscape that are not otherwise evident.

METHODOLOGY

Low Altitude Aerial Photography (LAAP) has been used in archaeology for more than a century. Since the first documented archeological application of aerial photography performed with a kite over the Forum Romanum in Rome (Castrianni 2008), technological development has changed the face of aerial prospection. The first and second decades of the 21st century have seen UAV's (unmanned aerial vehicles) gaining popularity among archaeologists as the platform of choice for obtaining low altitude images (Verhoeven 2009) due to features such as robustness, lack of weather-dependence, and high survey accuracy. In the case of the Collins site, the use of a UAV is superior over older platforms, like kites or helikites, in terms of its suitability for Structure from Motion (SfM, discussed below), an imaging technique where rows of overlapping images from an altitude of <50 m are required. Kites do not provide the necessary control over the flight-path as their position is largely dependent on local wind conditions. In contrast, radio controlled UAV reinforced with a GNSS (Global Navigation Satellite System) receiver, allows the operator to precisely navigate along fixed flightpaths.

The survey at the Collins site was completed over two consecutive days in May. As the main objective of the mission was to test the efficacy of this kind of survey before further prospection, it was decided to survey only the NW quarter of the site, containing Mound D. The survey was conducted in late morning with two 10 minute flights on the first day and a single flight on the second day. The hardware consisted of a DJI Phantom 2 quadcopter armed with a Cannon EOS M camera with a 22 mm lens. The camera was programmed using a Magic Lantern script to take pictures every two seconds. The camera was fixed to a UAV without a gimbal at a 90° angle in order to take almost vertical photos of the ground. Rubber shock absorbers were fitted on the camera mount to reduce vibration. The main technical difficulty related to the equipment during this survey was the lack of live preview from the UAV's camera. This rendered the accurate control of the flightpath and picture overlap impossible. Despite this issue, it was possible to fly along both the N-S and the E-W axis using visual control from the ground. A total of 748 pictures were taken from which 614 were used for further analysis.

In order to georeference as well as check the quality of the survey, four ground control points (GCP) were established with one in each corner of the study area. The GCP were measured using a real-time kinematic GNSS survey with the help of two Leica GS15 GNSS receivers and a CS15 controller. One receiver was established as the base station over a fixed control point. The other receiver was used as a rover for the collection of positional measurements. During the survey, the base continuously recorded its fixed position from GPS and GLONASS satellite signals while transmitting a correction signal to the rover. Both the base and the rover data were post-processed and yielded a

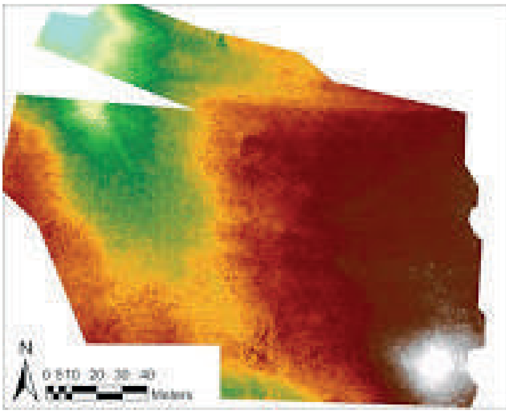

Figure 3. DEM of survey area.

Figure 4. Orthophoto of survey area.

horizontal accuracy of 2cm. Due to an equipment malfunction, measurements for only three of the four GCP (in the SW, SE and NW corners) were obtained.

The goal of the survey was to create an orthoimage and digital elevation model of the site. An orthoimage is a geometrically corrected photograph or mosaic of photographs that can be used for further mapping (Robinson et al. 1995). Usually in aerial archaeology such images are used for delineating features identified through soilmarks or cropmarks (Rączkowski 2015), however at the Collins site, both vegetation and soil conditions were unfavorable for such an application. Therefore, it was more purposeful to create a digital elevation model (DEM), which is a computer-based reflection of the site's topography (Li et al. 2004). Because the mound footprints are raised in the topography, an elevation model should highlight these features.

The Structure from Motion (SfM) pipeline was utilized for the creation of the DEM. SfM is a technique that enables the creation of 3D models using a series of overlapping photos (Häming and Peters 2010). The first step of the process is point identification using the Scale-invariant feature transform (SIFT) algorithm (Lowe 1999). The spatial position of every point is subsequently compared on all of the images in the dataset in order to evaluate their location. A point cloud is generated yielding the basis of a 3D model that can be converted into a triangle-based mesh and draped with texture.

In the case of our survey, 614 photos were used to create a 3D model covering 2.5 ha (Fig. 03). The model is of subdecimeter accuracy with an average point cloud density of 12,000 points per square meter. The model was supplemented by an orthoimage (Fig, 04) with a 5 cm ground sampling distance (GSD).

RESULTS

The outcome of the prospection was a 3D model and orthoimage of the NW quarter of the Collins site. As predicted, the orthoimage did not provide any new archaeological information. The digital elevation model, however, was far more informative. Though the majority of the survey area is relatively flat, the mound in the SE corner of the study area is easily visible.

The mound itself is not a particularly prominent feature in the landscape as it is just 1 meter high and has very gentle slopes. Therefore from the ground it could be easily omitted during ground prospection. However a close investigation of the DEM (Fig. 5 and 6) clearly reveals an archaeological feature that has a radius of 30 m and a morphology that is convergent with similar Mississippian mounds known from this area.

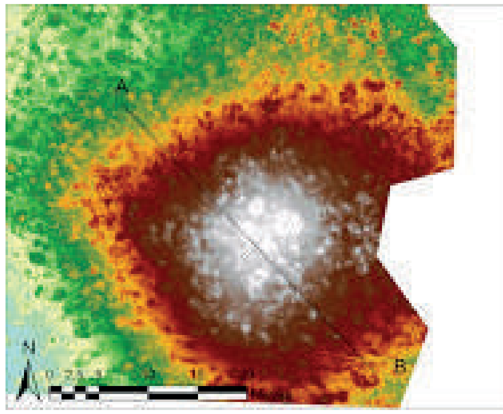

Figure 5. DEM of Mound D (A-B cross section is graphed in Figure 6).

DISCUSSION AND CONCLUSIONS

The Collins site is currently used as pasture for grazing cattle. Cow trails can be seen extending E-W in the DEM in the northern part of the survey area with a second path diverging diagonally and slightly to the southwest. In addition to the cow trails, the barbed wire fence extending E-W in the southernmost part of the survey area is also visible.

More interesting is what is revealed through the DEM about Mound D. Figure 7 displays the magnetic gradiometry data collected over Mound D by Sullivan and McKinnon (2013). The magnetic data was collected in 20x20 meter grids, shown outlined in black in Figure 7. To assist in orienting the magnetic data so it can be compared with the DEM, an outline of the location of the barbed wire fence has been included in the figure.

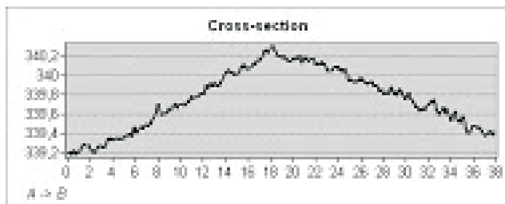

Figure 6. Thirty meter cross section of DEM over Mound D (location of cross section shown in Figure 5).

Note that the apex of the mound is rectilinear in shape and appears to be oriented similarly to the structure evident in the magnetic gradiometry data (see Figure 7). This suggests that the mound took the shape of the structure. It also supports the interpretation that the mound served to bury the structure associated with it after what was likely a ritual dismantling or destruction of the structure (Kay and Sabo 2006, Sullivan and McKinnon 2013).

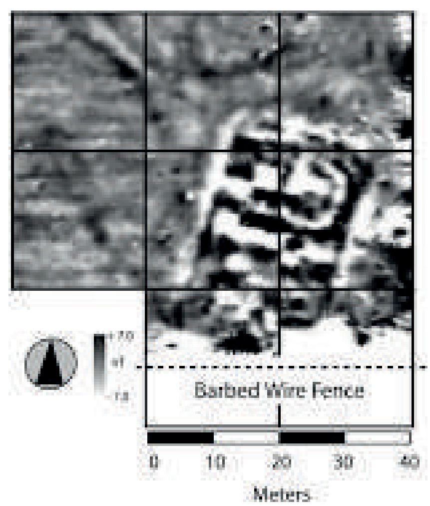

Figure 7. Magnetic gradiometry data over Mound D (after Sullivan and McKinnon 2013: 77).

The mound circumference as revealed in the DEM is larger than what is detectable by the eye when standing on the surface of the site and larger than what has been documented in previous mapping surveys (Kay et. al 1989). For example, in the DEM, the mound appears to extend south beyond the barbed wire fence line, where in Kay et. al (1989: 136) it does not. It is not prudent, however, to assert that the current mound boundary is the same as it was when the site was originally developed as it is likely that the current peripheral shape and extent of the mound has changed over time due to lateral spreading of mound sediment during plowing in addition to natural erosion processes.

The measurements inherent in the dataset of the DEM are useful beyond their purely visual aspects. The dataset provides elevational measurements of the topography which may be used when processing near-surface geophysical data. Technologies like ground-penetrating radar (GPR) yield a 3-dimensional cube of data. It can be difficult to determine the orientation of features detected with GPR when the data is collected over surfaces with great relief. A high-resolution DEM like the one collected in our survey can be used to topographically correct GPR data enhancing interpretation of the data. While Mound D may be of shallow enough relief not to warrant topographic correction of GPR data, Mounds B and C may benefit from this processing operation after a future GPR survey.

The objective of this research exercise was to test the efficacy of implementing a low altitude survey using a UAV and SfM pipeline for the prospection and mapping of the Mississippian earthwork. Therefore in the opinion of the authors the results are sufficiently encouraging to continue using such a method in future scientific endeavours. However some of the obstacles discussed above may need to be overcome in order to achieve efficient data collection in the field. Generally speaking, a generator or car battery AC adaptor would make it possible to increase the frequency of the flights, as the UAV batteries capacity limited the data collection time. Additionally, live video streaming on the ground would increase the flightpaths control which in turn would translate into improved data accuracy.

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Contributions in New World Archaeology 8

COLLECTION OF POTTERY AND LITHIC MATERIALS FROM THE MESA VERDE REGION, COLORADO, USA AT THE INSTITUTE OF ARCHAEOLOGY, JAGIELLONIAN UNIVERSITY IN KRAKOW

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Abstract

The central Mesa Verde region, located in southwestern Colorado and southeastern Utah, is well known to archaeologists and many tourists because of the famous cliff dwellings in the alcoves of the sandstone canyons. These ancient Pueblo culture villages and towns were constructed and inhabited during the thirteenth century AD, although the Ancestral Puebloan occupation of the area began many centuries before, in the first millennium BC Apart from the architecture, another well-known aspect of Pueblo culture is its materials culture, and especially the painted black-on-white pottery and stone and flint assemblages.

This paper presents and summarizes the collection of Pueblo culture artifacts that consist of pottery and lithic materials from the Mesa Verde region donated in 2014 by the Anasazi Heritage Center in Dolores, Colorado, a branch of the Bureau of Land Management to the Institute of Archaeology at the Jagiellonian University in Krakow, Poland. The donation was an element of the collaboration between these two institutions connected with the archaeological project that has been conducted by the Institute of Archaeology, JU in the Mesa Verde region since 2011.

Keywords: Mesa Verde archaeology, Mesa Verde pottery, Pueblo pottery, Pueblo lithic assemblages

Resumen

La región de Mesa Verde, situada al suroeste del actual estado de Colorado y la parte sureste del estado Utah, es muy conocida por los arqueólogos y turistas con motivo de las famosas viviendas en roca, construidas en los niches que se encuentran en las paredes de abruptos acantilados. Estas colonias de la antigua cultura de los indios pueblo fueron levantadas y habitadas en el siglo XIII d.C., pero los asentamientos de los pueblo en esta zona son mucho más antiguos y están documentados a partir del primer milenio antes de Cristo. Además de la arquitectura de piedra que constituye un rasgo característico de dicha cultura, otro de sus elementos conocidos corresponde a la cultura material, representada sobre todo por la cerámica pintada con tintes negros sobre los fondos blancos, y también las herramientas de piedra y sílex.

El presente artículo describe una colección de objetos de la cultura pueblo que consta de varias decenas de fragmentos de cerámica y herramientas de piedra, cedida en 2014 por el museo Anasazi Heritage Center, Dolores, Colorado, sección Bureau of Land Management, al Instituto de Arqueología de la Universidad Jaguelónica de Cracovia. Este donativo se hace en el contexto de la colaboración entre las mencionadas instituciones desarrollada en el marco de un proyecto arqueológico realizado a partir de 2011 por el Instituto de Arqueología de la Universidad Jaguelónica en la región de Mesa Verde, Colorado.

Palabras clave: arqueología de Mesa Verde, ceramica Mesa Verde, ceramica Pueblo, industria lítica Pueblo

INTRODUCTION

Since 2011, the detailed documentation and study of one of the Pueblo culture settlement communities of the Mesa Verde region, Castle Rock Community - dated to the thirteenth century AD - has been conducted by Sand Canyon-Castle Rock Community Archaeological Project, a project headed by the Institute of Archaeology, Jagiellonian University in Krakow. The project focuses on the analysis and reconstruction of the settlement structure and socio-cultural changes that took place in Pueblo culture sites located in three canyons: Sand Canyon, East Rock Creek Canyon, and Graveyard Canyon, dated to the thirteenth century AD in the central Mesa Verde region, southwestern Colorado (Fig. 1) (e.g., Palonka 2011, 2012, 2013, 2014). The project includes surveys and the documentation of the architecture thanks to new technologies such as photogrammetry as well as laser scanning, geophysical research, and the documentation of the rock art from the area.

The project is conducted with the cooperation with American institutions, Crow Canyon Archaeological Center (CCAC) in Cortez, Colorado and Anasazi Heritage Center (AHC), Bureau of Land Management, US Department of the Interior in Dolores, Colorado. The collection of artifacts was provided by Anasazi Heritage Center, BLM in June 2014, while the fourth season of the project was underway. Furthermore, in June, the collection was brought to Poland by the director of the project, Dr. Radosław Palonka. The collection was donated as an educational collection and comparative samples in order for the students of archaeology at the Institute of Archaeology, Jagiellonian University in Krakow to learn about the material culture of Ancient Pueblo people.

The donated collection consists mainly of painted and corrugated pottery (57 sherds) and stones and flints (13 tools and other fragments). The materials included in the collection were given to the Anasazi Heritage Center in 2013 by an unknown donor. We do not know the exact place where these artifacts were found, but based on the typology of pottery and lithic assemblages from the area as well as description of the collection, the Transfer of Custody issued by AHC and personal communication with AHC staff, we may estimate the location where the most of the artifacts were collected from as

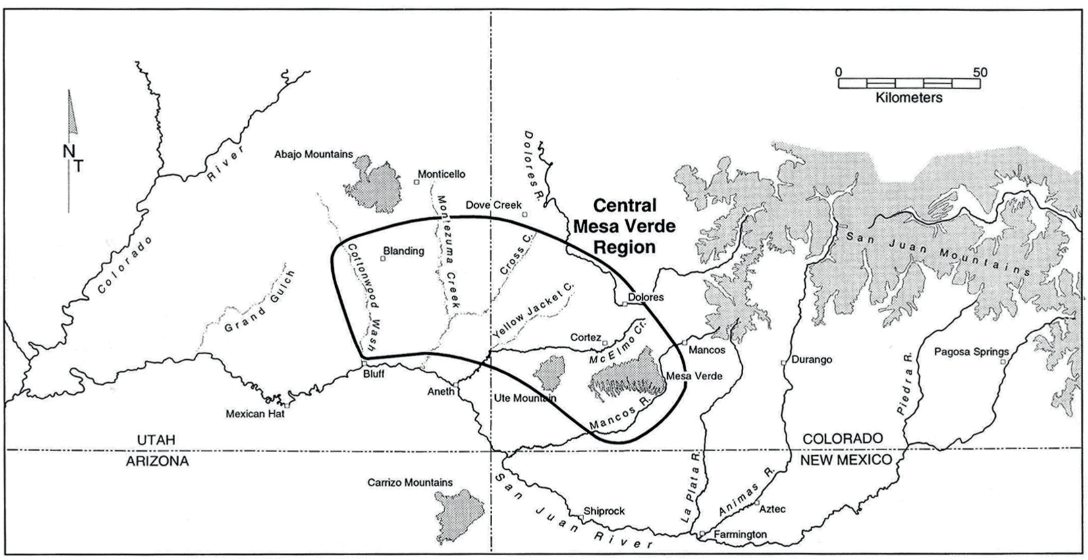

Figure 1. The location of the central Mesa Verde region in the North American Southwest (after Varien 2000: 8).

within a radius of approximately 25 km from Cortez, a town located in the Montezuma County, in the heart of the central Mesa Verde region.

PUEBLO CULTURE IN THE MESA VERDE REGION

The Mesa Verde region is part of a larger area called the North American Southwest. This area includes diverse geography and climatic conditions, though dry semi-desert plains prevail; these deserts covered with sagebrush are interrupted by high plateaus (*mesas*) cut by deep canyons and mountain ranges with pine and spruce woodlands. Archaeologically, the Mesa Verde region or Northern San Juan region includes adjacent parts of what are presently southeastern Utah, southwestern Colorado, northwestern New Mexico, and northeastern Arizona (e.g., Lipe 1995; Varien 2000); this area is also called the Four Corners region. The origin of the Pueblo culture dates from about 1000 BC and the Ancestral Puebloan occupation of the Mesa Verde region began later, ca. 500 BC (Cordell 1997; Lipe et al. 1999). The two main periods of Pueblo culture are as follows: Basketmaker II-III (1000 BC-750 AD) and Pueblo I-V (750 AD-present). However, the Pueblo culture occupation of the Mesa Verde region ceased at the end of the thirteenth century AD, at the end of the Pueblo III period (e.g. Cordell 1997; Lipe 1995). At that time, Pueblo groups migrated south and southeast into present-day northern and central parts of Arizona and New Mexico, where their descendants still live today (e.g., Plog 1997).

The economy of the Pueblo people was based on farming, dominated by growing maize as well as squash and later beans (e.g., Cordell 1997; Matson 1991; Plog 1997); wild turkeys were at least semi-domesticated in Basketmaker period, and domesticated turkeys became the principal source of animal protein for the Pueblo Indians by the late Pueblo II period (Van West and Dean 2000: 22). During the Basketmaker period, the ancient Pueblo Indians lived in pithouses (Cordell 1997; Plog 1997). During the Pueblo period, the architecture underwent a series of significant changes, and buildings two or more stories tall were constructed. The walls of these buildings were built from shaped sandstone slabs or clay *adobe* bricks; the roofs were of wooden beams and brush, topped with mud or soil. Underground ordinary-size kivas were the primary domiciles that were also used for household rituals, although great kivas were nonresidential structures used for ceremonies and other large gatherings (e.g., Lipe and Hegmon, eds. 1989). The first Europeans in the Southwest used the term “pueblo” for these settlements, a Spanish term meaning “village”.

Besides the residential and ceremonial architecture that has survived to this day, as well as the rock art, the most important elements of the material culture of the ancient Pueblo people are undoubtedly the pottery. The origins of its production in the Northern San Juan basin dates back to the time of the transition from Basketmaker III to Pueblo I (500-750 AD) when the so-called Grey Ware pottery appeared (Mills and Crown 1995: 7-11): the first vessels were jars with a slightly rounded bottom known to archaeologists as the Chapin Grey type. These vessels, like all subsequent Pueblo pottery, were modelled by hand. They were made with poor quality clay, to which a small amount of admixture of sand or small rocks was added and then fired at a relatively low temperature; they were grey or brown in color. Most likely, the production of the pottery was modelled on previous containers with gourds and baskets woven from plant fibres. Another type of pottery in the Mesa Verde region is ceramics with a white surface painted with a black dye (black-on-white pottery). This had most likely already appeared by the late sixth century AD and was then represented in the Mesa Verde region by the Chapin Black-on-White pottery, produced in this area until the ninth century AD (Green 2010: 12). Black-on-white ceramics with a smooth, polished surface were coated with a characteristic white slip painted with decorative black dye: they mainly featured geometrical forms, but also included effigies with animals and human figures. The most impressive black-on-white vessels were made in the later II and III phases of the Pueblo period, particularly in two styles typical for the area of Mesa Verde (Mills and Crown 1995: 14): Mesa Verde Black-on-white and McElmo Black-on-white. They are also the most common styles in the collection.

A separate type of pottery was the corrugated pottery. These vessels were used mainly for preparing meals. Very rarely were they painted, and the originally decorated surface was made mostly by fingerprint (often still visible today) (Pierce 2005: 91-92), or by scratching with a wooden stylus. The original texture is closely connected with the culinary usage of these vessels, whose puckered texture allowed for more efficient heat transfer and retention (Swink 2004: 246). In addition, they were better for storing and transporting. The most common samples include thick-walled vessels, mainly pots with wide openings, made of well-purified clay, with a touch of mainly coarsely crushed gneissic rock (igneous rock), a rarely used additive to crushed ceramics (Breternitz 1974: 17).

As for the assortment of stone and flint artifacts from the Pueblo culture of the Mesa Verde region, it was extremely diverse and made from various raw materials. When it comes to stone tools, one should mention first of all the stones for grinding corn into flour, the so-called *mano* and *metates*, as well as stone pestles and honed axes. These tools were made mostly of hard rocks such as granite. A separate group of tools includes items such as flint blades, scrapers, arrowheads and others, made of different kinds of flint, both local as well as some imported from far away. These flint artifacts are the second, next to pottery, most common part of the collection which, however, does not contain any objects made of hard stone.

POTTERY – PAINTED AND CORRUGATED BOWLS, JARS, AND MUGS

The ceramic material from the collection is mainly fragments of black-on-white painted vessels and corrugated ceramics (Tabs. 1, 2). The painted pottery from the collection comes mainly from the period of Pueblo II and III and includes, among other types, the Mancos Black-on-white (Pueblo II-early Pueblo III), McElmo Black-on-white (late Pueblo Pueblo II-III) and Mesa Verde Black-on-white (Pueblo III - especially late Pueblo III) (Figs. 2, 6-7); there is also a large group of painted vessels dated to this period, but difficult to classify within a particular group. In the collection there are also examples of some much earlier ceramics (Fig. 3): from the Basketmaker III-Pueblo I period to Chapin Black-on-white pottery and Cortez Black-on-white dated to the Early Pueblo II period, as well as at least three pieces of unpainted Grey Ware and two Red Ware pottery fragments painted with black dye on a red background (Fig. 5).

Sherds of pottery make up virtually all the types of vessels from the Pueblo culture found in the Mesa Verde region, including jars, bowls and dippers. Mugs are relatively common in Pueblo ceramics from this region cups as well as effigy pottery, whereas this collection only includes two or three sherds, including one that was probably part of a zoomorphic vessel, perhaps in the shape of a duck (Fig. 6.5). The collection has 5 sherds of handles from various utensils, including from a cup and jug, painted, but also without visible decoration (Fig. 7.8-7.9).

The painted black-on-white ceramics from the described collection are characterized by some technologically well-executed production - the paste is smooth, uniform, with a subtle (<1mm) admixture of ceramics and ideally fired. The surfaces of the vessels are perfectly smooth, often polished and coated with a slip. The painted decorative elements are carefully crafted, with a distinct and uniform color of the dish surface structure, while the colors are mostly mineral or carbon paintings (Mancos Black-on-white and McElmo Black-on-white) or organic (Mesa Verde Black-on-white). A common ornamental motif on the Mancos Black-on-white ceramics are triangular spirals, checkerboards and triangles filled with diagonal lines, while the McElmo Black-on-white ceramics mostly feature woven cotton textile-based designs including "bands filled with straight hachure, dots, triangles, diamonds,

Table 1. Types and forms of painted pottery from the collection.

Painted Black on White	Part of the vessel			
	Body	Rim	Handle	Base
Cortez	1 (jar)			
Chapin	1 (bowl)			
Mesa Verde		2 (bowl)		
Mc Elmo		3 (bowl)		
Mancos	2 (jar) 1 (bowl) 1 (dipper)	3 (bowl)		
Unidentified Pueblo I/II	2 (jar) 2 (bowl)			
Unindentified Pueblo II/III	2 (jar) 1 (corrugated exterior) 1 (bowl) 2 (dipper)	5 (bowl)	2 (jar) 2 (dipper)	1 (mug)
Unidentified Pueblo III	2 (bowl) 1 (duck-shape)	3 (bowl)		

Table 2. Types and forms of corrugated, red ware, and unpainted pottery from the collection.

Unpainted	Part of the vessel			
	Body	Rim	Handle	Base
Unpainted White Ware		1(bowl)	1	
Corrugated	4 (jar) 1 (bowl)	1 (Mancos jar) 2 (Mesa Verde jar) 1 jar		2 (jar)
Greyware	2 (plain jar)	1 (Chapin Grey jar)		
Red Ware	2 (bowl)			

and thickened lines” as well as "broad, boldly executed lines employed either in bands parallel to the rim or in triangular or rectilinear frets", and in the Mesa Verde Black-on-white pottery the designs are "similar to McElmo (but more complex)” and include triangles, dots, diamonds, and thickened lines (Green 2010: 22, 31, 34). In the collection most of the vessel sherds feature decorations made on the outside of the vessel, with some examples on the inside, as well as some cases on both the inside and outside of the vessel (particularly bowls).

Both styles characteristic mainly for the thirteenth century AD and present in the collection - i.e. McElmo Black-on-white and Mesa Verde Black-on-white - feature an extremely rich composition of geometric motifs dominated by: filled-in triangles, rectangular or triangular spirals, stepped ornaments, meanders, vertical lines and areas filled with tight cross-hatching. Sometimes unusual elements appear in the ceramics such as representations of the sun or sunflowers, or images of birds (absent in the collection). The flattened rims of the vessels also feature decoration in the form of dots, spaced in

Figure 2. Examples of pottery sherds from the collection: a), b) McElmo Black-on-white, c) Unidentified Pueblo III White Painted, d) Mesa Verde Black-on-white, e) Unidentified Pueblo II White Painted. Photo by R. Palonka.

Figure 3. Examples of pottery from the Mesa Verde region from earlier periods present in the collection: a – Chapin Black-on-white; b, c, d – Mancos Black-on-white. Photo by R. Palonka.

a particular way (Breternitz 1974: 44-47). The categorization of these two dominant styles from the Pueblo III period presents a challenge – because given their almost identical technical parameters, the differentiation is based, among others, on the characteristics of the painted decoration – the Mesa Verde type abounds with lines of varying thickness, while the McElmo vessels are covered lines of the

Figure 4. Examples of corrugated pottery from the collection including rims (a, b, e), body (d), and bottom (c). Photo by R. Słaboński.

Figure 5. Two examples of Red painted pottery from the collection. Photo by R. Palonka.

same width. In some cases we can differentiate the vessels based on small differences in technology. One of the indicators that facilitate the differentiation of these two types is the shape of the bowl's rim - the Mesa Verde type has thick, flattened edges with a distinctive, square cross-section. The McElmo type has semi-circular edges without any obvious angulation. These differences are conventional and

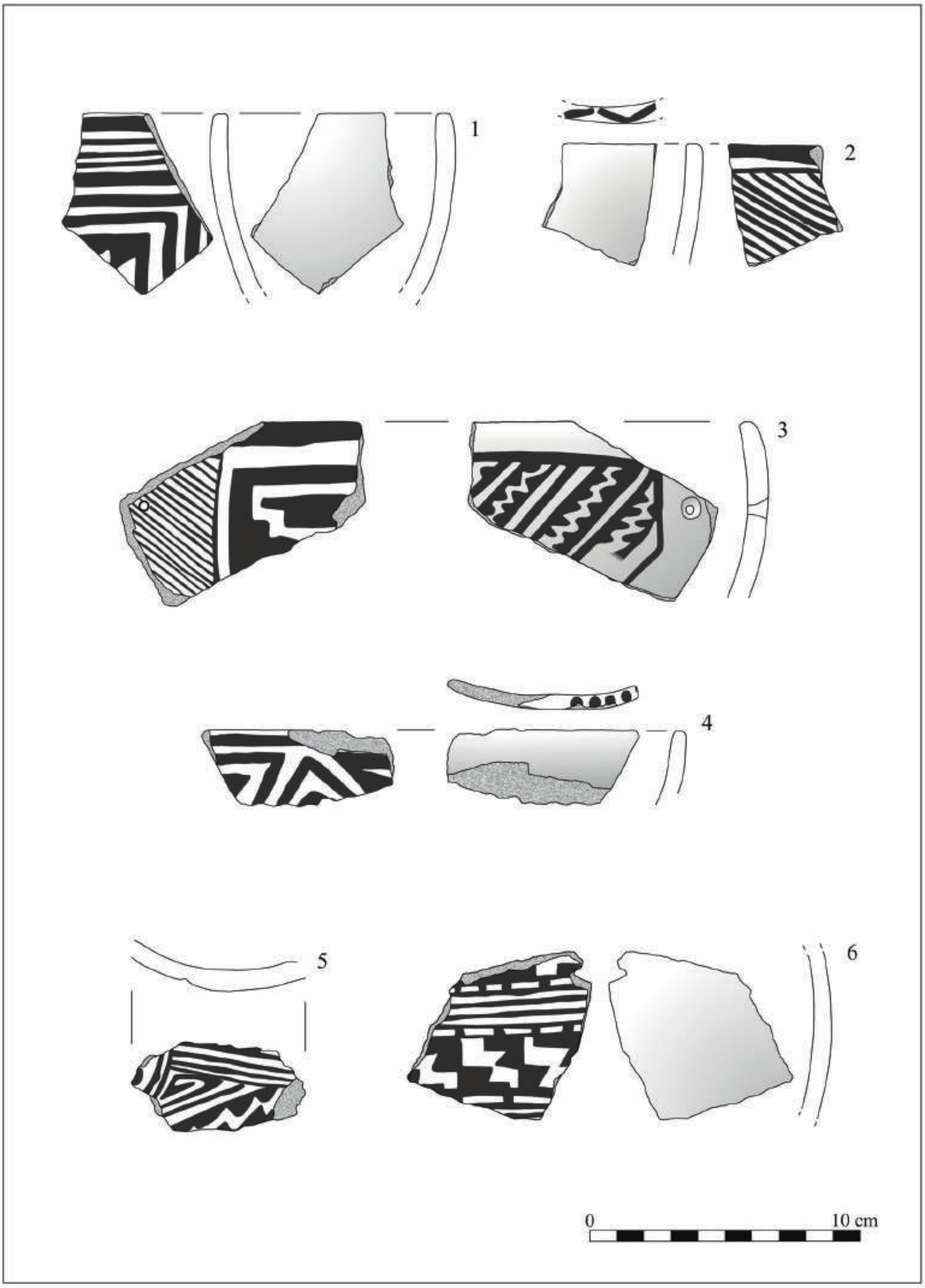

Figure 6. Typical designs of Pueblo painted pottery from the collection: 1, 2 – Mesa Verde Black-on-white; 3, 4 – McElmo Black-on-white; 5, 6 – Unidentified Pueblo III White Painted (the last is probably a fragment of effigy vessel). Drawing by A. Drabik and A. Węgrzynek.

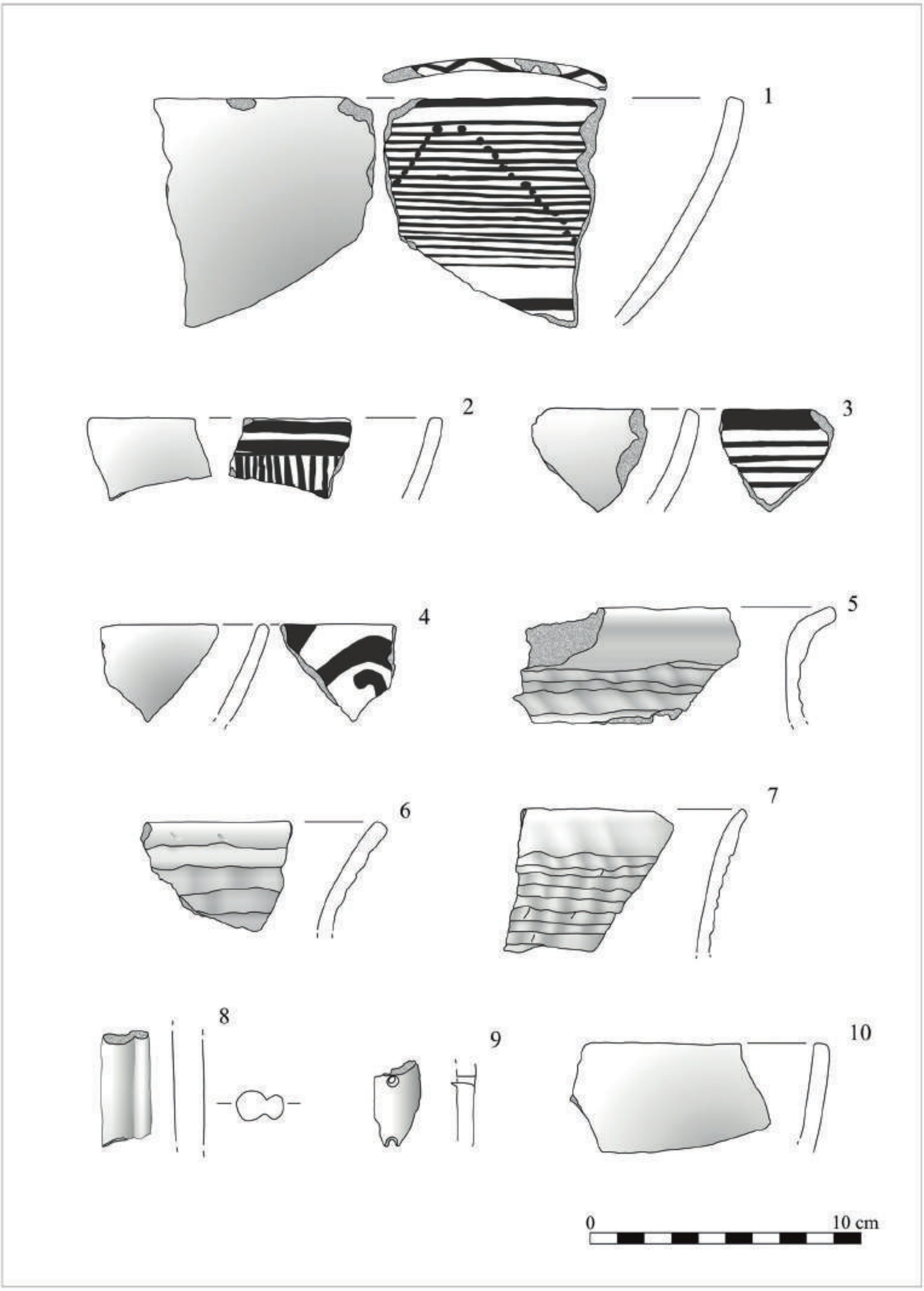

Figure 7. Drawings of examples of painted and corrugated pottery from the collection: 1 – Unidentified Pueblo III White Painted; 2-4 – Unidentified Pueblo II White Painted; 5-7 – corrugated pottery; 8-9 – fragments of White Painted pottery (from handles); 10 – Unidentified White Unpainted. Drawing by A. Drabik and A. Węgrzynek.

often difficult to observe, so many researchers do not differentiate these two different types, treating them as one single, rich decorative style typical of the Pueblo III period.

The collection also includes 11 sherds of corrugated vessels (Fig. 4, see also Fig. 7.5-7.7), also dated mainly to the Pueblo II and III periods. Among them are at least two bottoms and four rims. Two large sherds show signs of over-heating, which may be due to food preparation and fire from the hearth. One sherd has organic remains attached to the interior which will be submitted for biological analysis. There are two interesting corrugated vessel sherds with painting inside, which is not too common in Pueblo pottery from this region. Attempts to chronologically classify this material prove extremely difficult. There is a separate classification for the Mesa Verde region, based on the shape of the vessel rim and divided into three periods: Pueblo II (900-1150 AD), represented by the Mancos Corrugated type, with straight sides and perpendicular rims, Pueblo II/Pueblo III (1050-1230 AD), which accounts for the Dolores Corrugated type with a rim slightly more curved outwards as well as the of Mesa Verde Corrugated type attributable to the Pueblo III period (1100-1300 AD) and appearing right until the end of the settlement in this region, with a distinctive rim extremely curved to the outer edge (Green 2010; Swink 2004).

Among the ceramic sherds from the discussed collection, we can distinguish at least three types of sherds of unembellished Grey Ware ceramics appearing in the Mesa Verde region during the Basketmaker III period (Green 2010: 9). The collection also features two sherds of Red Ware pottery with an original reddish color. Red Ware pottery appears among Pueblo Indian pottery roughly from the period of Pueblo I. It is a typical variety of decorated ceramics that, due to a different firing atmosphere, has a distinctive red or red-orange color on the surface and was especially prevalent in south-eastern Utah and northeastern Arizona. The vessels were made with virtually the same technology as black-on-white ceramics, with native clay of a similar composition. Furthermore, the painted decoration featuring on the black-on-red type is reminiscent in terms of its design of motifs familiar from the described black-on-white vessels. An interesting phenomenon is the use of polychrome - and therefore also the use of yellow, orange and white pigments - mainly minerals, using local clays to create a multi-colored geometric decoration on the surface of the vessels. The most beautiful examples of such ceramics include vessels in the style of Tusayan and the Wingate Polychrome Polychrome (Green 2010: 11). Sherds of red pottery from the collection constitute evidence of contacts, most likely of a commercial nature, between the southwestern areas of Colorado and southeastern parts of Utah, from where the ceramics were most likely brought.

Most likely, as in the case of other areas with ceramics in this region, the source of raw clay was mined in nearby settlements: clay resources in this region are extensive and located in different places. This reddish clay relatively rich in iron compounds was dried in the sun and then triturated using *mano* and *metate* stone tools. Thus prepared, the fine clay was combined with water to form a ceramic paste from which the vessels were built (Swink 2004: 27). The clay was thinned with a special admixture, initially with sand from ground gneissic rocks (Hegmon 1995: 371-380), while in later periods the thinning admixture consisted entirely of broken and crushed pieces of broken vessels. This ceramic mass thus prepared was formed into rolls, which were then stuck together and shaped into vessels by hand. After obtaining the desired shape, the surface of the vessel was smoothed with small stones or pieces of plain ceramic, giving its final form.

The preparation of the dyes for ceramic painting involved the use of mineral pigments (especially manganese oxide, particularly popular during the Pueblo II era) and plants derived from the stems of plants called the Rocky Mountain Beeplant and Tansy Mustard. Painting with vegetable dyes was the dominant technique from the period of Pueblo II throughout the period of Pueblo III (Adams et al. 2002: 345-353), and it is from these eras that most of the ceramics from the collection originate. The ornamentation on the surface of the vessels was made by using brushes made from fibres of, for example, the Yucca plant. Vessels prepared in this way were fired in rectangular and rather shallow pits (so-called kilns) at a temperature of approx. 900 degrees Celsius in a reducing atmosphere (Heacock 1995: 392- 407), hence the grey-white color of the fired clay in the black-on-white vessels.

LITHIC MATERIALS – ARROWHEADS, BLADES AND FLAKES

The lithofact and stone artifact collection consists of thirteen pieces of tools and natural rocks (Tab. 3; Figs. 8-11). Seven of the eleven specimens have been recognized as man-made artifacts. The raw materials have been evaluated and determined on the basis of observation made by the naked eye alone, and additional problems may also arise from the state of preservation of the artifacts. Since they were handed by the finder to the museum and the context of their discovery is not fully known, they could have been subjected to the long-term influence of weather conditions. Their properties

Table 3. Types of lithic and stone assemblages from the collection.

No.	Type	Raw material	Retouch	Traces of weathering	Drawing	Lenght	Width	Thickness	Remarks
1	Arrowhead	Morrison Chert	yes	no	yes	40 mm	19,5 mm	4,5 mm	broken: distal part, stem and both barbs
2	Splintered piece	Brushy Basin Chert	no	no	yes	40 mm	27 mm	13 mm	on a piece, visible part of cortex
3	Denticulate tool	Morrison Silicified Sandstone	denticu-lated	no	yes	38 mm	23 mm	6 mm	2 visible scars; bulb of percussion preserved
4	Broken blade	Burro Canyon Quartzite	no	no	yes	23 mm	20 mm	7 mm	proksimal part of a blade/flake
5	Denticulate tool	Brushy Basin Chert	denticu-lated	yes	yes	55 mm	30 mm	10,5 mm	on a piece
6	Flake	Narbona Pass Chert	no	no	yes	31 mm	27 mm	5 mm	slightly twisted
7	Splintered piece	Morrison Mudstone	no	no	yes	19 mm	23 mm	11 mm	1 natural surface
8	Natural fragment	Burro Canyon Quartzite	no	yes	yes	55 mm	40 mm	10 mm	3 natural, fresh scars
9	Natural fragment	Bedded Chert	no	yes	no	35 mm	29 mm	16 mm	2 natural surfaces
10	Natural fragment	Chalcedony	no	yes	no	60 mm	31 mm	14 mm	visible traces of thermal cracks
11	Natural fragment	Calcite	no	yes	no	58 mm	42 mm	6,5 mm	visible traces of thermal cracks
12	Natural fragment	Sandstone	no	yes	no				burned

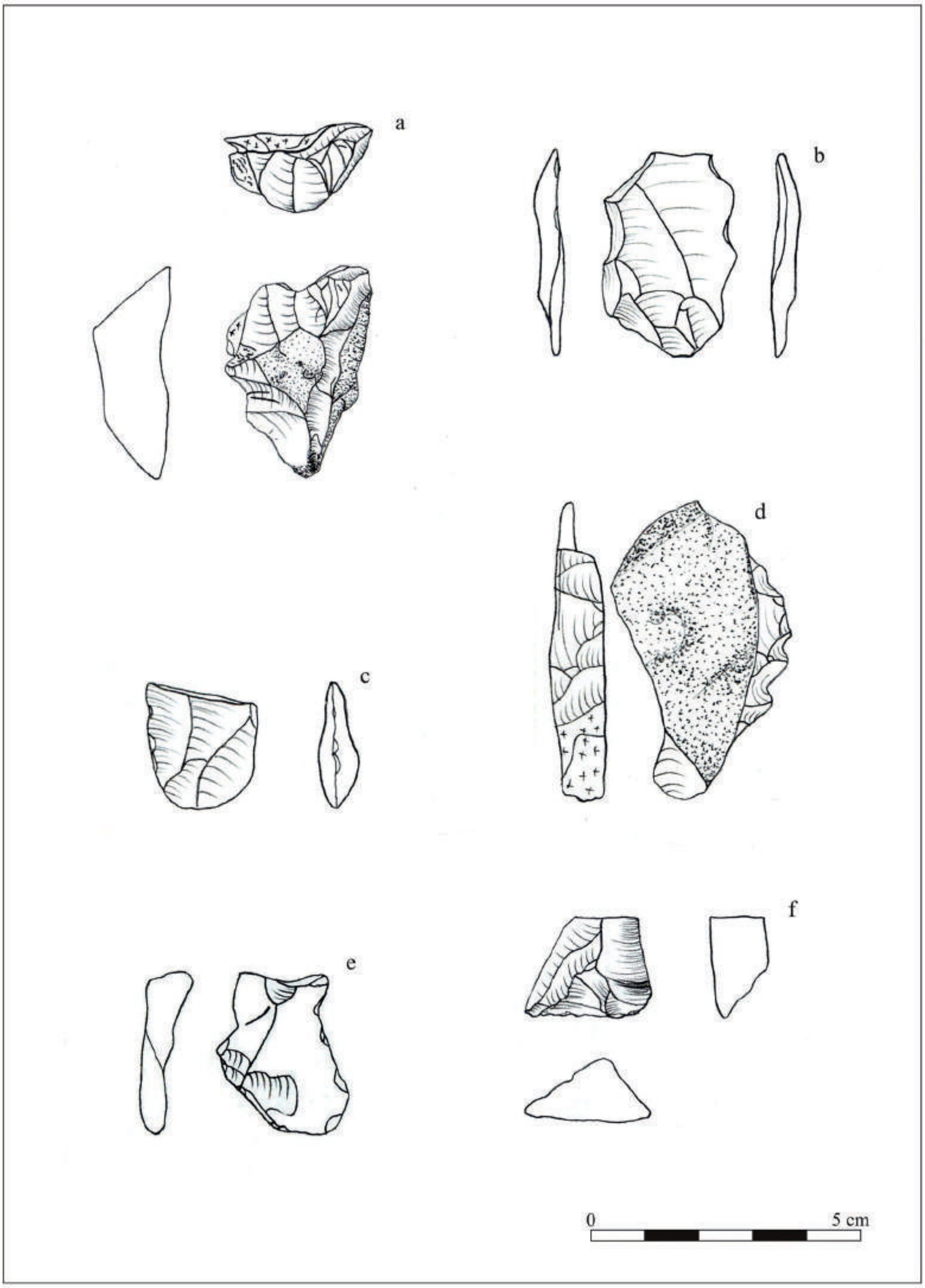

Figure 8. Drawing of selected flint artifacts from the collection: a, f – Splintered piece; b, d – Denticulate tool; c – Broken blade; e – Flake. Drawing by J. Kościuk.

Figure 9. Photo of the arrowhead made of Morrison Chert from the collection. Photo by R. Słaboński.

Figure 10. Photo of the arrowhead made of Morrison Chert from the collection. Photo by R. Słaboński.

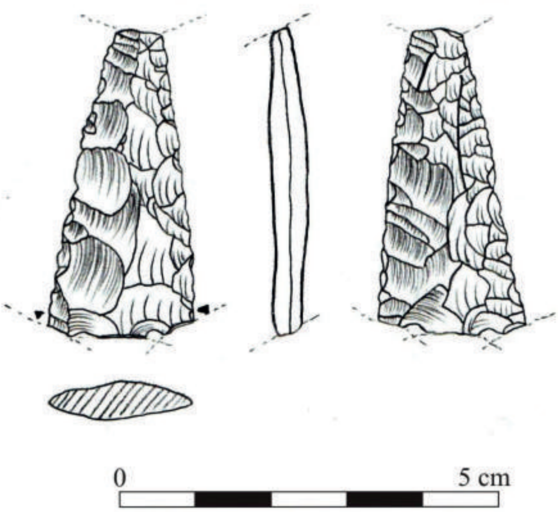

Figure 11. Drawing of the arrowhead. Drawing by J. Kościuk.

have undergone change - especially the color of the surface, which in this study was considered to be one of the most important characteristics for categorization. Only chemical analysis could enable a thorough and refined distinction in terms of the raw composition of these objects. In addition to the aforementioned color, the polish and the stone structure were also taken into account in determining the content of the raw materials, by means of determining the visibility of the grains. An attempt was made to categorize the artifacts according to their shape and traces of surface modification.

Most of the raw materials from which the specimens were made, were locally available. Twelve of the thirteen artifacts were made of local raw materials, while as many as five items have been made from raw materials belonging to Jurassic rocks of the Morrison Formation. These also include Morrison Silicified Sandstone, Mudstone, Chert as well as Brushy Basin Chert (e.g., Hopkins 2002; Baars 2002). These materials were readily available locally which explains the quantity of the tools. In addition, this rock material is cleavable, occurring mainly in brown, beige, cream and greenish hues. The next largest group is the raw materials belonging to formations of Burro Canyon-rock from the Cretaceous period (e.g., Gregory 1938; Hopkins 2002; Baars 2002). They consist of three objects, two of Burro Canyon Chert and one of Quartzite. In one case, the categorization is uncertain and varies between chalcedony (M. Wasilewski – oral information) and Burro Canyon Chert. Their quality can be generally described as good, both in terms of cleavage, and hardness. Among the twelve objects there were also natural fragments of chalcedony, calcite (pale pink in color) and a fragment of flint layer/chert.

Only one material, Narbona Pass Chert, formerly known as the Washington Pass Chert, represented by its twisted flake is of non-local origin; it comes from the Chuska Mountains (e.g., Ericson and Baugh 1993; Reed 2000), located about 120 kilometers from the Four Corners region. This raw material is characterized by being of high quality as well as cleavable, sharp enough even without retouching the edge. Its color, from bright orange to red, probably also drew the attention of contemporary toolmakers.

The collection contains seven probable tools and six natural rock fragments (two were burned). The best preserved and unquestionable in terms of the function is the arrowhead (Figs. 9-11). This artifact is made of Morrison Chert, and its dimensions are: (respectively length x width x thickness) 40 mm x 19.5 mm x 4.5 mm. The arrowhead is not complete, as the distal part, stem and both barbs are missing. It was created on a slightly curved blade and the arrowhead was fully bifacially retouched. An additional edge retouch seems to be fine, aggravating, slightly serrated. The flaking scars on the base of stem indicate that the barbs were formed with basal notches (Brosowske 2009). The projectile point has a lenticular cross section; its form is symmetrical. The cortex is not visible. The arrowhead described above is the only one from the collection that could be assigned to a defined time period. On basis of its proportions and shape, the artifact could be considered as a stemmed point of a Dolores type (Hranicky 2011; Dolores Projectile Points), and such arrowheads are typical to the Four Corners region. The Dolores type of arrowhead is roughly dated to between the Pueblo I and III periods (750 AD-1300 AD) (Einiger et al. 1982; Hranicky 2011), although the way it was produced could suggest Pueblo I period (Vierra and Phagan 1982).

The next four artifacts include two splintered pieces and two denticulate tools. One of the splintered pieces with visible traces of exfoliation is made of Morrison Mudstone of a greenish hue; the artifact is triangular in its inter-section, with a damaged proximal edge - probably through wear and tear. In the distal part there is a natural surface - black with claret tracks. The artifact is 19 mm x 23 mm x 11 mm in dimension. The second artifact, due to visible exfoliation from two adverse directions, on the ventral side, was also defined as a splintered piece. It was made from a piece of Brushy Basin Chert, of a beige hue. There is visible fragment of cortex, in the proximal part, of a brownish hue. The dimensions of this artifact are: 40 x 27 x 13 mm. Two denticulate tools include a blade made from Morrison Silicified Sandstone, of green hue and the second made from a thermal cracked piece of Brushy Basin Chert.

The material (rock) of the first one is quite coarse, making the flake scars on the ventral side barely visible. The blade seems to be complete - on the dorsal side there is a bulb of percussion, while in the distal part there appear to be no distinct ruptures. The butt of the flake is small and pointed, which possibly indicates the usage of a soft hammer percussor. On the right side, in the distal part, there are visible two notches, made by single strokes. The dimensions of the tool are: 38 mm x 23 mm x 6 mm. The material of the second denticulate tool was weathered on both sides and on the left part. A thick, semi-stepped unilineal retouch occurred on the right side in the medial part. The tool dimensions are roughly: 55 x 30 x 10.5 mm.

The next artifact is the proximal part of a blade or flake, made of Burro Canyon Quartzite. It was most probably blown from the unidirectional core, a theory which is supported by the arrangement of negative scars. On the edges there are visible traces of destruction and cracks, which removed the butt from the striking platform. The dimensions of this artifact are: 23 mm x 20 mm x 7 mm. The last stone artifact is the flake made of Narbona Pass Chert. The flint is of a red hue and is translucent. The material was probably transported from the Chuska Mountains in New Mexico (e.g., Ericson and Baugh 1993), about 120 km from the finding place. So it is the only one non-local artifact among the lithofacts belonging to the collection. The flake is twisted to the right. The proportions are comparable to the blades. Its dimensions are: 31 mm x 27 mm x 5 mm. A bulb of percussion and a small butt of flake remained, which again indicates the usage of a soft hammer percussor. The artifact seems to be complete and without any visible ruptures. Because of the lack of cortex, we can assume that this is a tertiary flake. The scientists emphasize that on sites located some distance away from the Narbona Pass Chert outcrops, there are no primary flakes or blades with a visible cortex or natural surface. Therefore, it is possible that before transportation, blocks of such material were pre-treated at the place of extraction in order to reduce the weight of the chunks. This activity also led to the initial preparation of the cores.

The collection also contained six natural pieces of rock. They would be described collectively because of a lack of distinguishable features. The materials are represented by: one piece of Burro Canyon Quartzite, one Chalcedony/Burro Canyon Chert, another of bedded chert, one of calcite, and the last two are burned sandstone fragments. All of them bear traces of weathering, thermal cracks, and even burning. The fragment made of Burro Canyon Quartzite is coarse, of beige material, and seemed to bear the signs of three retouch scars; but after closer observation they were recognized as relatively recent because of the lighter hue. Another fragment seemed to be a splintered piece, but because of its high level of patination and traces of weathering, this qualification was not possible. Finally, the latter fragments appear to be completely natural, especially the last two: a flat piece of rose calcite while the last one is chalcedony. The final two are fragments of burned sandstone.

SUMMARY AND CONCLUSIONS

The collection of ceramic artifacts and flints from the Mesa Verde region was donated in 2014 by the Anasazi Heritage Center, a division of the Bureau of Land Management in Dolores, Colorado, USA to the Institute of Archaeology at the Jagiellonian University in Krakow. The collection consists of 57 sherds of pottery and 13 pieces of flint and stone artifacts. The collection was transferred for the educational purposes of students and to learn about the material culture of ancient Pueblo communities inhabiting the Mesa Verde region, on the border of today's states of Utah and Colorado. Work on the collection was conducted separately on ceramics and on flint and stone artifacts. By using macroscopic examination, the artifacts have been classified chronologically and in terms of typology and possible functions. The initial classification of the artifacts was made by the American volunteers at the Anasazi Heritage Center, Colorado and later by students and faculty of the Institute of Archaeology at the Jagiellonian University.

It is clear that the material from the collection comes from different periods, so either at the location where it was found was the site of a multiphase settlement of the Pueblo culture, or it was collected from several different places, probably located fairly close by, as may be inferred by the fact that one person made the discovery. Yet, it cannot be completely ruled out that the artifacts were collected from further afield. Spoken information from the finder and donator of the collections as well as from the museum employees would indicate, however, that most probably the artifacts were collected from Montezuma County in the southwestern part of Colorado.

The macroscopic examination of ceramics according to the technologies of firing, additives and the type of decoration and pigments used to paint them allowed most of the ceramics from the collection to be pre-dated to the Pueblo II and III periods (ca. 900-1300 AD). Within the collection, McElmo Black-on-white and Mesa Verde Black-on-white can be distinguished among others types dating back to Pueblo III period, while there are also several fragments identified as the Mancos Black-on-white style - slightly earlier, typical for the Pueblo II and the beginning of the Pueblo III period in terms of vessel ornamentation, equally richly decorated. A common ornamental motif on this black-on-white painted ceramics are lines, checkerboard, triangular spirals as well as triangles filled with oblique lines and the edges of the dishes were often covered by dots, which is also characteristic for the Pueblo III period.

The collection includes also sherds of much earlier pottery, for example Chapin Black-on-white from the Basketmaker III-Pueblo I period (580-880 AD) and a few pottery sherds of unembellished Grey Ware. In addition, Pueblo pottery includes so-called corrugated ceramics, very rarely decorated with painting (although in our collection, we have two such items), with fingerprints or sticks impressions as the most common motif - such ceramics were used for cooking, and so often exposed to fire and other factors, so they had to be more durable than painted ceramics.

Small differences in the types of admixtures in different sites throughout the Mesa Verde region indicate that the pottery was produced in various places for their own needs and was in fact based on the same technology. Furthermore, it seems that based on analogies to other sites, the clay used for the pottery from the collection was sourced close to the settlements, usually within 0.5-1 kilometer.

When it comes to flint and stone material, part of the artifacts turned out to be natural rock fragment, but seven items have been classified as tools. The material is, to a considerable degree, weathered and cracked by heat, which is probably connected with the fact that they could have been lying on the ground for a long time exposed to adverse weather conditions. Only one item in the collection - a well-preserved arrowhead - shows morphological characteristics, allowing it to be dated to the Pueblo I or Pueblo II period. This does not, however, apply to the whole set, because the rest of the artifacts do not manifest any particular features to allow them to be chronologically classified with any satisfactory degree of precision.

Most of the artifacts and natural rocks from the collection are made from local raw materials, mostly from the Morrison and Dakota formations, readily available locally in the southwestern part of Colorado and these rocks were of relatively good quality. Despite the scarcity of flint material samples in the collection, among the objects there is a flake of imported raw material from Narbona Pass Chert, which probably comes from the Chuska Mountains in New Mexico and located around 100-120 kilometers from the Four Corners region. It reached the southwestern part of Colorado possibly as a result of trade or other relations. This material is characterized by its high quality and its color, which ranged from light orange to red, probably attracted also the attention of contemporary toolmakers. Although this artifact is not subliminal in form, it is valuable because of the information that it brings regarding its origin.

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