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CULTURAL AND ENVIRONMENTAL CHANGE OF THE TERMINAL PLEISTOCENE THROUGH THE EARLIEST HOLOCENE IN THE FRENCH PYRÉNÉES AND AMERICA'S SOUTHERN ROCKY MOUNTAINS

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Abstract

Cultural adaptive strategies in the French Pyrénées and north central Colorado Rocky Mountains in the Late Pleistocene and Early Holocene, although reflecting quite different cultural traditions, had broadly comparable topographies and experienced similar climatic and ecosystem changes in the Late Pleistocene through the Early Holocene. Archaeological and paleoenvironmental data presented in this article describe and compare broadly-based culture-environmental change models associated with the role of natural and human seasonal transhumance patterns of respective Late Pleistocene-Early Holocene landscapes of two widely separated world mountain regions, Europe's Pyrénées and the North America's Rocky Mountains.

Keywords: Pyrénées, southern Rocky Mountains, Late Pleistocene, Early Holocene, seasonal transhumance, Paleoindian, Magdalenian, Azilian, hunter-gatherers, game drives, parietal art, mobile art

Resumen

Las estrategias de adaptación cultural de los Pirineos franceses y el centronorte de las Montañas Rocosas americanas en el Pleistoceno tardío y el Holoceno temprano, aunque reflejan tradiciones culturales bastante diferentes, se basan en topografías ampliamente comparables y cambios del ecosistema ocasionados por el clima que, de hecho, acabaron poniendo fin al mundo de la Edad de Hielo y comenzaron un nuevo mundo, con menos desafíos climáticos para sus habitantes humanos. Los datos arqueológicos y paleoambientales se utilizan en este artículo para describir modelos comparativos del cambio cultural-ambiental de base amplia, así como el papel de la trashumancia estacional natural y humana dentro de los paisajes del Pleistoceno tardío-Holoceno temprano de dos regiones montañosas situadas en los Pirineos de Europa y las Montañas Rocosas de la América del Norte.

Palabras clave: Pirineos, Montañas Rocosas, Pleistoceno tardío, Holoceno temprano, trashumancia estacional, Paleoindio, Magdaleniense, Aziliense, cazadores-recolectores, cazar con trampas, arte rupestre, arte móvil

INTRODUCTION

Climate and environmental change in the terminal Pleistocene and early Holocene presented new challenges and opportunities for hunter-gatherer and proto-agricultural populations throughout our planet. Those opportunities were particularly great in mountain regions where ecologically diverse topographies were vertically distributed within short but often steeply angled travel distances. This article compares cultural and environmental change patterns associated with seasonally transhumant hunting systems in later millennia of the Late Pleistocene and earlier millennia of the Holocene in France's western Pyrénées mountains and the mountains and interior valleys of north central Colorado's (USA) southern Rockies. During that time, hunter-gatherers in both regions engaged in efficient, seasonally scheduled migratory subsistence patterns designed to exploit regionally resident and transhumant migrating game species such as reindeer, horses, ibex, and, possibly, red deer in the French Pyrénées while elk, mule deer, bison, and bighorn sheep were hunted in summer mountain landscapes in the Colorado Rocky Mountains. Deglaciation and the emergence of warm season ice- and snow-free montane, subalpine, and alpine ecosystems between ca. 16,000 and 14,000 ^{14}C cal yr b.p. in both northern (France) and southern (Spain) slopes of the Pyrénées (cf. Delmas 2015; Delmas *et al.* 2008) and ca. 14,000-11,000 ^{14}C cal yr b.p. (Brunswig 2014b, 2015b: 46-49; Brunswig and Doerner 2021) in the Rocky Mountains opened high mountain valleys and subalpine and tundra grasslands to exploitation by seasonally migrating (transhumant) game species and their human hunters.

PHYSIOGRAPHY AND ENVIRONMENTAL CONTEXTS OF THE TWO MOUNTAIN REGIONS

Southern Europe's Pyrénées and America's southern Rocky Mountains sub-divide neighboring regions of their respective continental land masses and both were subject to Late Pleistocene mountain glaciation (Figure 1).

Southwest Europe's Pyrénées Mountains

The Pyrénées are a 425 km-long, southeast-northwest trending mountain chain that separates southern France from northern Spain (Gibbons and Davies 1990; Jalut *et al.* 1996; Satterfield *et al.* 2019) (Figure 2).

The western Pyrénées, known as the Pyrénées-Atlantiques, rise from the Atlantic Coast and Bay of Biscay, reaching mountain peak heights of 1700 m a.s.l. within 100 km of the coastline. The eastern Pyrénées ascend from the Mediterranean Coast and its local Balearic Sea, reaching heights of 1,700 m a.s.l. over a shorter distance of 60 km. Fully land-bound central Pyrenean mountain ranges are resident to the Pyrénées' highest passes and peaks, ranging between 2700 and 3200 m a.s.l. The Pyrénées are located further north (Latitude 42º 45' N) than North America's southern Rocky Mountains (Latitude 40º 30' N), although they begin their ascent from sea level on the Atlantic Ocean and Mediterranean Sea coasts, a factor that tempered the severity of Ice Age glacial climate compared to that of the intra-continental Colorado Rocky Mountains which ascend from much higher foothill elevations of ~1750 m a.s.l.

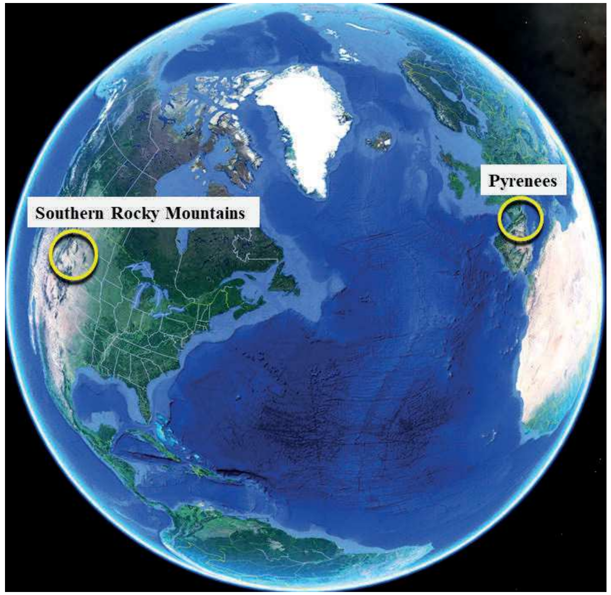

Figure 1. Global map showing relative locations of Europe's Pyrénées and the North American Southern Rocky Mountains.

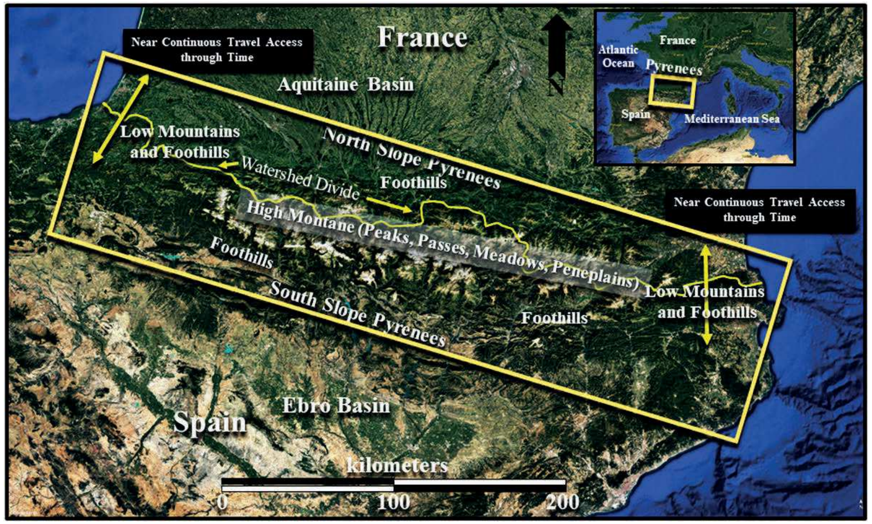

Figure 2. Physiographic map of the Pyrénées superimposed on a GoogleEarth™ satellite image.

As a comparative baseline, modern Pyrénéan temperatures and precipitation patterns range from wetter, cooler climate at their western Atlantic end to warmer, drier climate at their eastern Mediterranean end (cf. Batalla *et al.* 2018; Pepin and Kidd 2006). Prevailing weather systems arrive from the north and northeast and precipitation totals (snow and rain) are higher on the Pyrénées' north (southern France) slope but lower on their rain-shadowed south-facing slopes (northern Spain) (Macias 2006: 290-292). Variable iterations of the same east-west, north-south climate patterns, based on the Pyrénées' physical topography and proximity to large bodies of water of either end also would have influenced Late Pleistocene and Early Holocene climate throughout their length and breadth. In addition to the mountains themselves, it is also important to note that, during the world's Late Glacial Maximum (LGM), lowered sea levels (~100-130 m), due to water being taken up into ice sheet and mountain glacier masses, exposed now flooded coastal areas at the Atlantic and Mediterranean ends of the mountain chain, which would have strongly affected the region's Late Ice Age ecological and human landscapes (cf. Lambeck 1997; Lambeck and Bard 2000; Leorri *et al.* 2012). While archaeological data for those now-offshore coastal sea-bed areas is limited, current research shows that that at least some areas were seasonally occupied by Ice Age hunter-gatherers. Among the better known examples of near-coastal sea-bed habitation is Cosquer Cave near Marseille, with its LGM-dated (ca. 33,000-20,000 ^{14}C cal yr b.p.) cave paintings, originally accessed from an entrance now 40 m below modern Mediterranean sea level (Clottes *et al.* 1992; Valladas *et al.* 2017).

Pyrénéan geology mainly consists of up-thrusted Jurassic and Upper Cretaceous limestone formations that, in most places, contain extensive and deeply water-carved cave systems and smaller hillslope and stream-side rock-shelters and caves (cf. Sartégou *et al.* 2018). Rivers and streams flow north and south from the central Pyrénées' main divide into large adjacent foothill and piedmont zones, the Aquitaine (France) and Ebro (Spain) basins being the most prominent. A second northwest-southeast watershed divide within those foothills-piedmont further diverts rivers and streams either toward the Atlantic in the west or the Mediterranean in the east.

Modern bioscapes of the French and Spanish Pyrénées, similar to most mountain regions, are characterized by vertically-defined environmental zones (Cañellas-Boltà *et al.* 2009; Costamagno 2009). Modern (and prehistoric/historic) floral species that define those zones vary along an east-west line and are dependent on proximity to moderating climatic regime influences of the Mediterranean Sea or Atlantic Ocean. Modern elevation-defined environmental zones include: 1) the sub montane (sea-level-~800 m a.s.l. in the northern Pyrénées versus sea-level-~1,000 m a.s.l. in the southern Pyrénées); 2) montane (northern Pyrénées, ~800-1,700 m a.s.l.; southern Pyrénées, ~1,000-1,900 m a.s.l.); 3) subalpine (northern Pyrénées, ~1,700-2,200 m a.s.l.; southern Pyrénées, ~1,900-2,500 m a.s.l.); and 4) alpine (northern Pyrénées, ~2,200-2,500 m a.s.l.; southern Pyrénées: ~2,500-3,000 m a.s.l.) (Ninot *et al.* 2007; Petit and Thompson 1999: Appendix 2). While Pyrénéan environmental zones fluctuated in ecological composition and elevation boundaries over time, depending on prevailing climatic conditions (e.g., glacial cooling, etc.), following summaries of modern zones provide a baseline for the reader to better understand past variations discussed below and relate them to their inferred effect on Late Pleistocene-Early Holocene human populations in the Pyrénées. Today, the sub montane zone is dominated by deciduous tree species (such as oak or oak woods, *Quercus robur*, *Quercus petraea* or *Quercus pyrenaica* in the western Pyrénées and *Quercus pubescens* or *Quercion ilicis* in the eastern Pyrénees) while the Montane zone is characterized by pine (*Pinus sylvestris*), Fagus (*Fagus sylvatica*), and fir (*Abies alba*) species. The sub alpine is represented by pine (*Pinus uncinate*) mixed with low shrubs (*Juniperion nanae*, Rhododendro-

Vaccinion species), meadow grasses and forbs (*Nardus stricta*, *Festuca eskia*). The upper sub alpine zone transitions into alpine tundra along a variable ~200 m wide ecotone boundary in which pine forest is succeeded by dwarf pine and scrub krummholz tree islands surrounded by open alpine meadows. Alpine zone landscapes are diversely colonized by sub-communities of tundra plant species whose distributions are determined by variables related to terrain exposure, slope angles and aspects, soil conditions, and moisture availability. Alpine tundra consists of open treeless grasslands, dominated by alpine grass species with flowering grass fescue (*Festuca eskia*) common on more gentle slopes and steeper slopes more densely covered by alpine mat grass (*Nardus stricta*), frequently associated with other Pyrenean alpine plant species such as *Festuca eskia*, *Festuca nigrescens*, *Festuca rubra*, and *Alopecurus gerardii*. In some Pyrénées areas, alpine tundra is moderately extensive, its relative abundance dictated by the presence of open and flatter peneplain landscapes (Babault *et al.* 2005) while, in other areas, alpine tundra, often in high passes, covers steep-sided mountain slopes and narrow benches with limited areas of moderately steep and more open alpine grassland. Peneplain areas in past warmer climatic periods characterized by sufficient precipitation from winter snow or summer rain would have been associated with more extensive, productive alpine grasslands which provided rich summer forage for transhumant migratory wild herbivore game species from the latest Pleistocene through the arrival of seasonally migratory livestock herds of lowland-dwelling Neolithic pastoralists to highland pastures around ca. 6,700 ^{14}C cal yr b.p. (Galop *et al.* 2013: 20-21).

Physiography and Environments in Colorado's North Central Mountain Region of the Southern Rocky Mountains

This article's comparison mountains to the French Pyrénées are the north central Colorado region of North America's southern Rocky Mountains. The Rocky Mountains are a 4800 kilometer-long series of mountain ranges that extend from southeastern Alaska to northern New Mexico (Mutel and Emerick 1992: 2-7; Figure 3). The southern Rockies are the southernmost extension of the Rocky Mountain chain.

North central Colorado's highest peaks exceed 4000 m a.s.l. and average 3000 m a.s.l., forming the backbone of a winding north-south trending continental divide watershed from which streams and rivers flow eastward through foothills, piedmont, and eastern plains or westward through interior mountain valleys onto the northern Colorado Plateau. Within the southern Rockies study region (see Figure 4), the continental divide runs north to south along its northwest boundary before abruptly crossing to the east along a low mountain range that separates the North Park and Middle Park valleys, and then, after crossing into Rocky Mountain National Park, runs southward along a series of mountain ranges, exiting the region at its south central boundary.

Half the region's land area lies on alternate sides of the continental divide and dozens of rivers and streams provide access between its two large basin valleys. Surrounding the basin valleys are high mountain grazing areas (montane and subalpine meadows, ecotone, and alpine tundra) for seasonally migrating game species and the prehistoric hunters which followed them in summer (see below).

Colorado's mountains are dominated by Pre-Cambrian and Cambrian age granites and gneisses with occasional areas of overlying volcanic lava deposits. The large interior basin valleys of North Park and Middle Park have hills and high ridge-lines with Paleozoic and Mesozoic sedimentary formations that contain tool-grade cherts, quartzites, and sandstones along

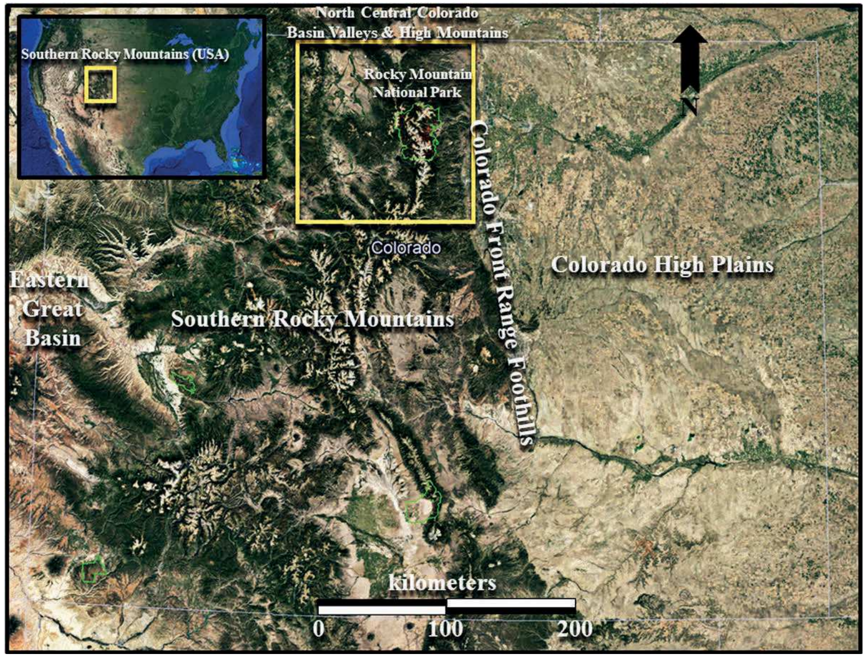

Figure 3. Physiographic map of the Colorado's Southern Rocky Mountains and their North Central Colorado region discussed in the text.

with extensive pockets of Tertiary Age volcanic deposits with welded tuff, basalt, and andesite/rhyolite, also useful for making stone tools (Chronic 1980). Unlike the Pyrénées' sedimentary geology with its extensive limestone cave and rock-shelter systems, north central Colorado's geology provided only limited natural shelter, e.g., rock-shelters and caves, opportunities for Late Pleistocene and Early Holocene hunter-gatherer bands. As a result, most Native American residential camp sites utilized open camp domestic architecture in the form of dome-shaped wickiups or conical tree-pole tipis covered with brush and/or animal hides, frequently situated in locations protected from adverse weather conditions (wind, snow-accumulation, forest margins, etc.) and near sources of water and fuel for fires.

The lowest environmental zone in the study area is the Inter-Mountain Basins Big Sagebrush Steppe zone, mainly occurring in the region's two large Middle Park and North Park basin valleys. Mountain ranges and smaller river and stream valleys surrounding the lower elevation basins are home to montane and higher environmental zones which ultimately rise into alpine tundra (Mutel and Emerick 1992). The basin valleys' Big Sagebrush Steppe zone (2,400-2,600 m a.s.l.) occupies river corridors and interior hills and ridgelines inside the two valley basins, terminating on valley margins where steppe transitions into lower montane forest. Common arid to semi-arid plant species in the valleys include big sagebrush (*Seriphidium vaseyanum*) cover with underlying fescue (*Festuca idahoensis*) and western wheat (*Pascopyrum smithii*)

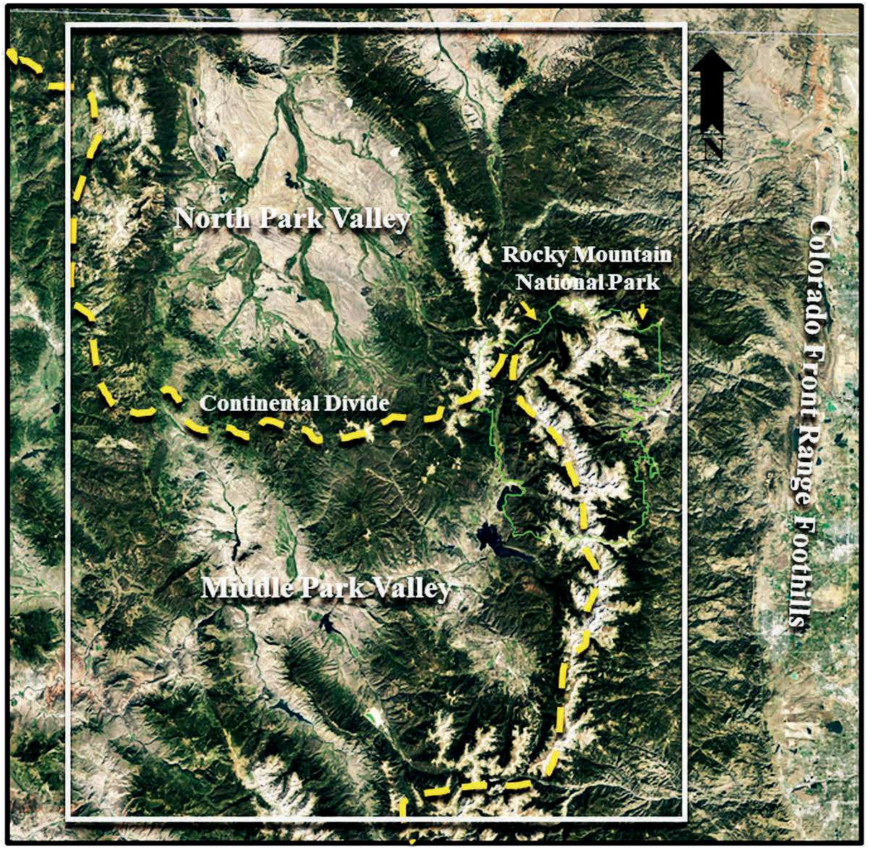

Figure 4. GoogleEarth™ satellite base map showing mountains, large basin valleys, location of Rocky Mountain National Park (thin outline on the right center "region box", and dashed line path of the region's continental line.

grasses. Occasional stands of aspen (*Populus tremuloides*) trees grow in wind-protected hill-side hollows, providing shelter and wood for past Native American hunter-gatherers in an otherwise treeless landscape. Perennial and seasonal natural springs are common to many North Park and Middle Park valley areas and abundant perennial rivers and small streams in both valleys have riparian vegetation dominated by two willow species, *Salix monticola* and *Salix geyeriana*. In the mountains outside the two large interior basins, the montane zone (~ 2,200-2,700 m a.s.l) rises from narrow riparian river valleys, open meadows, and forested mountain slopes, dominated by ponderosa pine (*Pinus ponderosa*) in its lower part, transitions into upper montane forests of Douglas Fir (*Pseudotsuga menziesii*), aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta*) (Mutel and Emerick 1992). At ~2,700 m a.s.l., montane zone ecosystems transition into the sub alpine forest zone, dominated by Engelmann spruce (*Picea engelmanni*) forest, that, in turn, at ~3,300 m a.s.l. along upper tree-line, is succeeded by subalpine-alpine ecotone with scattered krummholz (tree island) stands of dwarf spruce and fir trees and shrubs interspersed by open areas of alpine grasses and forbs. As elevations rise above ~3,500 m a.s.l., the ecotone is replaced by open alpine tundra with open treeless alpine grass and sedge meadows with low shrubs (e.g., willow-*Salix arctica*) growing in wind-sheltered locations. Elevation boundaries of all southern Rocky Mountain environmental zones vary due to a wide range of physiographic and climatic variables, such as slope steepness and aspect, exposure to seasonal wind, moisture, and temperature regimes.

Major game species in Colorado's Late Pleistocene-early Holocene Rocky Mountains mostly included modern species, mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), pronghorn antelope (*Antilocapra Americana)*, and bighorn sheep (*Ovis canadensis*) (cf. Armstrong 2008; Brunswig 2015a: 51-52; Brunswig and Doerner 2021: 10). Archaeological evidence suggests that most high mountain hunting focused on lowland (basin valleys) to upland (mid and high mountain), seasonally migrating game species such as elk and bighorn sheep. Bison were also important game animals for Paleoindian hunters in interior basin valleys but were less common than the other two species or even absent in high altitude tundra and upper montane environmental zones during the summer months (Brunswig 2014b: 100, 104). Paleontological and archaeological evidence have shown that the genus *Bison* has been a permanent mountain resident of the southern Rocky Mountains for 140,000 years. Skeletal remains of a Middle Pleistocene bison ancestral species (*Bison latifrons*) were excavated from the west central Colorado mountain lake/reservoir Snowmastodon site in the early 2000s and dated with multiple (radiocarbon, cosmogenic, uranium-series, and optically stimulated luminescence) methods between 141 and 77 ka (cf. Brunswig 2015b: 5-6; Miller *et al*. 2014: 624, Table 1).

Early Holocene bison associated with human hunting in this article's north central Colorado study region are documented in Middle Park basin valley (west of Rocky Mountain National Park) Paleoindian camps or ambush kills at Barger Gulch's Folsom culture, a Twin Mountain Goshen culture ambush kill, and Jerry Craig Cody culture bison kill sites (cf. Kornfeld *et al.* 1999; Kornfeld and Frison 2000). Both Barger Gulch (AMS dates of 12,750-12,270 ^{14}C cal yr b.p.) and Twin Mountain (averaged median date of 12,230 ^{14}C cal yr b.p.) were associated with hunting the Late Pleistocene-Earliest Holocene bison sub-species, *Bison antiquus*, while the Jerry Craig kill site (AMS median date of 10,530 cal yr b.p.) produced skeletal remains of the slightly later *Bison occidentalis* subspecies. The present-day subspecies, *Bison bison*, emerged in this region and throughout North America at ca. 10,000 ^{14}C cal yr b.p. Latest Pleistocene and Early Holocene bison (*Bison antiquus* and *Bison occidentalis*), still lacking direct fossil bison evidence in high Rocky Mountain contexts, are hypothesized by this author as possibly frequenting higher-elevation environmental zones during warmer climate interval summers as solitary individuals or in small herds during warmer Early Holocene climatic episodes when Late Paleoindian-era game drives and hunting camps first emerged in north central Colorado mountain and lower elevation basin valley landscapes (Brunswig 2003c, 2004b, 20014a, 2015b: 50-52; Brunswig and Doerner 2021). Later prehistoric (post-Paleoindian) physical evidence and historical bison records of radiocarbon-dated prehistoric bison skeletal remains recovered from the region's high mountain pass glaciers and millennia-old ice patches and documented from 3,470 ^{14}C cal yr b.p. through the late 19th Century, directly document a high altitude presence of bison in those later periods, after when bison had been hunted to regional extinction (Brunswig 2015a: 15-25, Table 1; Brunswig 2015b: 50; LaBelle and Whittenburg 2015; Lee and Benedict 2012: 43-44: Table 1; Lee *et al.* 2006).

PYRÉNÉAN AND SOUTHERN ROCKY MOUNTAIN TERMINAL PLEISTOCENE AND EARLY HOLOCENE PALEOENVIRONMENTS

France's Northern Slope Pyrénées

More than thirty glacial geology features (tarns, moraines) and glacial and periglacial lake and pond locations in northern and southern mountain river valleys along the Pyrénéan mountain divide have been studied for geological, sedimentary, and pollen evidence of glacial and post-glacial climate conditions (Cunilli *et al.* 2013; Delmas 2015; Delmas *et al.* 2008; Jalut *et al.* 1982, 1988, 1992; Jomelli *et al.* 2020; Leunda *et al.* 2020; Taillefer 1977). Collective evidence suggests Late Glacial Maximum (LGM) Pyrénéan glaciation was characterized by milder climatic/environmental conditions compared to northern latitude European regions closer to cold tundra desert near the Europe's (Weichselian) Ice Sheet but still severe enough to deny use of mid and upper Pyrénées mountain areas to human hunters and their game species (Figure 5; Batchelor *et al.* 2019; Böse *et al.* 2012).

Numerous Upper Paleolithic-age archaeological and geological sites have been sampled for sediment, pollen, and faunal evidence, providing key sources of information on latest Pleistocene/Early Holocene climates and environments. Sediment and palynological data from two important western Pyrénéan foothills rock shelter sites, Abri Dufaure and Duruthy (discussed below), constitute a rich source of paleoenvironmental information (Paquereau 1978; Paquereau and Paquereau 1995; Petraglia 1987: 62-67).

Two key paleoenvironment study sites, one in the eastern Pyrénées and the second in the central Pyrénées, Estarrés and Ech, respectively provide detailed paleoclimate and paleo

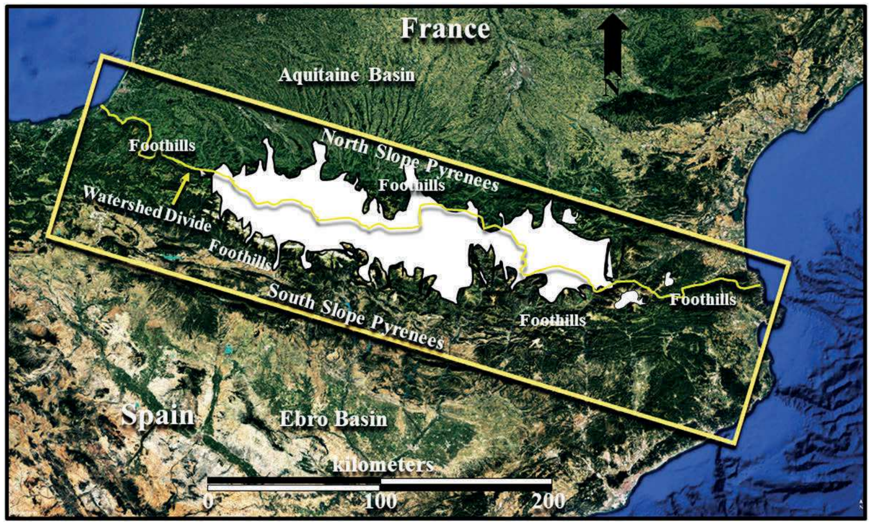

Figure 5. Map of Late Glacial Maximum (LGM) of reconstructed valley glacier and permanent snowfield cover based on current research.

ecological data on those regions' terminal and post glacial periods. Estarrés (356 m a.s.l.) is located on the mountain-foothills/piedmont boundary at the lower northern end of the eastern Pyrénéan Ossau Valley. Its pollen and sediment core data (Andrieu 1987; Delmas 2015: 366-367; Jalut *et al.* 1988, 1992: 460-467) and recent cosmogenic nuclide and thermoluminescence dating of post-glaciation exposed boulders (Delmas 2015; Delmas *et al.* 2008) provide the basis for long-term Late Pleistocene through early Holocene paleoclimatic records. Its data suggest that, between 42,000 and 29,500 ^{14}C cal yr b.p., the Ossau Valley (eastern Pyrénées) was home to a 38 km-long glacier that terminated immediately up valley from the Estarrés coring locality. Shortly afterward, between 26,600 and 24,400 ^{14}C cal yr b.p., as more northerly European glaciers and continental ice sheets continued their expansion, the Ossau, Pau, and other western Pyrénéan valley glaciers began to recede (Delmas *et al.* 2008: 231). In the Ossau Valley, Estarrès data show that its local Pyrénéan foothills and low mountains were fully deglaciated between 30, 975 and 20,809 ^{14}C cal yr b.p. At ca. 18,000 ^{14}C cal yr b.p., Estarrés pollen data show that cold, arid sage (*Artemisia*) shrub-lands in the lower north slope Pyrénées alternated with mixed but broadly open grassland, attracting summer grazing herd species such as reindeer, horses, red deer, and bison (see Arudy site descriptions below). Four millennia later, between 15,800 and 14,700 ^{14}C cal yr b.p., the Ossau valley's highest elevations (1750 m a.s.l.) had transformed into cold steppe grassland with only a small remnant of the former Ossau glacier being confined to its origin cirque at the valley's head (1700 m a.s.l.). At that time, the Col Pourtelet pass at the top of the Ossau Valley would have allowed animals and humans to access the Spanish Tena Valley and the Pyrénées' south slope in summer while upland tundra grassland would have also been accessible for seasonally migratory game and hunters during at least part of the summer.

Pollen and chironomid (fossil insect) analysis of sediment core samples from Ech paleolake at the western edge of the central Pyrénées (the Haute-Pyrénées) provides further records on temperature patterns, climate, and chronology from Late Glacial through earliest Holocene periods (cf. Millet *et al.* 2012; Rius *et al.* 2014). Ech and its associated peat bog is located in its formerly glaciated valley at 710 m a.s.l. At the end of the Older Dryas stadial and initiation of the succeeding Late Glacial Interstadial (LGI), prior to ca. 14,700 ^{14}C cal yr b.p., sediment and chironomid data show an abrupt increase in summer (July) temperatures from 11 ^{o}C to 16 ^{o}C. The warming was accompanied by increasing moisture and a decreasing presence of sage (*Artemisia*), the latter replaced by juniper (*Juniperus*) and willow (*Salix*). At that point, sediment and palynological studies at the Abri Dufaure and Duruthy rock shelters, thirty-seven km west of the Estarrés coring site, provide supplemental paleoenvironmental details (cf. Paquereau 1978; Paquereau and Paquereau 1995). Climatic reconstruction of Magdalenian (early middle through upper) occupations (17,770-12,890 ^{14}C cal yr b.p.) at Abri Dufaure and Duruthy shows the existence of open cold grass and shrub lands during the Older Dryas climatic episode, ending with more temperate humid conditions of the early Late Glacial Interstadial (LGI) (ca. 14,200 and 14,000 ^{14}C cal yr b.p.) when summer (July) temperatures rose ~5 ^{o}C from 11 ^{o}C to 16 ^{o}C (Millet *et al.* 2017: 92-93) and western Pyrénéan foothills landscapes came to be dominated by pine (*Pinus*) and birch (*Betula*). By ca. 14,000 ^{14}C cal yr b.p., pine was being replaced by warmer, moister climate-adapted cyprus (*Cyperceae*) but Late Glacial Interstadial warming was soon interrupted by gradual cooling of ~1 ^{o}C, followed by three sharp intense cooling events at ca. 13,900 ^{14}C cal yr b.p., 13,600 ^{14}C cal yr, and 13,100 ^{14}C cal yr b.p., the last event signaling transition to the Younger Dryas cold episode. The Younger Dryas, coincident with latest Final (Upper) Magdalenian occupations at the Abri Du Faure and Duruthy rock shelters, ca. 12,890-12,000 ^{14}C cal yr b.p., ended with transition from the geological technical end of the Late Pleistocene into more temperate, humid Preboreal climate of the Early Holocene and emergence of the Azilian cultural tradition from Magdalenian roots. Preboreal environments in the western Pyrénées were characterized by emergence of Atlantic Oak (*Quercus*) woodlands similar to those found in today's more natural (non-culturally altered) mid to lower elevation western Pyrénées. At the same time, higher elevation mountains and valleys (200-1200 m a.s.l.) came to be dominated by willow (*Salix*) and alder (*Alnus*) and upper mountain slopes and peaks (1200-3000+ m a.s.l.) were covered with Atlantic alpine vegetation, similar to that of today.

Terminal Pleistocene/Early Holocene Paleoenvironments of Colorado's Southern Rocky Mountains

Paleoclimatic/paleoenvironmental data for Colorado's late Pleistocene/early Holocene periods are available in numerous studies of pollen, sediments, and fossil insect remains from stratified fen, bog, and lake sediment core and stream terrace cut-bank and eolian (dune) deposits. Over the past half century, university and government agency research programs have assembled paleoclimate, paleoenvironmental, and glacial geology records in Colorado's southern Rocky Mountains, publishing a wide range of reports, books, and journal articles. Those research results cover an extensive inventory of methodologies and dating techniques, including the use of cosmogenic dating, AMS radiocarbon dating, and analysis and modeling of climate proxy data, e.g., fossil insect (beetle). Pollen, sediment lithostratigraphy, magnetic susceptibility, organic content, and bulk density studies have been done at dozens of research sites in diverse geographic locations, including high and lower elevation mountain fen, lake, and pond sediments and glacial geological features (see Brunswig 2014a, 2014b, and 2015b; Brunswig and Doerner 2021; Brunswig *et al.* 2009, 2014a, 2014b; Doerner 2004, 2005, 2009, 2014; Doerner and Brunswig 2008).

Current paleoclimate/paleoenvironment records show full mountain glaciation, the region's Pinedale IV stadial and its maximum extent, the Late Glacial Maximum or LGM, as having occurred in the southern Rocky Mountains at ca. 26,400 ^{14}C cal yr b.p./kyr (Benson *et al.* 2004: 196-197; Madole 1976, 1980; Madole *et al.* 1998; Pierce 2003: 68-70; see Figure 6 for the region's reconstructed extent of LGM glaciers and permanent snow fields).

High altitude lake and fen records indicate the onset of early mountain deglaciation of north central Colorado before 16,100 ^{14}C cal yr b.p. (Benson *et al.* 2004: 197). Shortly before 13,000 ^{14}C cal yr b.p., continued warming led to significant retreat of regional mountain glaciers toward their origin cirques while upper sub alpine tree lines ascended 25-50 m a.s.l. below modern levels of 3200-3400 m a.s.l., compared with earlier Late Glacial Maximum (LGM) maximum tree lines that earlier had been depressed 150 to 300 m a.s.l. below modern elevations (Brunswig 2001a: 41-42; 2002b: 19-20; Brunswig 2003a; Brunswig and Doerner 2021; Brunswig *et al.* 2014b: 50-51). Seasonal mountain temperatures by 13,100 ^{14}C cal yr b.p. appear to have been only moderately colder-than-at-present, but persistent snowfields likely existed in many areas above 3300 m a.s.l. in Colorado's southern Rockies, preventing their use for summer foraging by migratory herbivores and hunting of those animals by the region's earliest Clovis hunter-gatherers (see below). However, very latest Late Pleistocene warming temporarily ceased with onset of the Late Pleistocene-ending, short-term Younger Dryas (Dryas III) cooling episode (ca. 12,800-12,100 ^{14}C cal yr b.p.), resulting in minor re-glaciation of some previously deglaciated tarns and cirques and expansion of permanent snowfields above 3300 m a.s.l. (Brunswig *et al.* 2014b: 51). Based on the virtually complete absence of highest altitude

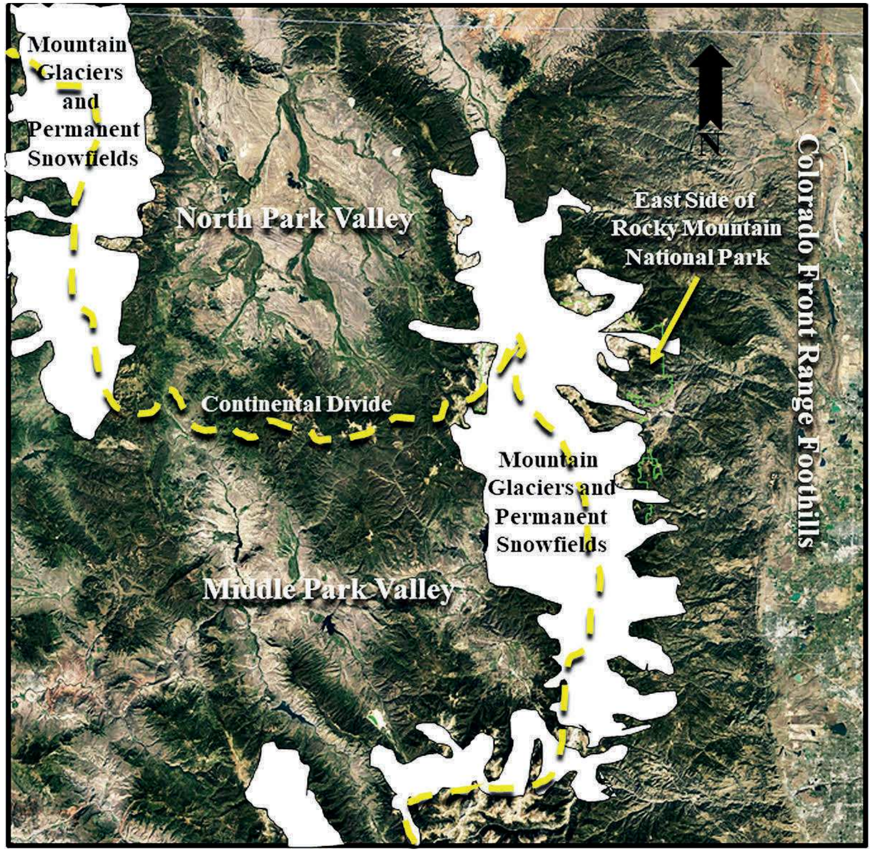

Figure 6. Map of North Central Colorado Mountain Valley Glacier and Permanent Snowfield Areas during the Pinedale IV Stadial (LGM).

post-Clovis archaeological evidence in the Younger Dryas period, the earliest archaeological evidence of human hunters in the southern Rockies having been occasional hunting Clovis culture bands (see below), human and game animal use of high altitude mountain areas appears to have been inhibited by renewed glaciation and expanded permanent snowfields in many, if not most, Rocky Mountain passes and highest subalpine forest and alpine zones above 3000 m a.s.l. Termination of the Younger Dryas resulted in rapid warming, with a fully developed Early Holocene (post-Younger Dryas) climatic optimum (warm phase) being established between ca. 11,000 ^{14}C cal yr b.p. and 10,600 ^{14}C cal yr b.p. By ca. 10,450 ^{14}C cal yr b.p. when tree-lines in Rocky Mountain National Park and equivalent high elevations in the north central Colorado region reached and subsequently exceeded modern parameters as even more rapid warming ensued, peaking around 9,600 ^{14}C cal yr b.p. (Elias 1983, 1985: 33, 35-36, 43-45, 1996, 2015).

A ~130 m rise of equilibrium line of altitude (ELA) tree-line has been documented in modern-day tundra pond deposits on Rocky Mountain National Park's Mount Ida Ridge between ca. 10,190 and 9,380 ^{14}C cal yr b.p. (cf. Brunswig 2014b: 62-63, 2015b: 50; Brunswig and Doerner 2021: 11-12; Brunswig *et al.* 2014b: 62-63). Between 11,400 and 9,300 ^{14}C cal yr b.p., Early Holocene Optimum climate conditions opened high altitude tundra grasslands to both accessibility and longer growing seasons (e.g., enhanced warm season biotic productivity) above 3000 m a.s.l. for summer foraging by migratory game (primarily elk, bighorn sheep, and occasional bison) and seasonally transhumant hunting bands seeking to exploit their economic potential (cf. Brunswig and Doerner 2021: 34-35).

COMPARATIVE ARCHAEOLOGY AND CULTURAL PATTERNS OF THE WESTERN PYRÉNÉES AND THE COLORADO ROCKIES

Late Magdalenian, Azilian, and Laborian Traditions in the French Pyrénées

France's (and Spain's) Pyrénées were home to three successive cultural traditions in the later Late Pleistocene and earliest Holocene; later (Middle and Upper) Magdalenian culture phases, the succeeding Azilian culture, and a subsequent, but the still poorly defined and dated transitional Azilian through Mesolithic (e.g., Epi-Azilian) Laborian culture (cf. Bahn 1984: 43-46, 94-117; Barshay-Szmidt *et al.* 2016; Camps 1979; Cheung 2020; French and Collins 2015; Gordon 1988: 32-33; Jacquier *et al.* 2020; Langlais *et al.* 2010, 2012, 2016, 2020; Langlais and Pétillon 2019; Naudinot 2013; Pétillon *et al.* 2015; Straus 1986b: 99-106; Table 1).

The two earlier Magdalenian and Azilian traditions share so many lithic technological traits that early Azilian components were once referred to as the "final Magdalenian" (Bahn 1984: 115). Both the Magdalenian and Azilian traditions were based on blade and carved bone and antler technologies that were well-adapted to lifestyles focused on hunting and fishing, but broadly having less emphasis on food plant collecting and processing (cf. Pétillon 2004, 2016). Later Magdalenian lithic technology is characterized by an increasing frequency of small (microlithic) blade tools, including the hafting of detached blade sections on bone and wood handles for making specialized composite tools (for details, see Langlais *et al.* 2012, 2016).

Magdalenian occupations in that culture's early, middle, and late phases are well-known for their rich cave wall (parietal) and sophisticated carved/etched mobile (mobilier) art (Garate *et al.* 2013a, 2013b; Ochoa and García-Diez 2015; Pettitt and Pike 2007; Plassard *et al.* 2015). The high quality and richness of that art is believed by many scholars to represent individual (personal), shamanic (religious specialists), and communal ritual worship, coupled with spiritual beliefs in a natural spirit world based on forces of nature and animal spirit beings (animism) (Arias 2009; Clottes and Lewis-Williams 1996; Clottes *et al.* 1992; Fuentes *et al.* 2019; Garate *et al.* 2015; Lewis-Williams 2011; Maidagan 2018; Naudinot *et al.* 2017; Wallis 2013). The succeeding Azilian culture is distinguished by a Magdalenian-derived microlithic tool kit but with a significantly reduced artistic inventory, the latter consisting of painted, mineral-stained, or engraved cobbles and pebbles with simple geometric designs rather than the earlier Magdalenian cave wall paintings and etchings, and carved bone and antler (Thevenin 1989; Thevenin and Welté 1996), although natural world animist spiritual beliefs and rituals likely continued to exist. In cases where occupation deposits of the two traditions are stratified in the same site, many lithic tool traits (e.g., small-blade based microlith types) appear to have developed along

Table 1. Cultural Traditions and their Radiocarbon Chronologies of the Late Pleistocene and Early Holocene in Southwest France's Western Pyrénées

Pyrénées-Atlantiques Late Pleistocene-Early Holocene Cultural Traditions[1]	Calendar-Age (Calibrated Age) Range of Traditions, their Periods and Phases[2]
Magdalenian Tradition Lower Magdalenian Middle Magdalenian Lower Magdalenian	Early Middle Magdalenian-19,406-18,867 cal yr b.p. Late Middle Magdalenian-18,101-17,590 cal yr b.p. Early Upper Magdalenian-16,730-16,191 cal yr b.p. Late Upper Magdalenian-15, 427-15,036 cal yr b.p.
Azilian Tradition	Azilian-15,500-11,500 cal yr b.p.
Laborian Culture	Laborian-ca. 12,500-11,000 cal yr b.p.[3]

[1] Sources used for this chart include Barshay-Szmidt *et al.* 2016: Table 3, 77-79; Frencli and Collins 2015; Langlais *et al*. 2020.
[2] The chart's Magdalenian chronology is based on comprehensive analysis and archaeological correlation of excavated Magdalenian cultural deposits and a total of 69 AMS radiocarbon dates from 18 sites, as part of the MAGDATIS Project in the French western Pyrénées. All the dates were calendar-age corrected using the Oxcal 4.2.4 radiocarbon calibration program (cf. Bronk and Ramsey 2009). The Azilian chronology, also Oxcal corrected, is based on recent analysis of available radiocarbon dates from excuated sites with Azilian cultural deposits in southwestern France (French and Collins 2015: Table 1).
[3] The Laborian culture, which forms a transition bridge between the latest Azilian and the French Mesolithic, is poorly dated at present and its date range as shown in the chart reflects its generalized stratigraphic and technological relationship to its Azilian predecessor and succeeding Mesolithic archaeological site assemblages.

a well-defined chronological sequence with some geographic regional variations. Laborian lithic tool assemblages, while less well known than those of the Magdalenian and Azilian traditions, evolved from late Azilian templates but are judged to have been technologically more distinguished "from the Azilian that preceded and the early Mesolithic that succeeded them." (Naudinot 2013: 233). In southern France, the early Laborian was characterized by Malaurie points (straight backed points with truncated bases) points and bitruncated backed blades, followed in its late phase with Blanchère (pointed backed bladlets) points and bitruncated trapezoidal microliths (Cheung 2015; Langlais *et al.* 2015, 2020; Naudinot 2013).

Magdalenian-Azilian Sites and Culture Dynamics of the Western Pyrénées

Late Ice Age and Early Holocene development of Middle and Late Magdalenian and Azilian traditions in the western Pyrénées are available from detailed archaeological and climatological evidence accumulated from more than a century of research, but particularly from rapidly expanding research programs and site excavations over the past three decades. Perhaps the most noteworthy recent advancements are precise site-specific and regional chronological frameworks based on high-resolution (AMS) radiocarbon dating and growing awareness of the emergence of sites occurring as closely spaced "community" clusters (or agglomérations) (see below) (cf. Bahn 1984: 94-117; Jacquier *et al.* 2020; Langlais *et al.* 2010, 2012, 2016, 2020; Naudinot 2013; Pétillon *et al.* 2015; and Straus 1986b: 99-106). Many western Pyrénéan sites

were initially excavated in the late nineteenth and early twentieth centuries when excavation techniques and reporting standards were poorly developed. As a result, accurate and scientific reconstruction of the region's archaeology from those periods has often been incomplete and problematic until recently when new scientifically advanced research programs (starting in the 2000s), often involving re-excavation of earlier explored sites, substantially advanced our understanding of western Pyrénéan Magdalenian and Azilian cultural developments.

Late Pleistocene and Early Holocene Archaeology of the Pyrénées-Atlantiques Region

Figure 7, although not showing a fully comprehensive site distribution map, does illustrate geographic locations of most of the better-known and archaeologically significant Late Pleistocene and Early Holocene sites in the Pyrénées-Atlantiques region.

Rock-shelters at Pastou Cliffs

Among the best known sites in the western Pyrénéan lower foothills are four rock-shelters in the southwest-facing Pastou Cliff, north of the Gave d'Oloron river in France's Landes Department. Pastou's closely spaced sites, Abri Dufaure, Duruthy, Grand Pastou, and Petit Pastou, were identified and excavated between the 1870s and the 1990s but only two, Duruthy and Abri Dufaure, have been subject to extensive modern-era excavations and scientific analyses (cf. Altuna *et al.* 1991; Arambourou 1962, 1973, 1976, 1978, 1979, 1990; Aramborou and Genet-Varcin 1965; Aramborou *et al.* 1986; Birouste *et al.* 2016; Breuil and Dubalen 1901; Delpech 1978; Le Gall and Martin 1996; Paquereau 1978; Paquereau and Paquereau 1995; Petragila 1987; Seronie-Vivien 1994, 1995; Straus 1980, 1981, 1982, 1983a, 1983b, 1984, 1985, 1986a, 1987, 1988b, 1995a: 12-15, 1995b; Straus *et al.* 1988). Both are often-cited examples of Late Pleistocene-Early Holocene cultural developments in the western Pyrénées foothills.

Collectively, the Pastou sites, at elevations ranging from 125-130 m a.s.l., are situated near a river crossing confluence of two major Pyrénéan rivers, the Gave d'Pau and Gave d'Oloron, a location which made them desirable for long term habitation and resource procurement (Figure 7, nos. 1, 2, 3, and 4). Today, the sites offer an excellent view up the Gave d'Oloron valley into Pyrénéan foothills and mountains to the south and southeast. Importantly, they are situated near multiple river fords believed to have been used by seasonally migrating reindeer, horses, and red deer. One major ford is located 1.5 km upstream from the sites, its inferred local Ice Age topography of marsh, steep cliff and ridge slopes having created optimal conditions "for the manipulation of [animal] herds the crossing the ford." (Bahn 1984: 106). In addition to the Pastou sites are two other nearby sites: Barthe Claverie (Figure 6, no. 5), an open camp a short distance upstream on the Gave d'Oloron's left bank, and Bourrouilla (Figure 7, no. 6), a cave site several km further upstream at Arancou. All six sites are believed to have been part of an extended community (e.g., agglomération) of late Middle and Upper Magdalenian/early Azilian settlements in the Landes area (Straus 1995:12) and are situated within what is believed to have been a former human and animal migration corridor that encompassed the Aquitaine Basin in the north, the Atlantic Coast to the west, and inner foothills and mountains of the western Pyrénées to the south (Gordon 1988). A series of high and mid mountain passes into modern Spain from the French side of the western Pyrénées are accessible along a southeast to southwest 50-70 km arc from the lower Gave d'Orloron valley (Utrilla and Mazo 1996). Many of those passes are low enough in elevation to have remained unglaciated at the height of the

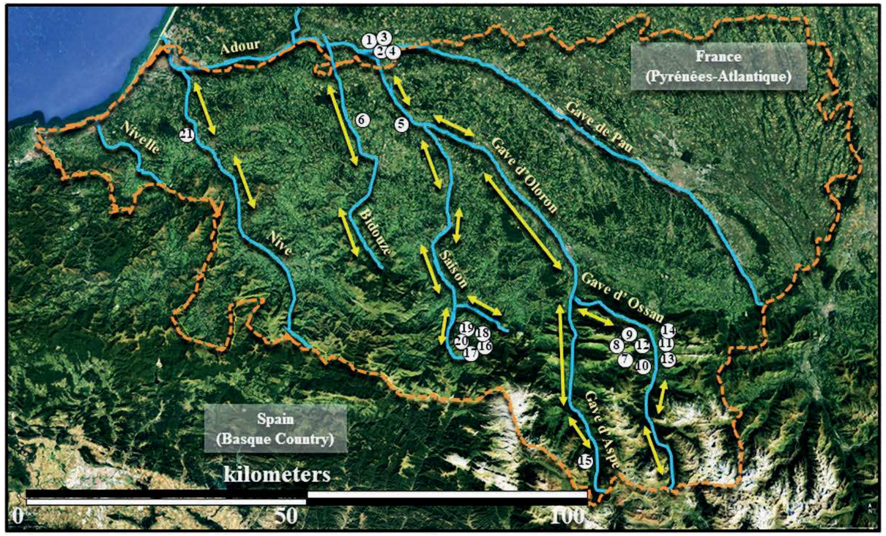

Figure 7. Map showing locations of Pyrénées Atlantiques sites with Magdalenian and/or Azilian cultural components. Double-ended arrows illustrate seasonal pathways along river drainage which would have been taken by spring and autumn migratory game herds and Magdalenian and Azilian hunting bands in the Late Pleistocene and Early Holocene.

Key to numbered sites: *Gave d'Orloron* - **1**. Abri Duruthy (Middle, Upper Magdalenian, Early Azilian); **2**. Grande Pistou (Upper Magdalenian, Azilian); **3**. Petet Pistou (Upper Magdalenian); **4**. Abri Dufaure (Middle and Upper Magdalenian, Early Azilian); **5**. Barthe Claverie-(Open Air site, Upper Magdalenian); *Upper d'Aspe* - **6**. Bourrouilla (Late Middle, Upper Magdalenian, possible Azilian); *Arudy/Gave d'Ossau* - **7**. Malarode 1 and Malarode 2 (Middle and Upper Magdalenian); **8**. Laa 2 (Lower, Middle, and Late Magdalenian); **9**. Tute-de-Carrelore (Upper Magdalenian, Azilian); **10**. Poeymaü (Middle and Upper Magdalenian, Azilian); **11**. Espalungue (Middle and Late Magdalenian, Azilian); **12**. Bignalats (Middle Magdalenian); **13**. Saint-Michel (Middle Magdalenian); **14**. Tastet and Samson Caves (Middle and Late Magdalenian); *Upper Gave d'Aspe (Larrau)* - **15**. Grotte Leherreko-Ziloa (Upper Magdalenian [?], Azilian); *Massif des Arbailes-Upper Nive* - **16**. Grotte d'Etxeberri (Middle to Upper Magdalenian, Major Parietal Cave); **17**. Sinhikole (Middle to Upper Magdalenian, Minor Parietal Cave); **18**. Gatzarria-(Middle to Upper Magdalenian, Habitation Cave); **19**. Harregi (Middle to Upper Magdalenian Habitation Cave); **20**. Sasizloaga (Lower to Upper Magdalenian, Minor Parietal Art Cave); *Altzerreka, Bidouze upper tributary* - **21**. Grotte d'Isturitz/Oxocelhaya Cave Complex (Lower to Upper Magdalenian, Azilian); *Nive River*.

LGM and known to have provided access (known as the Basque cross-roads) between north and south slopes of the Pyrénées for Solutréan and Gravettian hunter-gatherers during earlier Late Pleistocene (pre-LGM and LGM) glacial maxima times (cf. Arrizabalaga 2014; Arrizabalaga *et al.* 2021; Sanchez *et al.* 2019b).

The most completely and recently excavated Pastou Cliff site is Abri Dufaure, initially excavated in the late nineteenth century (Breuil and Dubalen 1901; Straus 1995: 12-15). More recent Abri Dufaure excavations from 1981 through 1984 found only 25 square meters of undisturbed site area preserved from earlier and poorly reported excavations of the 1870s through

the 1920s. The 1980s excavations documented largely intact middle and upper Magdalenian and Azilian cultural deposits (Arambourou *et al.* 1986; Fontugne and Hatté 1999; Straus 1980, 1981, 1983a, 1984, 1986a, 1986b, 1987, 1988a, 1988b, 1995, 2006, 2015: 100-102; Straus *et al.* 1988). Early Middle Magdalenian deposits were radiocarbon-dated between 16,300 and 15,800 ^{14}C cal yr b.p. and found to contain predominantly saiga antelope (*Saiga tatarica*) faunal remains, a cold tundra-adapted species. Succeeding late Middle Magdalenian cultural deposits, radiocarbon-dated from 14,240 to 13,020 ^{14}C cal yr b.p., were dominated by horse (*Equus ferus ferus*) with lower representation of reindeer (*Rangifer tarandus*), bison (*Bison priscus)*, and red deer (*Cervus elaphus*). Late Middle Magdalenian season-of-death faunal analyses at Abri Dufaure and its sister site of Duruthy support their focus on late-fall to early winter and spring reindeer hunting, which, as noted above, likely involved ambush kills of migrating herds at nearby river crossings and along a narrow pass through the cliff occupied by the Pastou rock shelters. The sites' faunal evidence has been interpreted to suggest that local river ford ambushes specifically targeted reindeer herds seasonally transiting the western Pyrenean foothills from the Aquitaine Basin to upland mountain pastures in spring and returning in autumn. Excavation of a salmon vertebrae at Abri Dufaure, a fish still found in the Gave d'Orloron, would have been caught during an up-stream spawn migration in summer, indicating seasonal occupation of the site in mid-late summer.

Abri Dufaure's Upper Magdalenian occupation was radiocarbon-dated between 12,800 and 10,870 ^{14}C cal yr b.p. During that occupation, the presence of reindeer decreased from dominance during the earlier late Middle Magdalenian to where they were gradually replaced by red deer (*Cervus elaphus*) by the end of the Upper Magdalenian. Horse (*Equus ferus ferus*), bison (*Bison priscus)*, and auroch (*Bos primigenius*) remains were also present in limited frequencies. Seasonal faunal data (dental laminations, age profile data, etc.) suggest the site was being used primarily in spring and fall-winter months. Attritional age/sex profiles of reindeer bone elements recovered from the two sites' Upper Magdalenian deposits support the hypothesis that mass herd kills occurred at least in the first half of that phase's occupations, ca. 12,800-10,870 ^{14}C cal yr b.p., as well as in the earlier late Middle Magdalenian occupation (Altuna *et al.* 1991). Reindeer season-of-death dental analyses also indicate a winter occupation (Le Gall and Martin 1996). Limited evidence for fish (trout and pike) remains suggests other fish species provided a minor dietary supplement. The presence of stone cobble pavement areas at the rock-shelter's entrance and front slope areas are interpreted as platforms used for meat-drying and/or meat-roasting. Abri Dufaure's latest deposits, identified with the Azilian Tradition, have been dated between 12,000-11,050 ^{14}C cal yr b.p. Its Azilian faunal assemblage was dominated by red deer (*Cervus elaphus*), followed by roe deer (*Capreolus capreolus*) and a limited amount of reindeer bone, the latter possibly redeposited from earlier Magdalenian levels. If reindeer were actually present at Abri Dufaure during its Azilian period, they would have represented declining remnants of a vanishing Pyrénéan reindeer population.

Lithic tool use-wear analyses for all Abri Dufaure cultural periods showed heavy emphasis on hide and bone/antler processing and carcass butchering. Lithic sourcing studies showed that Magdalenian and Azilian occupants of the rock shelter relied entirely on local (within 30 km) stone tool materials (Seronie-Vivien 1994, 1995). Analysis of site lithic artifacts and source material identification showed the use of local flint from nearby river gravels, tabular flint from Isturitz (a major Upper Paleolithic art and habitation 14 km to the south-southwest, described below) as well as flints from Bidache (9 km west of the Gave d'Pau), Tercis on the Adour River (19 km distant), and Benesse-les-Dax (12 km away).

The second Pastou Cliffs site described here is Duruthy, first excavated in the late nineteenth and early twentieth centuries and found to contain Middle and Upper Magdalenian and Azilian deposits (Breuil and Dubalen 1901). More scientifically rigorous excavations took place between 1958 and 1975 (Arambourou 1962, 1976, 1978, 1979, 1980, 1990; Arambourou and Genet-Varcin 1965; Birouste *et al.* 2016; Delpech 1978). Duruthy's Upper Magdalenian faunal assemblage was dominated by reindeer and horse but was also rich in salmon (*Salmo salar*) bone. Fishing tools in the form of round cross-sectioned Magdalenian harpoon points were also excavated. Seasonal occupation data from fish and animal bone suggest Duruthy was occupied later in the year (spring-summer) than Abri Dufaure, the latter site providing more substantial evidence for cold season (late autumn-winter-early spring) occupation (Straus *et al.* 1988: 345). Duruthy's Upper Magdalenian season-of-occupation evidence for summer use derives from the analysis of salmon and reindeer bone, with salmon bone traits showing its deposition coincided with the salmon spawning season in mid through late summer (Delpech 1978; Le Gall and Martin 1996). Duruthy and Abri Dufaure faunal data have also been interpreted as suggesting the lower Gave d'Oloron valley was at least partially abandoned in early through mid-summer when Upper Magdalenian and later Azilian bands migrated to the Atlantic Coast or to upland hunting territories in the Pyrénées foothills and mountains.

Azilian cultural deposits from both sites provide a picture of a steady decrease in reindeer populations, although reindeer may have lasted longer at the Pastou Cliff sites than at contemporary central and eastern Pyrenean Azilian sites. Persistence of reindeer in Pastou's Early Holocene archaeological records, although reduced in frequency, were once seen as due to the animal's relative isolation and survival in a "favorable biotope" (Bahn 1984: 115) (see further discussion below).

Barthe Claverie, a Magdalenian Reindeer River Crossing Ambush Camp

Open-air (Plein-Aire) camp sites, in contrast to more commonly investigated rock-shelter and cave sites, are poorly known in the Pyrénées-Atlantiques. Barth Claverie (Figure 7, no. 5), located adjacent to a river junction ford of the Gave d'Oloron and Saison Rivers and a short distance upstream from the Pastou sites, is a rare example of an open camp. It was excavated in the early 1920s (Passemard 1924) and, beyond limited published archaeological details, produced a lithic tool assemblage identified as late Middle to Upper Magdalenian (Dachary 2002: 56, 90; Straus 1995a: 12). As discussed later, Straus *et al.* (1988: 329) hypothesized that Barth Claverie represented a hunting camp associated with river ford ambush hunting of seasonally migrating reindeer.

Bourrouilla, a Late Pleistocene-Early Holocene Cave Camp in the lower Bidouze Valley

The small cave of Bourrouilla is another foothills site, located 9 km south of the Pastou sites and east of the Bidouze River (Figure 7, no. 6). Entrance and inner chambers of the cave contain Late Middle and Upper Magdalenian occupation deposits along with a less well-defined Azilian occupation and subsequent Mesolithic and Neolithic levels (Auriére *et al.* 2013; Chauchat 1999; Dachary 2002: 52-54, 2005, 2008; Dachary *et al.* 2013; Plassard *et al.* 2015; Szmidt *et al.* 2009a). Overlapping radiocarbon date ranges of its two Magdalenian phases were late Middle Magdalenian, 15,260 to 14,550 ^{14}C cal yr b.p., and Upper Magdalenian, 15,930 and 14,110 ^{14}C cal yr b.p. (Auriére *et al.* 2-13: Table 1; Szmidt *et al.* 2009a). Mobile art artifacts, in the form of etched sandstone and etched and carved bone and antler, pictured outlines of horses, canids (wolves or dogs), bear, bison or auroch, salmon, and geometric patterns, are consistent with known Magdalenian art mobilier styles of the Pyrénées (Auiére *et al.* 2013), Faunal inventories from its two Magdalenian phase occupations were dominated by red deer with lesser representation of reindeer, horse, and *Bos* (either bison or auroch) (Dachary 2002: 74-75; Fosse 1999). Season-of-death analysis of reindeer, deer, and Bos teeth indicated its primary season of use was summer (Dachary 2002: 78).

Late Magdalenian and Azilian Sites in the Ossau Valley's Arudy Basin

Seventy-two km southeast of the Pastou sites is a cluster of ten Paleolithic cave and rock-shelter sites, near the Ossau Valley mid-mountain town and local basin of Arudy (Figure 7, nos. 7-14). The Arudy sites, situated at elevations between 400 and 500 m a.s.l., are described by a number of journal articles and research reports as part of a larger Aquitaine Basin multidisciplinary research project on Magdalenian archaeology and paleoenvironment known as the Magdatis Project (cf. Pétillon *et al.* 2016). Earliest excavations at some Arudy sites took place in the 1860s (Garate *et al.* 2013b; Langlais and Pétillon 2019; Laroulandie *et al.* 2017; Pétillon *et al.* 2015, 2016, 2017). Three phases of Arudy archaeological investigations took place between 1864 and 1915 at Malarode 1, Malarode 2, Espalungue, Saint-Michel and Saint-Colome, followed by a second period of excavations between 1948 and 1987 at Malarode 1, Malarode 2, Poeymaü, and Bignalats. The most recent investigations took place from 2006-2010 and included extensive excavations at Laa 2 and Tastet with more limited excavations at Poeymaü, Espalungue, Bignalats, and Saint-Michel (Barshay-Szmidt *et al.* 2016; Garate *et al.* 2013b; Langlais and Pétillon 2019; Pétillon *et al.* 2015).

As noted earlier, the Arudy Basin segment of the Ossau Valley was effectively deglaciated between 20,000 and 19,000 ^{14}C cal yr b.p. (Pétillon *et al.* 2015: 128-129). With that de-glaciation timeline in mind, it is important to note that recent Laa 2 and Tastet excavations yielded AMS radiocarbon dates (mainly on bone): Laa 2-20,000 to 19,000 ^{14}C cal yr b.p. and Tastet-19,000 ^{14}C cal yr b.p., both from their late Lower Magdalenian occupation levels and presenting chronologies which are consistent with the area's full deglaciation. Middle Magdalenian occupations at Laa 2, Poeymaü, Espalungue, Bignalats, Saint-Michel, and Tastet were artifact-type and AMS radiocarbon dated between 18,000 and 17,500 ^{14}C cal yr b.p. while Upper Magdalenian occupations at Laa 2, Poeymaü, Espalungue, Bignalats, Saint-Michel, and Tastet, dated ca. 15,000-14,000 ^{14}C cal yr b.p. Only three sites, Espalungue, Poeymaü, and Bignalats, produced Azilian deposits (Dachary *et al.* 2014: 488; Marson 1979, 1988; Piette 1907).

Analysis of Arudy site lithic tool inventories and their tool material sources showed that ~80% of their artifacts were local (within 20-50 km) while remaining tool stone (~20%) came from more distant sources (50-250 km). A small percentage of Arudy site tool materials was traced to geological sources from across the Pyrénéan divide in Spain's Ebro Valley while "the recurrent presence of flint varieties from northern Aquitaine shows the existence of a 'north to south' circulation network of lithic material…(Pétillon *et al.* 2015: 140). By the start of the Late Glacial, at ca. 18,000 ^{14}C cal yr b.p., Magdatis Project (Arudy Basin) researchers concluded that "the Pyrénéan lower valleys were totally integrated into the hunter-gatherer's nomadic cycle…" (Pétillon *et al.* 2015: 141).

The Magdalenian Tradition in southern Europe is well-known for its parietal and mobile art, believed to have been integral to spiritual beliefs and rituals that formed the basis of, and reinforced, a sophisticated cultural and social integration system (Clottes and Lewis-Williams 1996; Fuentes *et al.* 2019; Garate *et al.* 2015; Medina-Alcaide 2018; Ochoa and Garcia-Diez 2015; Schwendler 2012: 343-344, 348-349). While many Magdalenian occupation sites contain mobile art (art mobilier) in the form of carved and etched bone and antler, far fewer have interior cave wall panel (parietal) art. Magdalenian parietal art is occasionally found in caves having both contemporary habitation deposits and wall art but also occurs in both large and smaller caves with *only* parietal art, often located in deep and difficult to access cave chambers and passageways. The Arudy sites include two caves, Espalungue and Saint-Michel, with mobile art associated with habitation deposits and one site, Tastet, which includes both habitation deposits and parietal art (Garate *et al.* 2013; Thiault and Roy 1996: 192-196, 293-297). Tastet has three wall art panels with a total of ten wall images (bison and horses) in a single small chamber just inside the cave entrance. Its panel images are engraved outlines of bison and horses, with one large bison outline covered in red ochre. In some cases, images overlap one another, with one or more later images engraved (or painted) over earlier ones, suggesting that the act of creating individual images was a significant ritual in itself but that any reverence and ritual significance of older images was not always retained beyond their time of creation. In addition to the bison and horse images, there is an engraved cross symbol and another with hatched parallel lines.

Faunal remains from six Arudy sites, Laa 2, Poeymaü, Espalungue, Bignalats, Saint-Michel, and Tastet, were recovered and analyzed for genus/species identification, minimum number of individuals (MNI), and species representation in each cultural level. Horse (*Equus* sp.) was most heavily represented in all three Magdalenian phases of four sites (Laa 2, Poeymaü, Espalungue, and Saint-Michel) while red deer (*Cervus elephus*) predominated at Bignalats. Reindeer (*Rangifer tarandus*) was secondarily dominant at most other regional sites in Middle and early Upper Magdalenian phases but was predominant in those phases only at Tastet (Pétillon *et al.* 2015: 135, Table 5). Reindeer was the second most common game species in Middle and early Upper Magdalenian phases of Laa 2, Poeymaü, and Bignalats. Ibex/chamois (*Capra* sp.) was present at all six Arudy sites as a secondary species while bison (*Bison priscus*) was present but again with secondary representation at four sites, the exceptions being Saint-Michel and Tastet.

Season of occupation data from the six Arudy sites are limited but data are available from analysis of seasonal tooth growth layers and fetal and neonate bone, the latter based on known gestation patterns of the analyzed species (cf. Pétillon *et al.* 2015: 136). Winter occupation at Saint-Michel was documented by horse, bison, and cervid (red deer or reindeer) fetus bone and at Espalungue by horse and reindeer fetal bone. Evidence for late winter through early spring occupations at Saint-Michel was inferred from horse fetus bone growth traits and neonate (newborn) horse and reindeer bone. Finally, summer-fall occupations at Espalungue are documented by an adolescent Bos (bison or auroch) tarsal bone. Altogether, season-of-occupation data from the Arudy sites provide evidence for some year-round residence along with probable summer in-migration into, and probably through, the area from lower elevation Magdalenian sites in the foothills and northern Aquitaine. Even limited summer occupation evidence suggest that lower elevation winter-spring-fall resident Magdalenian hunting bands, e.g., from the Pastou rock-shelter sites and the Aquitaine beyond, passed through the Arudy Valley on their way to higher elevation hunting territories. The hypothesis of seasonal Arudy Basin migratory pass-throughs by lower elevation-resident late spring-winter-autumn migrating Magdalenian hunters, coinciding with upslope migration of Arudy winter-resident hunter-gatherers to higher elevation hunting territories, is strengthened by the presence of south slope Pyrénéan sourced lithic tool material in Arudy sites from Spain's Ebro Valley.

Grotte Leherreko near the Pyrénéean Mountain Divide

The highest Late Pleistocene site in the Pyrénées-Atlantiques known to this author is Grotte Leherreko, at 820 m a.s.l. (Figure 7, no. 15). It is located in France's Larrau commune and lies below the Port de Larrau mountain pass that transits the French and Spanish slopes of the Pyrénées (1578 m a.s.l.) (Dachary 2009: 437; Dachary *et al.* 2014: 488, 496; Valdeyron 2001). Limited excavations at Grotte Leherreko uncovered Azilian cultural deposits overlying an earlier disturbed occupation with an Upper Magdalenian beveled projectile point fragment (Valdeyron 2001).

The Massif des Arbailes Magdalenian Site Cluster

A cluster of five Magdalenian cave sites, Grotte d'Etxeberri, Sinikole, Gattzarria, Harregi, and Sasizloaga, are scattered along the eastern slopes of the Massif des Arbailles mountain range (120 km^2), overlooking upper headwaters of the Le Saison River (Figure 7, nos. 16, 17, 18, 19, and 20; Garate *et al.* 2015: 639, Figure 1; Garate and Bourrillon 2009: 74-75, Fig. 1; Laplace 1952a, 1952b; Paillet 1989). Le Saison is a tributary of the Gave d'Oloron River, joining it near the Pastou Cliff sites, and its valley corridor provides direct upland access to the Arbailles sites and beyond to the Pyrénéan divide between modern-day France and Spain. The Arbailles sites are situated in mid-mountains of France's Basque Country at elevations between 400-450 m a.s.l. and 40 km south of the Pastou sites. All five sites contain Magdalenian archaeology, with two, Gatzarria and Harregi, being solely Middle and Upper Magdalenian habitation sites, while the remaining three, Grotte d'Etxeberri, Sinhikole, and Sasizloaga, are parietal art caves with no evidence of Magdalenian habitation (Garate *et al.* 2015; Garate and Bourrillon 2009; Garate Maidagen *et al.* 2012; Laplace 1952a, 1952b; Paillet 1989).

Grotte d'Etxeberri (400 m a.s.l.) is the most significant Arbailes site. It contains five art panels, located deep in its interior (150-200 m from the entrance), with engraved red ochre and charcoal outlined images, many further "dusted" in red ochre. Its panel images represent nineteen animals: fourteen horses, two bison, an ibex, and two animals of indeterminate species. A free-standing sculpted-clay horse was also found on the floor of a short passage off the cave's innermost painted gallery. Excavations below one panel uncovered stone tool fragments, powdered red ochre, plant remains, charcoal, and burnt bone, believed to represent an artist's work area. Both art style and burnt bone radiocarbon dates indicated that most, if not all, the wall art was Middle Magdalenian in date (Garate and Bourrillon 2009: 73-76; Garate Maidagan *et al.* 2012: 646-649, Table 2; Garate *et al.* 2015: 288). Median age range calibrated radiocarbon bone dates were 15,858 ^{14}C cal yr b.p. and 16,395 ^{14}C cal yr b.p.

Both Sasiziloaga and Sinhkole are smaller, shallower caves with limited parietal art images located in single panel locations in their deepest galleries (cf. Garate and Bourrillon 2009: 76-78, Figs. 3, 4, and 5). Sasiziloaga's art panel presents bichrome (red ochre and black charcoal) etched outlines of two bison while Sinhkole has three clustered images, with a bison partially overlaid in its lower part by a horse outline and an anthromorph (animal-human composite) head outline. Dating and cultural affiliation of imagery in both caves, like that of d'Etxeberri, are believed, based on art style analysis, to be Middle Magdalenian.

Major Parietal Art and Occupation Caves near the Atlantic Coast

Isturitz, Oxocelhaya-Hariztoya, and Erberua caves belong to a single three-tiered cave complex inside a limestone hill overlooking a Nive River tributary, 14 km southwest of the Pastou Cliff sites (Figure 7, no. 21; cf. Garate *et al.* 2013a; Goutas and Tejero 2016:82; Henry-Gambier *et al.* 2013; Larriabau and Prudhomme 1983; Lenoble and Texier 2016; Normand 2002; Normand *et al.* 2007; Passemard 1913, 1922, 1924, 1944a, 1944b; Pétillon 2013; Pétillon 2004, 2006, Pétillon *et al.* 2003; Rivero 2014; Saint-Périer 1930, 1936, 1952; Saint-Périer and Saint-Périer 1952; Szmidt *et al.* 2009b; Szmidt *et al.* 2010). All three caves contain habitation deposits and parietal art although the upper-most level of Isturitz Cave is the most extensive, best preserved, and most thoroughly researched, and only discussed here for the purposes of this article. The caves were formed in three successive phases stages of Arberoue River flow-through erosion of their galleries and passageways, a process which began in the Early Quaternary, ca. 2 million years ago. The third and final cutting cycle resulted in the river exiting the hill through the present entrance to Erberua Cave, lowest of the three cave levels.

Isturitz Cave (209 m a.s.l.) is very large, 200 m long and 50 m wide, with gallery ceilings reaching to 15 m. The cave has five interior galleries arranged along a single axis and with one off-center line lateral gallery, all having rough, uneven floors littered with small to massive roof-fall blocks and sections of drip stone columns (stalactites and stalagmites). Narrow passageways connect all its galleries. Habitation levels in the front galleries are frequently found to have been disturbed and partially intact, having been subject to intermixing and redeposition of successive cultural strata by past interior cave water erosion, sedimentation, and roof-fall (cf. Lenoble and Texier 2016: 11-12, 19; Szmidt *et al.* 2020: 760). Archaeological excavations have been limited, particularly considering its large open spaces, although there are limited areas of substantially intact and stratified cultural deposits. Isturitz's earliest excavations began in 1912 and continued through the 1950s while more recent excavations took place between 1999 and 2010 (see above cited sources).

Isturitz habitation occupations, based on its excavated stratigraphy, has been reconstructed through analysis of lithic tool type assemblages and radiocarbon dating, radiocarbon dates being mainly derived from cultural animal bone. Its cultural history includes Proto-Aurignacian/Aurignacian (early modern human) occupations, dated at 41,820 ^{14}C cal yr b.p. (average of six AMS bone dates, Szmidt *et al.* 2010: 764), Middle-Upper Gravettian occupations, ca. 31,500-27,000 ^{14}C cal yr b.p. (Banks *et al.* 2019; Goutas and Tejero 2016: 82-83), and, of interest for this article, Middle Magdalenian (ca. 17,000-16,500 ^{14}C cal yr b.p.) and Upper (ca. 14,000-13,000 ^{14}C cal yr b.p.) occupations, the later culture's chronology being based on stratigraphic analysis and AMS radiocarbon dating of nine bone samples (Szmidt *et al.* 2009b: 591, Table 1). There is also limited archaeological evidence of very early Mousterian (Neanderthal) and late Azilian occupations.

Faunal analysis of 575 bones recovered from Isturitz Magdalenian deposits in two galleries, the Grand Salle and Salle de Saint-Martin, provided genus/species identification of 328 bone elements (Pétillon *et al.* 2003). The highest frequency (42%) of represented species belonged to reindeer (*Rangifer tarandus*), followed by horse (*Equus ferus ferus*) at 25%, fox (*Vulpes vulpes*) at 9.5%, and red deer (*Cervus elephus*) at 9%. Smaller frequencies of wolf (*Canis lupus spelaeus?*) (9.4%), roe deer (*Capreolus capreolus*) (7%), Bos/Bison (*Bison priscus*?) (6%), and boar (*Sus scrofa*) (0.6%) were also identified. Season-of-death data broadly identified Magdalenian occupation seasonal use of Isturitz from analysis of reindeer teeth in early spring through late summer. Although it cannot be assumed that summer was the only season Isturitz was in use as a Magdalenian hunting camp and ritual site, its surrounding hills and valleys would have provided abundant summer foraging for reindeer, horses, red deer, and bison.

Four Isturitz galleries have parietal art, all judged, based on art stylistic analysis, as belonging to the Middle Magdalenian phase. A systematic inventory of parietal art images (Garate *et al.* 2013) identified twenty-two painted or paint-outlined images of animals (reindeer, deer, ibex, bear), fish, paint dots, lines, and a comb-shaped symbol. Fourteen deeply etched (bas-relief) images, mostly animals, are also recorded, the most prominent example being rock-cut outlines of a large reindeer partly overlying an earlier etched body of a headless deer. Both were engraved on a massive free-standing pillar in the cave's Grand Salle. A second line of evidence for ritual behavior in the cave is dozens of insertions of objects (bone, flint artifacts, animal teeth, and fragments of color mineral, such as ochre) into wall cracks, crevices, and water-cut cavities (cf. Clottes 2009; Garate *et al.* 2013: 269-270; Garate *et al.* 2019; Labarge *et al.* 2015).

Isturitz, and quite probably its two lesser explored sister caves, represented a major center of residence and ritual practices for Magdalenian hunter-gatherers. Even though limited season-of-occupation evidence suggests summer occupancy, there may also have been cold-season residence as well, a year-round pattern described above for some of the Arudy sites. Other Magdalenian sites, still undiscovered or unreported, likely exist in the surrounding Nive Valley landscape and Isturitz itself is only one of dozens of parietal art caves which extend for hundreds of km around the western end of the Pyrénees into Cantabrian Spain and eastward into Spain's Ebro Basin as far as the Mediterranean Sea (cf. Utrilla and Mazo 1996; Utrilla *et al.* 2012).

Reindeer, Horses, Red Deer, and Roe Deer as Transhumant Migratory Game Animals in the Western Pyrénéan Magdalenian and Azilian Periods

Recent syntheses of reindeer faunal studies at multiple Magdalenian and Azilian sites in the Pyrénées and the Aquitaine Basin to the north (e.g., the Magdis and Fyssen projects) have clearly established that reindeer disappeared from Pyrénées' regions no later than the earliest Azilian at ca. 14,000 ^{14}C cal yr b.p. (Costamagno *et al.* 2016: Tables 1-5, Fig. 3, 45-48). North of the Pyrénées, in the Aquitaine Basin and Perigord-Dordogne hill region, isolated reindeer populations persisted well into the Azilian Period until ca. 12,600 ^{14}C cal yr b.p. (Costamagno *et al.* 2016: Fig. 4, 46-48). It is also interesting to note that Late Magdalenian and early Azilian reindeer remains from western Pyrénéan sites were physically larger than their counterparts in the central and eastern Pyrénées or Perigord-Dordogne regions, suggesting the existence of richer foraging ecosystems, arguably in part due to the region's rich periglacial steppe-lands after the height of the LGM and subsequent development of mid-high elevation summer meadows and tundra grasslands, accessed by development of annual reindeer upland summer migration patterns. Immediately post-LGM timing of that scenario was emphasized by Bahn (1984: 115) when he suggested that such "superior" reindeer specimens evolved due "to their close proximity to snowfields and the rich periglacial ecosystem of the region" in earlier Late Pleistocene times. It is also important to note that the abrupt temperature rise which marked the end of the Oldest Dryas stadial and onset of the Late Glacial Interstadial after ca. 15,500 ^{14}C cal yr b.p. expanded mid and high mountain upper montane forest meadow and alpine tundra grazing areas which:

> "could have led to an altitudinal migration of reindeer seeking refuge in the mountains during the warm months…[and the] new [Ech Lake described above] radiocarbon dates coupled with faunal associations [at regional archaeological sites] indicate that these altitudinal migrations would have taken place earlier…around 15,500 ^{14}C cal yr b.p."
>
> (Costamagno *et al.* 2016: 52-53)

Magdalenian-Azilian Aggregation Sites in the Late Glacial and Early Holocene Pyrénées

Later (Middle and Upper) Magdalenian and earlier Azilian occupations in some French Pyrénées regions are distinguished by what have been interpreted as seasonal multi-band aggregation (agglomérations) camps or geographic clusters of closely dispersed single band camps. Bahn (1982: 262-265) proposed that Magdalenian and Azilian site concentrations served as strategically placed winter season aggregation camps "spaced at intervals of around 50 km at the points where major rivers emerge from the uplands". Such camps, typically situated in protective rock-shelters and caves, were viewed as seasonal foci of maximum bands; a loose network of smaller bands whose membership and cohesion were reinforced by ritual and economic interaction. Bahn's aggregation model also proposed that Upper Magdalenian site concentrations were centered on two "super sites", Mas d'Azil in the central Pyrénées and Isturitz in the western Pyrénées, which served as multi-band communal social and religious centers (Bahn 1977, 1982: 263).

Assessment of the Late Pleistocene-Early Holocene Seasonal Transhumance Model

One lesser known aspect of late Upper Paleolithic subsistence patterns is whether higher elevation mountain areas were being directly exploited for summer grazing herds of horses, reindeer, and ibex, and particularly reindeer, from high Pyrénéan upper montane, subalpine, ecotone, and alpine tundra zones after 15,500 ^{14}C cal yr b.p. when reindeer and horses disappeared from the archaeological record. It should be emphasized that seasonal upland transhumant migration of game species herds and hunting bands would not necessarily have ended with the decline and disappearance of reindeer (or horses) from their Late Ice Age western Pyrénéan habitats in the latest Magdalenian and earliest Azilian cultural periods. During those same periods, reindeer are documented as being replaced by red deer and roe deer in multiple Pyrénées-Atlantiques faunal records (cf. Costamagno *et al.* 2009). However, red deer in particular, but also roe deer (*Capreolus capreolus*), are prime candidates for continuation of summer migratory high elevation reindeer transhumant migration patterns exploited by earlier Magdalenian hunting bands. European red deer (*Cervus elaphus*) are the same species as North American elk (*Cervus elaphus*), which are commonly a seasonally transhumant migrating game species in Colorado's southern Rocky Mountains. Even in today's Europe, many red deer (and some roe deer - *Capreolus capreolus*) populations engage in seasonal migrations that involve lowland-highland transhumance (cf. Georgii and Schröder 1983; Jarnemo 2007; Kropil *et al.* 2015; Luccarini *et al.* 2006; Mysterud 1999). It is probable that Late Pleistocene red deer in the Pyrénées, along with reindeer, horses, and bison, engaged in seasonal transhumant migrations in earlier Magdalenian times and continued that pattern after reindeer, horses, and bison populations diminished and faded from terminal Pleistocene landscapes.

As discussed above, only a limited number of high altitude archaeological surveys have been conducted in the French and Spanish Pyrénées, surveys which potentially could identify evidence for late Pleistocene and early Holocene high altitude hunting (cf. Ballbè *et al.* 2016, 2017; Champagne and Le Couédic 2012; Le Couédic and Champagne 2013). At least four factors have limited high altitude archaeological surveys in the highest Pyrénées: 1) the absorbing attraction of archaeologists to numerous well-stratified, protected cave and rock-shelter sites in the mountain system's limestone formations, 2) the modern presence of heavy archaeology-concealing ground-cover, 3) the presence of often steep and heavily eroded terrain that has removed and obscures surface camp and game kill sites, and 4) an intensive pattern (often seasonal and pastoral in nature) of high mountain land-use activities since Neolithic times, e.g. later period use of mountain landscapes, obscuring earlier (Late Pleistocene-Early Holocene) occupations by co-opting and destroying evidence of their original presence (cf. Bal *et al.* 2020; Galop 2006; Galop *et al.* 2013; Leigh *et al.* 2015). Recent examples of upper montane (~1350 m a.s.l.) archaeological surveys in the eastern Pyrénées in France's Larrau commune illustrate the relative abundance and nature of Neolithic and later structural features (pastoralist huts, stock animal enclosures, rock walls, etc.) which could overlie (and conceal) mountain benches and hollows used for earlier ephemeral Magdalenian and Azilian hunting camp, game blinds, or kill localities (cf. Champagne and Le Couédic 2012: structure 23, p. 48, structure 28, p. 53, structure 55, p. 29; Le Couédic and Champagne 2013: structure 58, p. 80, structure 60, p. 84, structure 64, p. 94).

Systematic efforts to identify more such evidence would go far in completing our picture of late Ice Age subsistence patterns in the Pyrénées, and, if found, would provide important clues about its general nature and meaning, a development which might benefit from lessons learned from high altitude archaeological research in the Colorado Rocky Mountains, described below. There is evidence, in the form of sea mollusks recovered from the Pastou Cliff and other western Pyrénéan sites, that seasonal migrations were undertaken to the nearby Atlantic coast, presumably during the summer months. There is also direct evidence of whale bone artifacts being transported for distances of up to 350 km from the Atlantic Coast (western Pyrénées) to the eastern Pyrénées during the Middle and Late Magdalenian periods (ca. 17,500-15,000 ^{14}C cal b.p.) (Pétillon 2013), demonstrating the existence of coastal-inland interaction networks along the Pyrénées mountain chain in Late Glacial times. Further, as noted earlier, paleoenvironmental and archaeological faunal evidence suggest the existence of north slope Pyrénéan lowland-upland seasonal migration of reindeer and (later) red deer herds to mountain alpine tundra pastures prior to 15,700 ^{14}C cal yr b.p. As early as 1977, Bahn (1977: 247) commented on the likely former existence of such migrations, observing that:

> "Modern-reindeer migration patterns suggest that short-range movement of no more than 50 km would have only occurred in situations where environmental change was considerable within a small area; obviously this requirement exists in the Pyrénées, but this does not alter the fact thatman had to move with the reindeer."

In 1973, French archaeologist Robert Arambourou proposed that the Gave d'Oloron sites may have constituted a dispersed Magdalenian "village" from which its inhabitants followed reindeer herds into mountain pastures in the late spring and summer. Bahn (1977: 248) later commented that, while direct evidence for seasonal high altitude hunting patterns in the late Pleistocene Pyrénées was, at that time, still absent:

> "There is little evidence for late glacial occupation of the higher reaches of the Pyrénées, but this may be due to both the traditional concentration by archaeology on the lower chain, and to the probability that summer sites were transitory, leaving little or no trace of dwellings made presumably of organic materials."

The relative lack of archaeological investigations in higher reaches, e.g., upper montane and alpine tundra zones, of both the French and Spanish Pyrénées, likely due to a lack of expectations for success in high altitude surveys due to challenging steep terrain, past erosion of sites in that steep terrain, often heavy surface-concealing ground cover, and the ephemeral nature of prehistoric hunting camps and game kill localities (cf. Ballbè *et al.* 2016, 2017). At the same time, lower and mid elevation Pyrenean valleys and foothills with their archaeologically rich caves, rock shelters, and river terrace sites have proved far more attractive to generations of French and Spanish archaeologists. A similar situation of poor expectations for high altitude archaeological evidence once existed in this article's other comparative region, the southern Rocky Mountains (USA) (cf. Pitblado and Brunswig 2014: 63-65). However, after more than three decades of expanding high altitude Rocky Mountain cultural landscapes research, it has been shown that archaeological investigations in such environments can be extremely rewarding for producing evidence on seasonally migratory lifestyles in diverse, vertically distributed mountain ecosystems. Unfortunately, research programs to fill that gap of knowledge in Pyrenean prehistory remain few and far between although progress has been made in recent years.

From the above evidence, this author would conclude that seasonal transhumance in the Pyrénées-Atlantiques region (and beyond in the central and eastern Pyrénées) certainly existed and was a key component of Middle to Upper Magdalenian (and likely subsequent Azilian) subsistence behavior. Evidence for Late Pleistocene high altitude and cross-Pyrenean cultural activity is documented by the earlier described Larrau commune Magdalenian-Azilian site of Grotte de Leherreko at 630 m a.s.l. and from Pyrénéen western near-coastal and more southerly Cantabrian (Spain) archaeological research. Utrilla and Mazo (1996) have pointed out close stylistic similarities of archaeological assemblages from Spanish and French at Upper Magdalenian and early Azilian sites in the western Pyrénées and the fact that several lower (350-1600 m a.s.l.) passes in the region allowed easy access to either side of the Pyrénéan divide and to upper montane, ecotone, and alpine tundra pastures. Those same passes, and the valleys that access them, would have provided important migratory routes to late Pleistocene-early Holocene summer game territories.

Further east of the Pyrénées-Atlantiques region, there are a growing small number of excavations on the southern (Spanish Catalonian) side of the eastern Pyrénées which provide evidence for high altitude exploitation of mountain environments and human crossing of the Pyrénéan divide in the Late Pleistocene, among them the open-air site of Montleó at 1100 m a.s.l. (Mas *et al.* 2018; Sanchez *et al.* 2017, 2019a, 2019b; 2019c). Although those sites are some distance from the western Pyrénées-Atlantiques region, they provide evidence that high altitude sites were in use during the Late Pleistocene once the Pyrénées' glacial maximum ended. Montleó produced Magdalenian occupation deposits along with Lower and early Middle Magdalenian radiocarbon dates between 20,135 and 18,535 ^{14}C cal yr b.p. (Sanchez *et al.* 2019a: 2376). It is significant that Montleó not only documents a very early high altitude Magdalenian mountain presence, but produced Magdalenian tools made from French lithic material transported from the opposite (northern) side of the Pyrénées (Sanchez *et al*. 2017, 2019a, 2019b, 2019c).

Gordon (1988: 151-152), in his study of Upper Paleolithic reindeer hunting in southern France, suggested that Arudy Basin (mid-Ossau Valley) Magdalenian sites, upstream from the Pastou sites, should, based on seasonal occupation data from reindeer skeletal elements at Poeymaü, be interpreted as reflecting their occupation "in late spring when herds were ascending to Pyrenean valleys to the calving grounds and in July [summer] when descending." More recently, Arudy cave and rock-shelter site (at ~400 m a.s.l.) excavations (described above) along the eastern Pyrenean upper foothills-mid-mountain boundary showed they were occupied immediately after recession of the LGM Ossau Glacier by earlier Middle Magdalenian hunter-gatherer bands between 20,000-19,000 ^{14}C cal yr b.p., occupations that continued at some Arudy sites into the Azilian Period through the end of the Pleistocene and into the early millennia of the Holocene. Figure 8 shows a cross-section profile illustration of the Pyrénées' that visually models how a Late Pleistocene-early Holocene transhumant hunting system might have functioned in the Pyrénées, with Magdalenian and Azilian hunter-gatherers moving from lower to higher elevations and seasonally crossing through its foothills-mountain environmental zones.

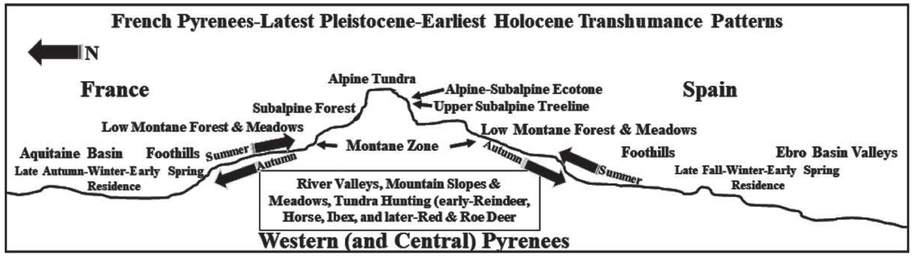

Figure 8. East-facing cross-section profile of the western and central Pyrénées showing altitude-defined environmental zones through which Magdalenian and Azilian hunting bands would have moved in seasonal transhumant migrations following regionally available game species.

Paleoindian Archaeology of North Central Colorado's Rocky Mountains

Three decades ago, Black (1991) and Frison (1992, 1997) proposed models for earliest development of Native American mountain-adapted cultural traditions in the USA's southern and central Rocky Mountains, from Paleoindian (no later than 10,000 ^{14}C cal yr b.p.) through late Prehistoric times (ca. 500 b.p.). Archaeological evidence for mountain resident and culturally-adapted traditions in north central Colorado's southern Rockies are now well-defined by decades of earlier field studies (Benedict 1981, 1985, 1992, 1996; Cassells 1995; 2000a; Cassells [editor] 2000b; Husted 1962; Kornfeld and Frison 2000; Kornfeld *et al.* 1999) and, more recently, by the author's own University of Northern Colorado (UNC) surveys and site excavations (1998-2003) in Rocky Mountain National Park (RMNP) and the neighboring interior mountain North Park Valley (2003-2020). Prior to the RMNP project, documentation of an early (Paleoindian) mountain presence in the southern Rocky Mountains, with the exception of Middle Park (University of Wyoming), west of RMNP, the San Luis valley (Smithsonian Institution) in the southeastern Rockies, and the Gunnison Basin in the southwestern Rockies,

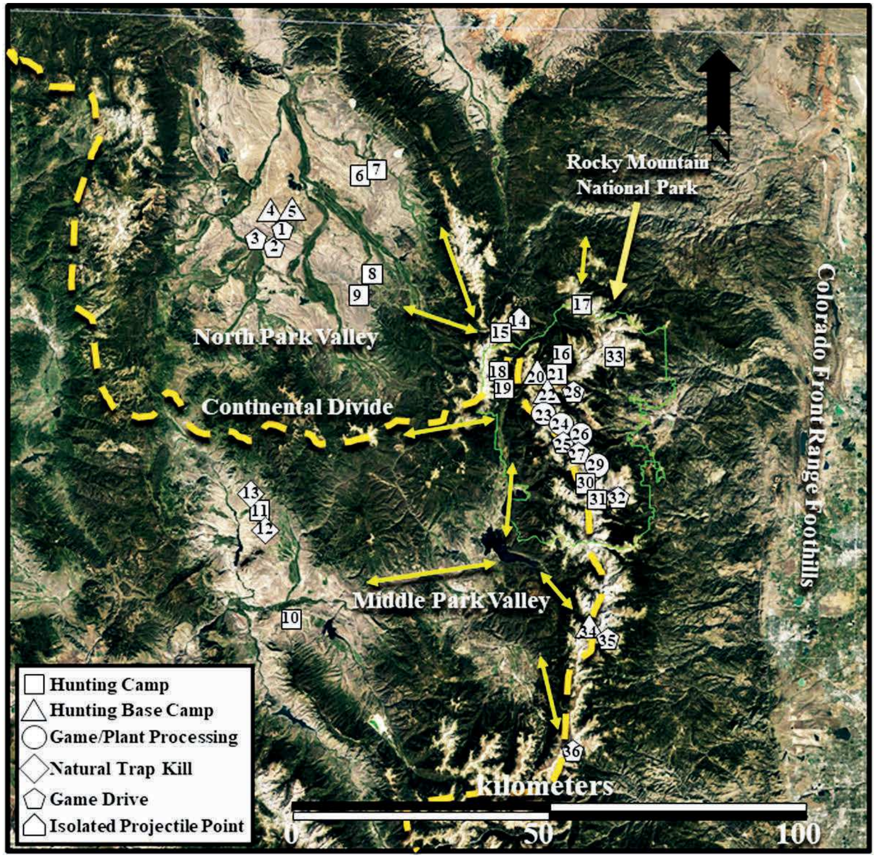

Figure 9. Map of Selected Valley Basin and High Mountains Paleoindian sites (and site types) which made up latest Pleistocene/Early Holocene Seasonal Transhumant Hunting System in the north central Colorado region of the southern Rocky Mountains. Double-ended arrows illustrate some of the more commonly used migratory routes between lower (basin valley) and high altitude hunting territories.

Key to map sites: **1**. Buffalo Ridge (5JA321) Extensive Game Drive System, Late Paleoindian (Agate Basin, JAF, Angostura) Sagebrush Steppe; **2**. Peterson Ridge (5JA1475) Game Drive System (Late Paleoindian-Cody, JAF) Sagebrush Steppe; **3**. 5JA1804 (Peterson Ridge) Ridge Slope Swale Game Drive (Late Paleoindian-Agate Basin) Sagebrush Steppe; **4**. 5JA304 (Antelope Springs West) Spring Hunting Camp, Base Camp for Buffalo Ridge Game Drive System (Late Paleoindian [2]-Type Indet.) Sagebrush Steppe; **5**. 5JA320 (Buffalo Ridge) Game Drive Base Camp (Late Paleoindian-Agate Basin, JAF, Angostura) Sagebrush Steppe; **6**. 5LR421 (Ballinger Draw) Hunting Camp (Late Paleoindian-Angostura, JAF) Sagebrush Steppe; **7**. 5JA1810 (Ballinger Draw) Hunting Camp (Early Paleoindian-Goshen; Late Paleoindian-Agate Basin, Angostura, and JAF) Sagebrush Steppe; **8**. 5JA1183 (Spring Creek) Hunting Camp (Late Paleoindian-Cody, Hearth AMS date median age, 10,550 cal yr b.p.) Sagebrush Steppe; **9**. 5JA47 (Eastern Owl Ridge) Hunting Camp (Late Paleoindian) Sagebrush Steppe; **10**. 5GA195 Barger Gulch, Locality B (Middle Park) Camp Site (Early Paleoindian-Folsom; Hearth area AMS date ave. *12,560 cal yr b.p.*) Sagebrush Steppe; **11**. 5JA295 Upper Hay Springs (Middle Park) ►

Colorado Rockies, had been limited (see Brunswig 2001b:439-441; Pitblado and Brunswig 2014a: 53-62). However, from 1998 through 2008, UNC archaeologists field-surveyed 132 km^2 in RMNP from its lower elevation montane valleys to its highest alpine tundra, recording more than four hundred prehistoric sites, including thirty-seven with Paleoindian occupations (cf. Brunswig 2003a, 2014a; 2015b). A second mountain research program by UNC, the North Park Cultural Landscapes Project, conducted surveys and excavations in the interior montane North Park Valley northwest of RMNP between 2003 and 2020, intensively surveying an area of 6 km^2 and recording twelve sites with Paleoindian occupations. Figure 9 shows locations of selected Paleoindian sites in the north central Colorado mountain region, discussed in the section below.

A Cultural-Chronological Framework for Southern Rocky Mountain Paleoindian Archaeology

In 1999, Pitblado (1999a: 202-205; 2003:13-15) proposed a southern Rocky Mountain Paleoindian cultural framework with two developmental periods: early (ca. 13,200-12,000 ^{14}C cal yr b.p.) and late (12,200-7,800 ^{14}C cal yr b.p.). She later refined her definition of the Late Paleoindian Period, incorporating elements of previous mountain Paleoindian occupation models proposed by Black (1991), Frison (1992, 1997), and Husted (1962), as including a recognizable year-round mountain-residential pattern, rather than a seasonally in-migrating

◄ Camp Site (Early Paleoindian-Folsom) Sagebrush Steppe; **12**. 5GA639 Jerry Craig (Middle Park) Bison kill site (Late Paleoindian-Cody;AMS date median age *10,740 cal yr b.p.*) Sagebrush Steppe; **13**. 5GA1513 Upper Twin Mountain (Middle Park) Bison kill site (Early Paleoindian-Goshen-Plainview; AMS date ave. *12,230 cal yr b.p.*) Sagebrush Steppe; **14**. 5LR11261 (Poudre Pass, RMNP) Isolated Find, Late Paleoindian-Agate Basin Projectile Point) Subalpine Forest Stream-bank Meadow; **15**. 5LR10242 (Poudre Pass, RMNP) Pass hunting camp (Early Paleoindian-Clovis Point) Subalpine Forest Meadow; **16**. 5LR9826 (Cache La Poudre, RMNP) Camp (Late Paleoindian-JAF) Montane; **17**. 5LR10210 (Mummy Pass, RMNP) Hunting Camp (Late Paleoindian-JAF) Alpine Tundra; **18**. 5LR90 (Specimen Mountain, RMNP) Camp, Quarry and Tool Manufacturing (Early Paleoindian-Clovis, Late Paleoindian-Cody, James Allen-Frederick, Angostura, and Lovell Stemmed-Constricted) Alpine Tundra; **19**. 5GA2537 (Milner Pass, RMNP) Hunting Camp (Early Paleoindian-Goshen-Plainview) Subalpine; **20**. 5LR2 (Forest Canyon Pass) Game Drive Base and Trail Camp (Early Paleoindian-Folsom, Late Paleoindian Agate Basin, Cody, JAF, Mountain Paleoindian) Subalpine Forest; **21**. 5LR12141 (Forest Canyon Pass, RMNP) Hunting Camp (Late Paleoindian-Cody) Subalpine Forest; **22**. 5LR12138 Game Drive Base Camp (Forest Canyon Pass, RMNP) (Late Paleoindian-Angostura) Subalpine Forest; **23**. 5LR81 Game Processing Site (Mt Ida Ridge, RMNP) (Late Paleoindian) Alpine Tundra; **24**. 5LR327 Game Processing Site (Mt Ida Ridge, RMNP) Late Paleoindian) Alpine Tundra; **25**. 5GA1095 Game Drive (Mt Ida Ridge, RMNP) (Late Paleoindian-JAF) Alpine Tundra; **26**. 5LR7108 Game Processing Site, accessible to both Mt Ida Ridge (RMNP) Game Drives (Late Paleoindian-Late Mountain Paleoindian) Alpine Tundra; **27**. 5GA2002 Game Drive Mt Ida Ridge (Late Paleoindian-James Allen-Frederick) Alpine Tundra; **28**. 5LR15 Game Drive (Trail Ridge, RMNP) (Late Paleoindian-Cody) Alpine Tundra; **29**. 5GA2262 (Bighorn Flats, RMNP) Game Processing Camp (Late Paleoindian) Alpine Tundra; **30**. 5GA2721 (Bighorn Flats, RMNP) Hunting Camp (Late Paleoindian-JAF) Ecotone; **31**. 5GA2712 (Bighorn Flats, RMNP) Hunting Camp (Late Paleoindian) Alpine Tundra; **32**. 5LR6 (Flattop Mountain, RMNP) Game Drive (Late Paleoindian-Cody, JAF) Alpine Tundra; **33**. 5LR318 (Lawn Lake, RMNP) Hunting Camp (Late Paleoindian-Angostura; two AMS dates, upper level, 7,960 cal yr b.p., lower level 8,930 cal yr b.p.) Subalpine Forest; **34**. 5GA22 (Caribou Lake, Arapaho Pass) Hunting Camp, Base Camp (Late Paleoindian-JAF, Angostura; two hearth dates, ave. date *8,810 cal yr b.p.*) Subalpine Forest; **35**. 5BL120 (Fourth of July Game Drive) Game Drive System (Late Paleoindian-JAF, Mountain Paleoindian) Alpine Tundra; **36**. 5BL3440 (Devil's Thumb Game Drive) Game Drive System (Cody, JAF, Angostura; granite weathering date of drive wall boulder, ~10,000 b.p.) Alpine Tundra.

(mountain visitation) or migratory transient (temporary resident groups passing through the mountains) pattern. Pitblado (2014), along with Frison (1992, 1997; Kornfeld *et al.* 2010: 95-106), and others, argued that some Paleoindian projectile point types (e.g., Angostura and Mountain-Foothills types) were created over time as integral parts of native mountain tool-kits, in contrast to other Early and Late Paleoindian point types, e.g. Agate Basin, Hell Gap, Cody-Firstview, James Allen, and Frederick, which originated outside mountain regions and often proposed to have appeared in those regions primarily through short-term forays from adjoining foothills, plains, plateaus, and non-montane basin and river valleys (cf. Kornfeld *et al.* 2010: 73-94; Pitblado 2003: 52-59, 81-97, 104-112). Table 2 shows the chronological order listing of Paleoindian cultures/techno-complexes that have been documented in the southern Rocky Mountains along with their respective calendar-age radiocarbon time ranges.

Unlike Late Pleistocene and Early Holocene cultural traditions in the Pyrénées, American Rocky Mountain Paleoindian cultures are primary distinguished by evolving variations in technically and chronologically-defined projectile point types rather than the wider range of culture traits used to define Late Pleistocene-Early Holocene French Pyrénéan culture traditions (e.g. Magdalenian, Azilian, Laborian), including distinctive variants in lithic tool types and parietal (cave wall surface) and mobile (carved bone, antler, decorated or carved stone) art.

The region's early Paleoindian phase began with its earliest verified cultural tradition (e.g., techno-complex), the Clovis culture (ca. 13,550-12,770 ^{14}C cal yr b.p., Table 2), characterized by a distinctive, bifacially-flaked medium to large leaf-shaped projectile point, usually with short

Table 2. Southern Rocky Mountain Paleoindian Culture Complexes and their Calendar-Age Radiocarbon Chronologies

Southern Rocky Mountain Paleoindian Phases and Associated Techno-Complexes[1]	Calendar-Age (Calibrated Age) Range[2]
Early Paleoindian Phase	*Clovis*-13,550-12,770 cal yr b.p. *Folsom*-12,770-12,160 cal yr b.p. *Goshen-Plainview*-12,500-11,800 cal yr b.p.
Late Paleoindian Phase (western North American Generic)	*Agate Basin*-12,210-10,590 cal yr b.p. *Cody-Firstview-Eden*-10,860-9,350 cal yr b.p. *Angostura*-11,040-8,350 cal yr b.p. *James Allen/Frederick*-10,560-8,900 cal yr b.p.
Late Mountain (or Mountain-Foothills) Paleoindian	*Lovell Constricted, Pryor Stemmed, Concave Base Stemmed*-10,560-8,500 cal yr b.p.

[1] Primary techno-complex (culture), projectile point type definitions and compiled radiocarbon-date chronologies sources are assembled from Benedict and Olson 1978; Brunswig 2007, 2012; Chenault 1999; Gilmore 1999; Kornfeld *et al.* 2010; Miller *et al.* 2013; Pitblado 2003: 79-124, Table 5.12; Surovell *et al*. 2016; Tate 1999.
[2] Calendar-age date ranges. Corrections for past radiocarbon fluctuations are based on Oxford University's on-line Oxcal 4.4 calibration program (cf., Reimer *et al*. 2013). All calibrated dates are rounded up (or down) to the nearest tenth (decadal) number. Each culture period date range consists of start and end dates each calculated as median averaged dates of Oxcal calibrated age ranges.

basal fluting (cf. Morrow 2019). Clovis is chronologically (and to some degree technologically) succeeded by later early Paleoindian sites containing chronologically overlapping Folsom and Goshen-Plainview techno-complexes (12,770-11,800 ^{14}C cal yr b.p., Table 2), defined by their own distinctive Folsom (Sellet 2004) and Goshen/Plainview (Neeley 2018) projectile point types.

Pitblado's Late Paleoindian Period proposed two broadly overlapping early and late sub-phases, each associated with their own sets of projectile point types, defining them as cultures or techno-complexes (cf. Pitblado 2003: 79-144). The early sub-phase (12,210-9,350 ^{14}C cal yr b.p; Table 2) includes rare sites with mountain-associated Agate Basin, Haskett I and II, Hell Gap, and Cody Complex/Techno-complex (Eden-Firstview, San Jon, and Scottsbluff) projectile point types while the late sub-phase is represented by Angostura, James Allen-Frederick, and Lovell Constricted projectile points. In addition to projectile point form differences, earlier phase projectile point types (Agate Basin, Haskett, Hell Gap, and Cody) are generally distinguished by often distinctive parallel-transverse (horizontal) thinning flake scars across their faces while late phase types (Angostura, James Allen-Frederick, Lovell-Constricted, Pryor Stemmed, Concave Base Stemmed) typically have parallel-oblique (angled) flake-scarring patterning. Slightly later late phase point types (10,560-8,500 ^{14}C cal yr b.p., Table 2) are represented by Lovell-Constricted, Pryor Stemmed and Concave Based Stemmed points. One Late Paleoindian projectile point type, Angostura, is viewed by Pitblado (2014) as clearly representing a mountain-developed artifact, present in the southern (and central) Rockies throughout the Late Paleoindian sub-phase, ca. 11,040-8,350 ^{14}C cal yr b.p.

Paleoindian Cultural Adaptations and Site Patterns of the North Central Colorado Mountain Region

The existence of Early Paleoindian phase components is moderately well-documented in southern Rocky Mountain interior valleys and Front Range foothills-plains areas east of the Rockies (Chenault 1999; Frison 1991; Kornfeld 1998a; Kornfield and Frison 2000; Kornfeld *et al.* 1999). Earliest Clovis techno-complex sites and isolated projectile point finds occur as very rare short-term open-air camps, kill-butchering localities, and occasional isolated projectile point finds (assumed to have been lost during hunting). Its presence in the north central Colorado region, described below, is strictly limited. Only a very small number of Clovis sites occurring in western USA mountain regions are defined by excavations and/or radiocarbon-dated cultural materials (cf. Pitblado 2017: 72-75, Fig. 8). In north central Colorado, along with rare Clovis camp sites and isolated projectile point finds, the best documented Early Paleoindian components are post-Clovis in date and found in the Middle Park Valley, immediately west of Rocky Mountain National Park, where Folsom and Goshen-Plainview kill deposits represent "late fall-early winter bison procurement [for] a year-round occupation" (Kornfeld *et al.* 1999: 672; see also Kornfeld and Frison 2000: 147-148; Surovell *et al.* 2001; Figure 9, nos. 11, 12, 13). Tool materials from early phase Middle Park sites are almost exclusively made from locally available chert, jasper, and quartzite (Kornfeld 1999: 669-671; Kornfeld and Frison 2000: 145-147; Kornfeld *et al.* 2001), providing evidence of an intimate local knowledge of inner montane lithic sources. The earlier, limited Clovis-age evidence has been primarily documented in nearby Rocky Mountain National Park in the form of Clovis projectile points recovered from multi-component (representing occupation from several cultural periods) open camps in the La Poudre (3108 m a.s.l.) and Milner mountain passes (Figure 9, no. 15 and 18). A second complete point and two probable Clovis point fragments came from lower montane forest zones (2280-2680 m a.s.l.) and a single Clovis point base, placed in the park's museum collection in 1932, is attributed as having come from RMNP's Trail Ridge area in modern-day alpine tundra (3600-3780 m a.s.l.). Four of the above Clovis artifacts were made of inner mountain valley (Middle Park) materials, providing support for existence of an evolving mountain-adapted subsistence and raw materials procurement system prior to 12,770 ^{14}C cal yr b.p. (Brunswig 2001c, 2003b). In contrast to later Middle Park Folsom (post-Clovis) sites, there is little evidence for presence of that culture in Rocky Mountain National Park or in high elevation mountain areas to the south or north (Brunswig 2004a, 2014a: 275). The only Folsom artifact found in RMNP was a reworked, and possibly "curated" (brought to the location by a later group), projectile point from a large multi-component camp in the upper subalpine-alpine ecotone at Forest Canyon Pass (3450 m a.s.l.) (Figure 9, no. 20). Benedict (2000: 162-164, Fig. 5.4b) documented a Folsom point in a private artifact collection from the Fourth of July Mine site (Arapaho Pass), but it was heavily reworked and may have also been curated and transported to the site by a later group. The only other Early Paleoindian presence in Rocky Mountain National Park consists of a Goshen-Plainview projectile point recovered from a small upper subalpine forest camp on Milner Pass (3260 m a.s.l.) (Figure 9, no. 19). While several late phase Paleoindian sites have been documented from lower elevation western divide mountain valleys of Middle and North Park (Kornfeld and Frison 2000: 138-143; Lischka *et al.* 1983: 165-167), UNC surveys and park museum collection studies recently documented thirty-two sites with late phase Paleoindian components and isolated projectile point finds of forty-two individual artifacts. The majority of late phase components, 47%, were found in modern alpine tundra while 31% occurred in alpine-subalpine ecotone zones, all above 3300 m a.s.l. (Brunswig 2003a, 2014a: 290). Late period projectile point types include those belonging to the Agate Basin Complex, Cody Complex (Eden, Scottsbluff I and a single Cody knife), with some Cody artifacts having parallel-oblique flaking patterns rather than the more common parallel-transverse flaking pattern, and a wide variety of other types such as James Allen-Frederick, Angostura, early and late Pryor Stemmed, and Lovell Constricted, and Pryor Stemmed, collectively dating between 12,210-8,500 ^{14}C cal yr b.p. (see Pitblado 1999a, 2003: 94-127, Table 5.12 for dates and formal definitions; Table 2 above). Early Late Paleoindian phase mountain occupations demonstrate the earliest definitive high altitude adaptations by ca. 12,210 ^{14}C cal yr b.p. RMNP has produced two Agate Basin components; an Agate Basin projectile point placed in its museum collection in 1932 and recorded as having come from (or from the vicinity of) a major site (5LR2) in Forest Canyon Pass (3450 m a.s.l.) (Figure 9, no. 20) and a fully intact Agate Basin projectile point (5LR11261) recovered from the park's La Poudre Pass (Figure 9, no. 14; elevation-3,102 m) by a hiker in 2006 (Butler 2006). The latter point was made of Palmer Divide petrified wood from Colorado's Front Range foothills, east of the Rocky Mountains.

Agate Basin, Cody, Angostura, James Allen/ Frederick and Great Basin Stemmed projectile points from RMNP were also recorded in twelve alpine tundra sites (fourteen points in all), at nine alpine-subalpine ecotone sites (seventeen points), and at six upper subalpine sites (six points). None were located in montane zone forests or meadows. Three sites with early phase Cody (Eden and Scottsbluff) projectile points at high mountain elevations have been recorded outside RMNP in the Indian Peaks Wilderness south of the park at the Fourth of July Mine site in the Arapaho Pass area (Benedict 2000: 163-167, Figs. 5.5y, z, 5.8). Adjacent to RMNP, the Middle Park valley has produced several Cody sites, including the Jerry Craig bison kill site (Logan *et al.* 1998; Richings 1998; Figure 9, no. 12). Middle Park Cody lithic assemblages consist entirely of artifacts made of local cherts, jaspers, and quartzites. Seasonality studies of Jerry Craig bison skeletal remains showed a summer-early fall bison procurement pattern. Subsequent late phase components related to Angostura and James Allen/Frederick point types are common at alpine and alpine-subalpine ecotone sites in Rocky Mountain National Park (sixteen in all) while several related sites are known from nearby Middle Park. One Middle Park site, Williams Fork Reservoir, was the source of twenty-eight James Allen individual projectile point fragments, documented from a private collection (Kornfeld 1998b:50-51; Wiesend and Frison 1998). James Allen/Frederick projectile points and point fragments have been radiocarbon-dated to 8,930 ^{14}C cal yr b.p. at the park's Lawn Lake site (Brunswig 2001a, 2001c; Brunswig and Doerner 2021: 24) and between 10,280 and 8,820 ^{14}C cal yr b.p. at the Caribou Lake site below Arapaho Pass (Pitblado 1999b, 2000: 138-146). The most recent late phase components from RMNP, with Pryor Stemmed and Concave Based Stemmed point types, are rare, although some early phase types (Angostura and James Allen-Frederick) overlap Pryor Stemmed and Concave Base Stemmed types in age. UNC's park investigations documented only two alpine sites and one alpine-subalpine ecotone site with Pryor Stemmed points.

Lithic Source Materials and Lowland-Highland Paleoindian Transhumance

Detailed analysis of lithic material sources of Paleoindian projectile points in RMNP suggests an overwhelming dependence (~72%) on 'local' [interior] mountain valley sources rather than the eastern Front Range foothills and plains (Brunswig 2003a, 2005: 181-182, 2015b: 48-49). 41% were made of Kremmling chert and Table Mountain jasper from Middle Park while an additional 31% were made of Dakota orthoquartzite, a material from a geological formation and ancient river lag deposits in Middle Park and North Park. The remaining 28% of the park's Late Paleoindian projectile points came from exotic Wyoming sources to the north and northwest. Lithic sourcing evidence supports the hypothesis that Late Paleoindian Phase (ca. 12,210-8,500 ^{14}C cal yr b.p.) sites in Middle Park and other interior mountain valleys west of the continental divide represent winter-spring camps and late summer-fall bison kills (cf. Brunswig 2015b: 49-52; Brunswig and Doerner 2021). The presence of Late Paleoindian projectile point types at high elevations in RMNP that were manufactured predominantly with Middle Park and North Park lithic source materials supports the hypothesis that many, if not most, high mountain Paleoindian hunting bands wintered in those interior valleys and seasonally (summer-fall) migrated to alpine tundra hunting territories in the park and neighboring mountain ranges to the north and south.

Late Paleoindian Hunting Systems and Site Types

High altitude Paleoindian occupations occur as isolated finds of culturally diagnostic biface (projectile point) types, single component lithic scatters associated with culturally diagnostic points or point fragments, open camps in protected topographic settings with single or multi-component deposits (with Paleoindian *and* later periods being represented), and as parts of former hunting systems, often referred to as game drives. Hunting systems were situated in topographic settings where animals (elk, bighorn sheep) could be ambushed as they moved along game trails, during daily forage movements, or were "maneuvered" into natural and/or artificial traps. Hunting systems research in Colorado's southern Rockies has been particularly productive in recent decades. More than fifty mountain hunting systems, most in upper subalpine or alpine environmental zones, have been recorded in north central Colorado (Benedict 1992, 1996; Brunswig 2001b, 2001d, 2002a, 2002b, 2003a, 2003c, Brunswig 2015b; Brunswig and Doerner 2021; Cassells 1995, 2000b; Cassells [editor] 2000). Colorado mountain Paleoindian (and later) hunting systems represented empirical solutions for acquiring game animals, utilizing local environmental variables and specialized topographic features (e.g., wind patterns, natural concealment, ease of access for retrieving and processing animals, and exploiting specific instinctive behaviors of various prey species). They often, but not always, relied on the use of existing natural features, e.g., steep slopes, saddles, drainage swales, and boulder fields or rock outcrops, or involved enhancement of natural features through construction of linear rock walls and/or oval to circular rock wall blinds. While environmental zone tiered (e.g. montane-subalpine-ecotone-tundra) hunting systems with lower elevation and longer-term residence (centrally organized collector-oriented system) base camps, designed to access and support higher elevation and short-term use game drives and game/plant processing areas, were common in the north central Colorado Rockies (cf. Brunswig 2015b: 91-93; Kelly 1992, 1995, 1998, 2013), some small hunting camps (see Brunswig and Doerner 2021) do not appear to have been associated with lower hunt base (staging) camps and likely represented a more persistently mobile foraging hunt strategy. In the southern Rocky Mountains, hunter-gatherer sites, whether part of a longer-term residential base camp/hunting territory (game drive) or short-term hunting camp foray (based in a more frequently mobile hunting camp system) are almost invariably multicomponent, representing time-persistent mixed hunting and processing tool refurbishment activities by multiple cultural groups accumulated over millennia.

The above described data on early and late phase Paleoindian diagnostic artifacts and associated tool assemblages recovered from high altitude mountain and mid altitude mountain valleys suggest sites, including game drives, were generated by a mix of foraging and logistically-organized procurement strategies embedded in millennia-long and continually evolving seasonal transhumant migration patterns (Brunswig 2001b, 2003a, 2003c, 2015b: 49-52; Pitblado 1999a: 464-469, 2003: 272-277; Figure 10).

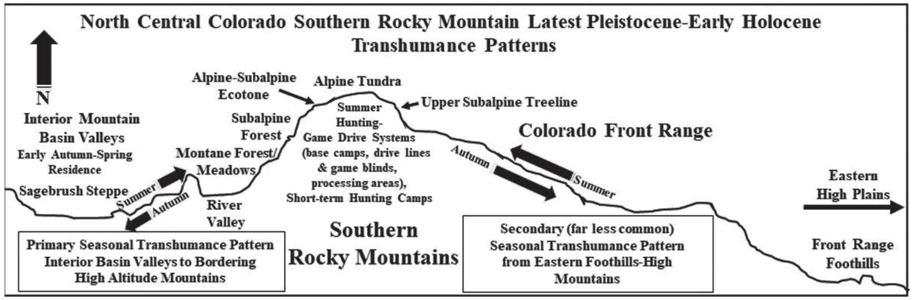

Figure 10. North-oriented profile of the eastern side of the north central Colorado Rocky Mountains study region, showing an archaeology-paleoenvironment based model of human-game animal seasonal transhumant migration patterns from (primarily) interior basin valley to high montane environmental zones, first established in earliest Holocene times. The model, based on available data-sets, shows only limited, but still present, seasonal migrations over time from lower-elevation eastern Front Range foothills into and from high mountain resource zones.

Both mountain economic systems, within a continually flexible foraging-collector spectrum, began in the Colorado Rocky Mountains during the terminal Late Pleistocene with the arrival of limited numbers of Clovis hunter-gatherers who, while leaving a small archaeological imprint on the landscape, moved over even the region's highest mountain tundra landscapes and, based on identified lithic material sources of mountain Clovis artifacts, were familiar with high-quality lithic stone tool resources in the region's sedimentary basin valleys of Middle Park and North Park (Brunswig 2003b, 2014a: 269-272). While arrival of the last cold climate pulse of the Pleistocene, in the form of limited Younger Dryas re-glaciation, restricted high altitude (subalpine and alpine zones) access by migratory herd animals and hunters, Folsom hunting bands in the lower-elevation Middle Park valley exploited Ice-Age bison (*Bison antiquus*) (Kornfeld 1998b; Kornfeld and Frison 2000; Surovell *et al.* 2001; Surovell and Waguespack 2014). With rapid post-Younger Dryas warming and onset of the Early Holocene, high mountain tundra opened to summer season ungulate (elk, big-horn sheep, and limited numbers of bison) grazing and Late Paleoindian hunters which seasonally migrated from the large basin valleys (North Park and Middle Park) west of Rocky Mountain National Park and, possibly, from Front Range foothills to the east. Whichever strategy prevailed among post-Folsom Paleoindian hunter-gatherers, either persistently mobile forging or longer-term residentially-based and logistically coordinated strategies, each would have considered factors related to game response-to-hunting behavior patterns, local game abundance, and variability in topography.

Case Descriptions of Paleoindian-Associated Valley and Mountain-top Game Drive Systems

The construction and use of game drives in both mid and high elevation mountain landscapes, many initially established by Late Paleoindian hunters, required specific topographic features, e.g., high steep-sided ridgelines in mountain basin valleys and open tundra grassland, steep mountain slopes, game-channeling swales, terrain-concealed ambush points (enhanced through rock wall game blind construction), and local availability of medium to large rocks for wall and blind construction in alpine tundra (Benedict 1996, 2002, 2005; Brunswig 2015b: 51-52, 62-84; Brunswig and Doerner 2008; Cassells 1995, 2000a; LaBelle and Pelton 2013). Game drive hunting in both mid- (basin valley) and high- elevation (ecotone and alpine tundra) mountain landscapes depended on hunters' intimate understanding of predictable individual animal and group (herd) behavior of the species being hunted, e.g., stimulating herd flight-responses to enter and traverse drive corridors into ambush zones bordered by strategically placed game blinds.

Fifty-four game drives have been identified, most on high-altitude tundra, in the north central Colorado mountains (cf. Cassells 2000a: 190; Labelle and Pelton 2013: 46-47, Fig. 1). In addition, recent years of archaeological research in the lower-altitude North Park basin valley have discovered and mapped more than a dozen game drives on intra-valley ridgelines, further expanding our understanding of mountain game drive systems during and since Late Paleoindian times (Brunswig 2008, 2016). One such drive system is the Buffalo Ridge Game Drive (2550 m a.s.l.) which is a 1.5 km long series of drive wall corridors and hunting blinds extending along the top of a 60 m high North Park ridgeline, northwest of RMNP (Figure 9, no. 1). Figure 11 illustrates the spatial organization of the drive complex which was surveyed and mapped at sub-meter (<30 cm) Global-Positioning System (GPS) resolution from 2012 through 2017. The system has fourteen individual rock-built drive lane walls, eighteen rock-wall game blinds, and hundreds of associated lithic artifacts, including butchering tools and projectile points.

Recovery of projectile point types throughout the drive system showed it developed, and was in near continuous use, as a multi-generation palimpsest (surface accumulation) of accumulated, temporarily abandoned, and often re-used and re-modeled sets of rock-and-sagebrush drive walls, game blinds, and stone tool refurbishment and butchering localities over the past nine millennia. Its long-term chronology and cultural complex affiliations are well-established by associated diagnostic projectile point types and radiocarbon-dates of surface-recovered historic period bison horns. Earliest Late Paleoindian elements of the system are documented by direct association with projectile point types, dated elsewhere in western USA regions by radiocarbon-dated sites between 10,560 and 8,900 ^{14}C cal yr b.p. (see Figure 11 and Table 2).

Evidence from several hunting base (hunt staging) and game processing camps adjacent to the game drive ridge shows that bison (*Bison bison*), documented by locally and regionally excavated post-Paleoindian skeletal remains, were a key prey species for the drive, along with pronghorn antelope (*Antilocapra americana*). Although the drive is associated with several hunt-staging and game-processing base camps, the most prominent site (see 5JA320 at the top of Figure 11) is situated at the northern base of the drive ridge near a natural spring. That camp, like the drive itself, produced a nine millennia-long record of projectile point types (including several Late Paleoindian points), along with hearths, butchering tools, and grinding stones

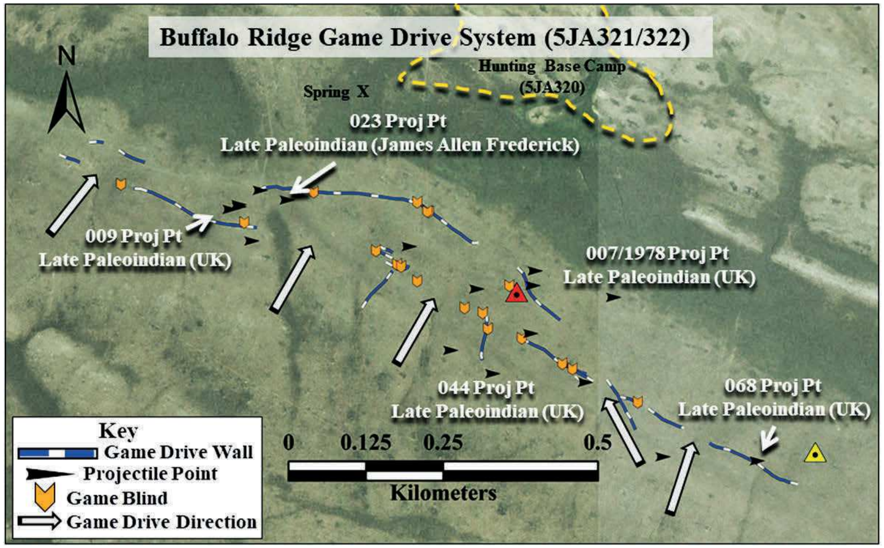

Figure 11. Computer-generated (GIS) model of the Buffalo Ridge Game Drive, situated on the top and upper south slope of a 30 m high, northwest-southeast ridge line in Colorado's North Park Valley. Drive walls (light and dark lines) and rock-wall game blinds (chevron symbols) show individual components (drive lane sub-sets) of the drive, accumulated over nine millennia of use. Black right-facing arrows show locations of hunt discarded or lost projectile points with only those of Paleoindian origin being labeled. A large multi-component (periodically occupied over nine millennia) hunting case camp is outlined at the top of the figure map.

for processing local food plants. Although it is unknown if the drive and its hunt-staging and processing camps represent multi-family hunting bands which seasonally gathered to operate the drive system, archaeological evidence suggests that a longer-term collector (logistically-organized) strategy was employed for its maintenance and operation.

A second game drive example, that of a high-elevation mountain system, is the Mount Ida Game Drive (5GA2002) in Rocky Mountain National Park (Figure 6, no. 27). The Mount Ida Game Drive (3645 m a.s.l.) (Figure 12) is located on a narrow alpine tundra ridge-top, directly on the continental divide (cf. Brunswig 2015b: 68-72). Its targeted game animals are believed to have been elk (*Cervus elaphus*) and Bighorn sheep (*Ovis canadensis*) which were hunted by being driven upslope from a mountain-side grazing area to a ridgetop kill zone blocked by rock walls and pit game blind pits. The drive, associated with several diagnostic projectile points, was in use from Late Paleoindian (James-Allen-Frederick) through Early Ceramic times, ca. 10,560-1,000 ^{14}C cal yr b.p. Stone butchering tools and lithic flakes from tool refurbishment and butchering activities were found concentrated north of the drive's kill zone. Sandstone grinding stone fragments, scattered several meters northwest of the butchering area, marked a locality for processing bistort (*Bistorta bistortoides*), an edible alpine root plant (Benedict 2007: 14-16; Brunswig 2015b: 70-72) that grows on the site today along with other alpine food plants. Meat may also have been dried and ground into powder on site for mixing with animal fat and bone marrow to make a nutrient rich food product known to some Native American tribes as pemmican. The grinding stone material was Lyons sandstone, transported to the site from geological formations in the eastern Front Range foothills, 80 km to the east. The abundance of Lyons Sandstone ground stone artifacts on alpine tundra game drives and hunting camps is one of the few lines of evidence in Rocky Mountain National Park for cultural interactions with the eastern Front Range foothills during the Paleoindian (and later) periods (cf. Brunswig 2015b: 88-89).

Logistical support for Late Paleoindian hunters at the Mount Ida Game Drive, and a second drive (5GA1095) on the same ridgeline to its northwest (Figure 9, no. 25), is believed to have come from several hunting base camps closely clustered in Forest Canyon Pass' upper subalpine forest (Figure 9, nos. 20, 21, 22), 3.4 km northeast of the game drives.

In addition to game drives, other Paleoindian mountain hunting evidence includes the earlier described Late Paleoindian bison kills in Middle Park (Figure 9, nos. 12 and 13), which, while not having produced evidence of drive architecture (e.g., rock walls and blinds), took advantage of natural trap terrain features, such as hillside ravines and erosion swales, to confine and ambush small bison herds (Kornfeld *et al*. 1999; Logan *et al.* 1998). Documentation of other ambush kill sites in the region's large basin valleys, while generally absent in the region's archaeological literature, is, in this author's view, lacking more to limited efforts to systematically identify such sites.

Short-Term Forager Hunting Camps

Small hunting parties, and more opportunistic, shorter-term (forager-based) hunting camp strategies in lower (montane and subalpine zone) *and* higher (ecotone and alpine) hunting territories emphasized the ambush of individuals or small groups of game animals by employing natural terrain and plant (trees and shrubs) features as cover (cf. Brunswig 2015b: 57-62; Brunswig and Doerner 2021: 34-35). Those tactics were distinct from the more organized (collector) system of construction and maintenance of built game drives with its use of drive-

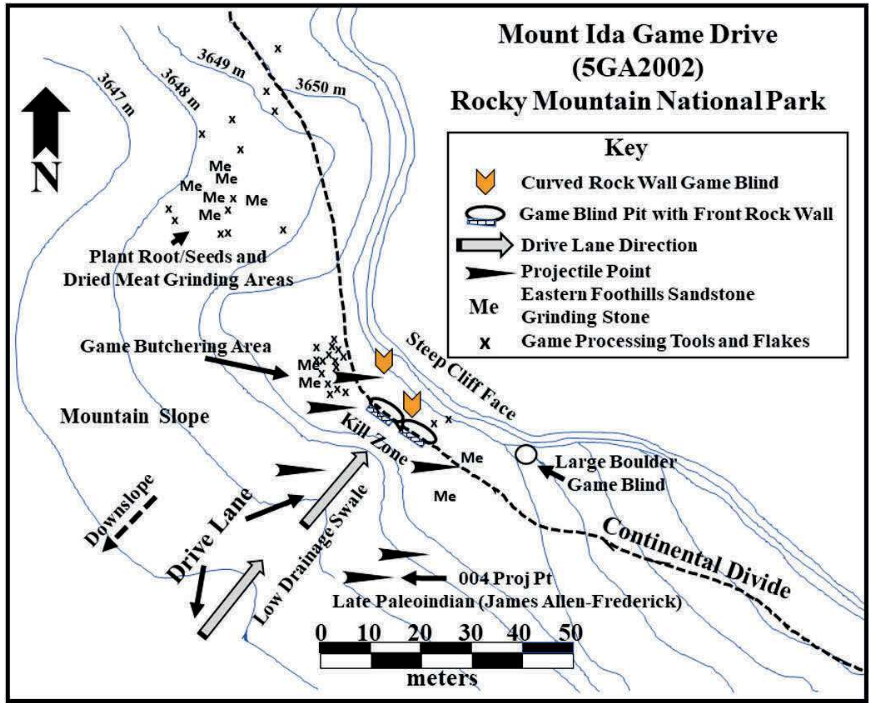

Figure 12. Map of the Mount Ida Game Drive at the top of the continental divide in Rocky Mountain National Park. The drive uses a shallow drainage swale to direct herd animals (elk) into a confined kill zone where hunters were concealed behind rock wall, pit and wall, and large boulder game blinds. Note projectile point locations, including a labeled Late Paleoindian James Allen-Frederick point, and game and plant product processing areas.

supporting (usually lower-elevation subalpine or ecotone zone) base (hunt staging and post-kill processing) camps and specialized activity (early stage processing and tool-refurbishment) areas. One example is the small multi-component Spring Creek hunting camp (2528 m a.s.l.), excavated by the author and his colleagues in the North Park valley (Figure 9, no. 8). The camp, which overlooks a natural spring, was in use for more than nine millennia and excavated faunal remains from its post-Paleoindian occupation levels showed its short-term occupants were engaged in hunting bison (*Bison bison*) and pronghorn antelope (*Antilocapra americana*). Its earliest Late Paleoindian occupation is documented by the surface-find of a Late Paleoindian Cody Complex projectile point and excavation of a deeply buried camp hearth that was AMS-radiocarbon dated (median calibrated range date) at 10,555 ^{14}C cal yr b.p. (Brunswig *in prep*; Figure 9, no. 8). A second short-term hunting camp, also unassociated with a game drive, is the Lawn Lake site (3355 m a.s.l.), located in RMNP's upper subalpine forest zone (Brunswig and Doerner 2021). Its lowest occupations consisted of multiple thinly layered (very short-

term) Late Paleoindian camp surfaces dating over a millennium. Artifacts recovered from the camp levels included a Late Paleoindian Angostura projectile point (from the earliest level) along with lithic butchering tools, a grinding stone fragment, lithic tool re-sharpening flakes, and two stratified hearths that were AMS-dated, respectively, at 8,930 and 7,960 ^{14}C cal yr b.p. (Brunswig and Doerner 2021; Figure 9, no. 33).

Ritual and Religion in Colorado Paleoindian Cultures

Unlike significant archaeological evidence for religious and ritual behavior in Pyrénéan cultural traditions, e.g., parietal, mobile art, and wall cracks and niche insertions of objects, in both inhabited and uninhabited caves where such evidence is protected from exposure from most natural elements, there is no equivalent evidence (or natural protection) for similar religious activities by southern Rocky Mountain Paleoindians. Given the integral role of religious beliefs and activities (e.g., rituals) in all human cultures, it is difficult to believe that Colorado Paleoindian hunter-gathers did not have a sophisticated belief system and parallel ritual behaviors to those documented in the Pyrénées. But absence of evidence, as one saying goes, is not evidence of absence. There is rare evidence of Paleoindian ritual behavior in the wider North American landscape. In a small number of cases, engraved bone, ivory, and stone artifacts, probable indicators of ritual activities and symbols, are known from a variety of Clovis and later Paleoindian sites (cf. Lemke *et al.* 2015; Walker *et al.* 2012: 698-700). Even rarer is Paleoindian rock art (petroglyphs), known in a very few cases in North America's Great Basin and central Rocky Mountains (cf. Malotki and Wallace 2011; Middleton *et al.* 2014; Walker *et al.* 2012: 701-707). Clovis lithic artifact caches, sometimes consisting of high quality unused Clovis projectile points, have been proposed to represent Paleoindian ritual behavior. Two well-known Paleoindian burials, Fenn and Anzick, are associated with projectile point caches (Pitblado 2017: 65-74). Both burials and their lithic caches are often associated with the use of red ochre powder, an iron hematite material associated with ritual ceremonies and behavior in both North American Paleoindian and European Paleolithic contexts (Roper 1992).

Even though there is no direct evidence of Paleoindian ritual behavior from the north central Colorado mountains, a later analogue for what a Paleoindian religious system in the region might have looked like does exist. Since the early 2000s, this author and his colleagues have conducted a sacred landscapes research program in the region, investigating built rock features on tundra mountain tops and valley ridgelines for their ritual rather than domestic or hunting system significance (cf. Brunswig 2005, 2020; Brunswig *et al.* 2009, 2010; Diggs and Brunswig 2013; Montgomery *et al.* 2020). Using a synthesis of archaeological, landscape GIS modeling, historic document analysis, and Native American tribal consultations, it has been documented that a sophisticated mountain-based religious system associated with prehistoric and historic Ute tribal ancestors existed in the north central Colorado Rockies from ca. 1,000 through 90 b.p. Its focus was on seasonally scheduled interactions with animal and mythic spiritual beings (e.g., animism and spirit world communication) and involved the construction and use of specialized rock-built ritual features (rock circles, dance rings, semi-circular rock walls, rock walls, altars…) in individual (e.g., vision-questing) and group rituals and ceremonies. It is suggested that an equivalent religious system was practiced by earlier Paleoindian occupants of the region but that its recognizable physical evidence has been largely erased by natural erosion and reworking by later Native American generations or has gone unrecognized in most mountain archaeological landscapes.

CONCLUSION

Late Pleistocene through early Holocene climatic and environmental change in France's western Pyrénées and north central Colorado's Rocky Mountains presented their respective hunter-gatherer populations with challenges and new opportunities for survival in a late and post Ice Age world. As mountain deglaciation occurred after each region's Late Glacial Maximum (ca. 20,000-19,000 ^{14}C cal yr b.p.), their alpine, subalpine, and montane zones were opened to allow summer transhumant migrations of game species such as reindeer, horses, red deer, and bison in the Pyrénées and elk, bighorn sheep, and bison to high mountaintop elevations in the southern Rocky Mountains. Hunter-gatherers in both regions developed specific sets of socio-cultural and economic strategies, based in part on their respective "following the herds" transhumance patterns to exploit emerging highland resources. Western Pyrénées groups appear to have formed clusters of socially and economically interconnected seasonal settlements, sometimes referred as "supersites", typically based within the abundant caves or rock shelters of the Pyrénées mountains. Localized clusters of both seasonally and multi-season occupied sites facilitated coordination of multi-community (e.g., groupings of socially and genetically related multi-family bands) economic, social, and ritual/religious activities during the cold season months. In spring, early summer and fall, individual and collective bands conducted hunts of seasonally migrating game, primarily reindeer and horses in the western Pyrénées, ambushing them at river fords, valley cliff passes, and along hill ridgelines and hill slope drainage swales, and in other natural topographic traps in Pyrénéan foothills and high elevation mountain valleys and passes. As migrating game herds ascended north slopes of the Pyrénées into (and through) montane forest and meadowlands and upslope into high mountain subalpine and alpine tundra, they were followed by hunting bands moving from winter camps in the southern Aquitaine Basin and Pyrénées-Atlantiques foothills and western coast. Based on still limited evidence, it is suggested that, as new grassland ecosystems opened in higher elevation areas of the western Pyrénées, Middle and Upper Magdalenian and early Azilian hunters, ca. 19,000-11,000 ^{14}C cal yr b.p., developed multi-seasonal, logistically organized hunting strategies attuned to seasonal migrations, first of reindeer herds in late Middle and Upper Magdalenian times and later as reindeer, horse, and bison populations disappeared from the region, Pyrénéan hunter-gatherers transitioned to hunting summer upland migrating red deer. Unlike the Colorado Rockies, there is no current evidence that Late Pleistocene-Early Holocene hunting strategies in the Pyrénées-Atlantiques region were associated with physically modified landscapes in the form of constructed game drives although such evidence may emerge in time with further archaeological investigations in the higher elevation Pyrénées.

Later in time, compared to the Pyrénées, Late Pleistocene climatic and paleoenvironmental changes in Colorado's southern Rockies led to the opening of new mountain tundra grasslands and the first appearance of humans in the form of rare Clovis Culture hunting bands (ca. 13,600-12,800 ^{14}C cal yr b.p.). The temporal lag in de-glaciation and opening of upper elevation ecosystems to migratory herbivores and hunters between the two world regions is no doubt in part due to differences in absolute elevation of the two mountain systems, with the Pyrénées rising from sea-level on two coastlines to maximum altitudes of ~3000 m a.s.l. while the southern Rocky Mountains begin at ~1750 m a.sl. and rise to mountain peaks as high as 4000 m a.s.l.

In contrast to the Rocky Mountains, human use of the Pyrénées dates hundreds of thousands of years earlier to pre-modern human species while human presence in the western USA mountains is far more recent, only in the final millennia of the Pleistocene. When more positive Clovis-associated climatic and ecological conditions ended with the onset of short but intense Younger Dryas cooling and renewed, but modest, mountain re-glaciation (ca. 12,800-12,100 ^{14}C cal yr b.p.), earlier exploitation of high elevation mountain areas by summer migratory herd species and Clovis hunting bands appears to have largely ceased during the Younger Dryas although early Paleoindian Folsom and Goshen hunting bands occupied camps and hunted Ice Age bison in the region's lower elevation Middle Park Valley. With the onset of Early Holocene warming at the end of the Younger Dryas (and technical end of the Pleistocene), a sustained period of climate warming (the temperate Early Holocene Optimum) opened snow- and ice-free tundra grasslands in the summer months to migrating game species. The Early Holocene's earliest post-Pleistocene hunter-gatherers in the north central Colorado mountain region are documented by Agate Basin projectile point finds in the North Park Valley and Rocky Mountain National Park as early as ca. 12,210 ^{14}C cal yr b.p. No later than ca. 10,500 ^{14}C cal yr b.p., regional game species such as elk, bighorn sheep, and, to a lesser degree, bison, established renewed lowland (mountain basin valley) to upland herd transhumant migratory patterns, moving seasonally to high elevation summer tundra pastures. Within a short time, Late Paleoindian hunter-gatherers developed early elements of very long-lived, logistically-organized, annual subsistence patterns of mountain game hunting during early to late summer, then migrating back to lower elevation valleys to hunt bison and pronghorn antelope in late summer-autumn (and possibly mid-late spring), followed by over-wintering in those valleys before repeating the same transhumance cycle each new year. Unlike the Pyrénées, where hunting-gathering diminished as a primary lifestyle with the onset of Neolithic pastoralism and farming, hunting-based seasonal transhumance (and game-drive use) in Colorado's Rocky Mountains persisted, with evolving variations in hunting technologies and socio-cultural practices, until early historic times.

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