



Proceedings of the TerQua Meeting
May 12, 2012
Burpee Museum of Natural History
Rockford, Illinois

HOME ON THE RANGE: BIOGEOGRAPHIC DISTRIBUTION OF BISON IN ARIZONA

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Sarah E. Wolff. 2013. Home on the Range: Biogeographic Distribution of Bison in Arizona. – PalArch's Journal of Vertebrate Palaeontology 10(4) (2013), 1-11. ISSN 1567-2158. 11 pages + 3 figures, 1 table.

Keywords: Bison, Biogeography, Arizona, Southwest historical ecology

ABSTRACT

The American bison are traditionally thought of as animals of the vast plains and grasslands, but paleontological and archaeological evidence supports the view that the biogeographic range of bison extended throughout the continental United States to include the American Southwest and Arizona. During the Pleistocene (2,588,000 BP to 11,700 BP), there are several paleontological and archaeological signatures of bison herds in Arizona. From approximately 12,000 BP to AD 1 there is no evidence for bison in the area. This changes around AD 1 when the climate became more favorable, and bison expanded back into Arizona. The last historic bison remains in Arizona date to AD 1650. From AD 1650 until the early 1900s, there are no bison documented in Arizona. Reintroduction of bison to Arizona's national forests and ranches began in the early 1900s and continues to today. Bison can still be seen on the Arizona landscape demonstrating the temporal longevity of the biogeographic distribution of bison in Arizona.

Introduction

Biogeographic distribution of bison as previously established exclude the American Southwest (Allen, 1974; Lott, 2002), but paleontological and archaeological excavations demonstrate that bison once roamed not just the grass plains of the interior but also the arid regions of the Southwest (Mead, 2006; Scott, 2008). This evidence establishes a lasting consistent marginal presence of bison in Arizona and the Greater Southwest. Although not the ideal habitat for bison, Arizona, in particular, hosted small populations over such a long period of time that it must be considered possible bison range and habitat.

Bison Range

Spanish and English settlers historically reported dense herds of bison in the Great Plains east of the Rocky Mountains (Allen, 1974; Hornaday, 2002; Lott, 2002). Bison, as the icon of the Great Plains and the west, was perpetuated by much popular culture through popular western artwork such as that by George Catlin, 1796-1872 (Olsen, 2008). Today, images of bison grace the state quarters of Kansas, North Dakota, and Montana. A bison also appears on the state flag of Wyoming.

Despite this popular western image of bison, historical records demonstrate that bison stretched from nearly the Atlantic to the Pacific Oceans (Meagher, 1986). Bison natively appeared in areas far removed from the Great Plains including Idaho, Oregon, Utah, New York, Pennsylvania, Virginia, North and South Carolina, Georgia, Florida, and the Mexican states of Tamaulipas, Nuevo Leon, Coahuila, Chihuahua, and Durango (Allen, 1974: 74, 128, 129). Regional names hint at the historic range of bison, such as Buffalo Creek in New York (Allen, 1974). Buffalo is the given name for eleven areas or cities throughout the United States, including the states of New York, Iowa, Kansas, Kentucky, Minnesota, Illinois, Indiana, Montana, North Dakota, Missouri, and Wyoming. Cibola, the Spanish word for bison, is the given name for several areas in the southern United States such as in Texas, New Mexico, and Arizona.

Although historic records do not indicate bison living in Arizona, there is paleontological and archaeological evidence of the history of bison in the region.

Arizona is a somewhat surprising area to find bison because of the desert ecology that dominates the state today. Grassland dots areas in the north and south of the state, while piñon-juniper woodlands now dominate the northeastern corner. Ponderosa pine forest and spruce-fir forests occur in isolated patches in the northeastern areas of the Arizona (Lomolino *et al.*, 2010). The Sonoran desert dominates much of the central to Southwestern part of the state. There are also intrusions of the Mojave (Northwest), Great Basin (Northeast), and Chihuahuan (Southeast) Deserts. Four deserts meet in Arizona, none of which is ideal habitat for this species. However, Arizona is also a state that has several mountain range uplifts that allow for water and a variety of vegetation. Desert bighorn sheep, *Ovis canadensis*, is an example of a large ruminant herbivore that inhabited the desert areas of Arizona in prehistoric times in dense numbers, and now exists in sparse numbers (Monson, 1980).

Although Arizona is currently dominated by desert scrub, this has only come about during the Holocene (10,000 years ago to present). During the Pleistocene (2,588,000 BP to 11,700 BP) Arizona fluctuated in environment, and during the late Wisconsin glacial stage (14,000 years ago) woodland savanna persisted through much of the state (McDonald, 1981). During glaciation periods, the cold jet stream across the northern part of North America caused a cold cycle, which shifted the warm Westerlies southward bringing heavy precipitation to the now arid American Southwest (Lomolino *et al.*, 2010). The increased rain in the American Southwest changed the flora and fauna of the area. During the Pleistocene, the desert was confined to a small area in the southwest corner of the state. The dominant vegetation in the rest of the southern part of was piñon-juniper woodlands/chaparral/grasslands. In the Northeast corner of the state, mixed conifer forests dominated the landscape. Pluvial lakes, spruce-fir forests, and alpine areas dotted the state (Lomolino *et al.*, 2010).

Bison Evolution

Bison are a northern adapted bovid that evolved in the large herbivore grazing niche across Eurasia. *Bos*, another large bovid commonly called cattle, occupied the more southern grazing

niche. To the far south, buffalo occupied a similar habitat, such as water buffalo in Southeast Asia and Africa (Guthrie, 1970). Because bison were the cold adapted bovid in Eurasia, their migration through and habitation of Beringia, the area of land connecting Eurasia to North America, was possible.

Beringia was a natural habitat for bison and allowed them access into the New World, while cattle were not able to enter North America until the introduction by Europeans in the 1500s and 1600s (Sheridan, 1988). The local climate and geology created an ice-free refugium across this land bridge that could support megafauna, such as bison (Shapiro *et al.*, 2004). Beth Shapiro's ancient DNA research suggests that bison inhabited Beringia from ca. 300,000 to 130,000 B.P. Bison then moved southward from ca. 130,000 to 75,000 B.P., during an interglacial period (Shapiro *et al.*, 2004). However, these dates are not without controversy.

Bison fossil data presents and interprets a different migratory trajectory. Evidence from Bell *et al.* (2004) suggests an intermediate arrival of bison into North America, ca. 210,000 to 160,000 B.P. Finally, fossil evidence of bison in Sonora, Mexico, suggests an early arrival of bison ca. 570,000 to 310,000 B.P (Mead *et al.*, 2006). All that can be said conclusively is that bison migrated from Eurasia across Beringia into the New World sometime between ca. 570,000 to 75,000 B.P.

The open grasslands of North America were exploited by bison and then undergo an adaptive radiation of the genus across the North American continent. Several species of bison evolved to fill this open niche, although several arguments are made for the differential evolution of bison species in North America. A brief synopsis of these arguments follows.

There were four key species that possibly evolved into *B. bison*. These are *Bison priscus*, *Bison latifrons*, *Bison antiquus* and *Bison occidentalis*. The first bison species in North America, and thought to be the ancestor to all the subsequent species, is *B. priscus*, also called the steppe bison (Meagher & Meyer, 2007). There is no exact agreement to the evolutionary path from *B. priscus* to *B. bison*. An evolutionary branch from *B. priscus*, *B. latifrons*, became the dominant species in North America, while *B. priscus* remained in the northern latitudes of Alaska. *B. latifrons* went extinct around 22,000 B.P.,

and *B. antiquus* became the prominent North American species until its extinction approximately 10,000 B.P. (Lott, 2002). After 10,000 BP, *B. occidentalis* appears in part of the vacant niches left open by *B. antiquus*. *B. occidentalis* appeared to be an offshoot of *B. priscus* that persisted in northern latitudes during the Wisconsin glaciation period (26,000 to 13,300 B.P.). After the Wisconsin glaciation period, this smaller bison spread down into the *B. antiquus*' now vacant territory (Guthrie, 1970). *Bison occidentalis* was a brief species and never expanded into all of *B. antiquus*' territory, including Arizona and California (Guthrie, 1970; Lott, 2002:64). By approximately 5,000 BP, *B. bison*, modern bison, had replaced *B. occidentalis* (Lott, 2002). The exact genetic and evolutionary relationship between these species is unknown and highly debated.

Paleoindian Period (15,000-8,000 BCE)

Prior to human colonization in North America, it is likely that both, *B. antiquus* and *B. latifrons* populated Arizona and the Greater Southwest (McDonald, 1981; Skinner & Kaisen, 1947). *Bison latifrons* remains have been found at paleontological (non-human) sites such as Greater-ville/Empire South (Agenbroad & Haynes, 1975; Lindsay & Tessman, 1974). Further south in Mexico, there are several reports of extinct bison fossils such as *B. antiquus*, *B. latifrons*, and *B. priscus* (Lindsay & Tessman, 1974; Mead *et al.*, 2006). Extinct bison fossils, similar to *Bison antiquus*, have also been found in the Mojave Desert of Southern California and Nevada. Interestingly, the bison in the Mojave Desert are underrepresented compared to other large mammals, such as mammoths, horses and camels, but the numbers do suggest that bison were present in varying abundance in different locations (Scott & Cox, 2008).

Bison antiquus most likely inhabited Arizona in fairly substantial numbers (McDonald, 1981; Skinner & Kaisen, 1947). During the Paleoindian period, there are numerous instances of bison in Arizona, including at least sixteen sites of *B. antiquus* remains. These sites were primarily focused in the southeastern corner of the state (figure 1). These sites included Murray Springs, The Lehner Ranch, Hargis Site, Lindsay Ranch, Ventana Cave, Willcox Playa, Double Adobe, Naco, San Rafael, Fenn Site, Tucson

Extinct Bison

- 1) Murray Springs
- 2) Lehner Ranch
- 3) Hargis Site
- 4) Greaterville (*B. latifrons*)
- 5) Lindsay Ranch
- 6) Ventana Cave
- 7) Willcox Playa
- 8) Double Adobe
- 9) Naco
- 10) San Rafael
- 11) Fenn Site
- 12) Tucson Brickyard
- 13) Werner Site
- 14) Papago Springs Cave
- 15) Charley Day Spring
- 16) Keams Canyon
- 17) Scottsdale

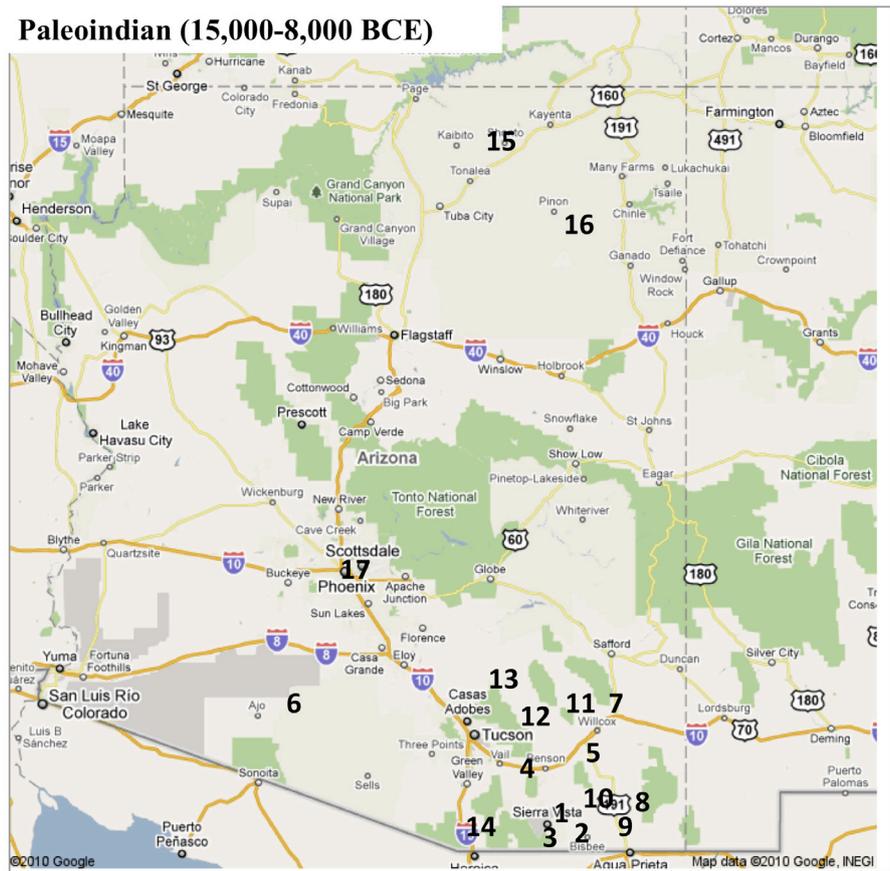


Figure 1. Map of the distribution of sites containing extinct bison in Arizona. Map by S. Wolff.

Brickyard, Werner Site, Papago Springs Cave, Charley Day Spring, Keams Canyon, and Stanton's Cave (Agenbroad & Haynes, 1975; Pasenko & Agenbroad, 2012). At the Murray Springs Clovis site located along the San Pedro River in Southern Arizona, six disarticulated *B. antiquus* individuals, including one juvenile, a subadult, and four adults, were found at a single bison kill site (Agenbroad & Haynes, 1975; Wilson *et al.*, 2007).

The size of the *B. antiquus* population may have been substantial, as indicated from the presence of a juvenile found at Murray Springs (Pasenko & Agenbroad, In Press). While, the fossil record is not abundant, it is important to keep in mind that it represents only a small percentage of the living population that was in the area (Agenbroad & Hesse, 2004). On the Colorado Plateau, which covers the northern portion of Arizona, the *B. antiquus* populations might have been greater during this time than any other time in history (Agenbroad & Hesse, 2004).

It is possible that bison may have migrated into and through Arizona instead of perma-

nently inhabiting the area during this period of time, since there is evidence that bison occasionally migrated great distances. A *B. antiquus* mandible from Nebraska was found to contain the fungal pathogen *Coccidioides*, commonly called Valley Fever or coccidioidomycosis. Valley Fever is now restricted to the arid Southwest climate where the fungus grows in the soil. This individual bison either had to migrate from the American Southwest to Nebraska, a more likely scenario, or the area of Valley Fever distribution had to be considerably larger and wetter than it is today, a less likely scenario (Morrow, 2006).

Archaic/Preceramic Period (10,000 BCE-AD 1)

During the Archaic period human habitation in Arizona was sparse. Archaeological evidence is very limited, and this period remains largely a mystery (Reid & Whittlesey, 1997). Evidence for large animals is also sparse. No bison appear to be living in Arizona during this time, since no bison skeletal remains of this age have been discovered. This could be due to bison not be-

ing present in Arizona, or possibly poor preservation. After the extinction of the megafauna during the Paleoindian period, Archaic hunters began to exploit smaller game such as deer, antelope, and rabbits (Thiel, 1998). At the end of the Archaic period, early agriculturists appeared in Arizona.

Prehistoric/Ceramic (AD 1-1650)

Thirteen sites in Arizona contain bison remains from the Ceramic period (table 1, figure 2). An additional ten sites containing bison were found in the areas surrounding Arizona, such as northern Mexico, western New Mexico, and southwest Colorado.

The presence of bison in Arizona archaeological sites does not necessarily mean that bison lived in the area. Bison remains could have been traded into the pueblos and other human habitation areas. Pueblos in western New Mexico known to have traded bison meat with groups on the plains of eastern New Mexico and Texas during this time period (Speth, 1991; Speth & Parry, 1978; Spielmann, 1982, 1990). However, it is doubtful that bison were ever a component in the diet of Arizona people (Haury, 1965).

Three key signatures indicated that the bison either lived or migrated into Arizona during this time period. First, there were high concentrations of bison remains at Bat Cave, NM,

located very close to the central Arizona border, indicating that bison lived in that area. Bat Cave contained 1,800 bison bones, comprises 87.5% of the archaeological faunal assemblage (Dick, 1965). All skeletal elements from bison were represented, indicating that there were numerous complete individuals present in the faunal assemblage (Dick, 1965).

A second indication that bison intruded into Arizona include three bison remains that come from non-anthropological sites (figure 2). These three independent sites were composed of bison not found in association with humans. Two of the sites are comprised of one isolated cranium (Mead & Dyer, 2001; Mead & Johnson, 2004). Of particular interest at the third site was a nearly complete cow with fetus (Agenbroad & Haynes, 1975). These remains suggested that bison wandered into the area independent of human influence.

Finally, two instances of nearly complete skeletons were found in Arizona. The first individual was the bison cow and fetus described above from a non-anthropological context (Agenbroad & Haynes, 1975). The second comes from a nearly complete bison burial at Babocomari Village (Di Peso, 1951). The presence of a complete bison individual suggested that living bison were present in the area, and that humans were not trading bison meat into the area. If only bison meat was traded

LOCATION	TIME	ELEMENTS REPRESENTED
Bear Ruin, AZ	AD 650	Lower jaw
Snaketown, AZ	AD 675-700 & AD 950-1125	4 horn cores, 1 first lower molar, ear bones, & end of a humerus
Winona & Ridge Ruin, AZ	AD 1077-1173	Not Described
Las Colinas, AZ	AD 1200-1380	Radius and pelvises
Babocomari Village, AZ	AD 1200-1450	Burial including skull, leg bones, and ribs and second finding in cooking pit trash fill
Homol'ovi I, AZ	AD 1290-1400	Distal immature femur
Homol'ovi Kiva 903, AZ	AD 1200-1300	Distal adult femur
University Indian Ruins, AZ	AD 1150-1450	Ulna, mandible, & molar
Point of Pines, AZ	AD 1325-1400 & 1400-1425	Limb bone & not described
San Rafael Ranch State Park, AZ	AD 1440-1640	Cranium- Non-anthropological
San Rafael Valley, AZ	AD 1580-1630	Cranium- Non-anthropological
Murray Springs, AZ	AD 1610	Nearly complete female skeleton with fetus – Non-anthropological
Awatovi, AZ	Unclear	Not Described

Table 1. A listing of the twenty-three prehistoric recordings of *B. bison* remains with accurate dates in archaeological and non-anthropological contexts.

Bison bison

- 1) Murray Springs
- 2) Babocomari
- 3) Snaketown
- 4) Point of Pines
- 5) Las Colinas
- 6) Bear Ruin
- 7) Ridge Ruin
- 8) Awatovi
- 9) Bat Cave
- 10) Prehistoric Village in New Mexico
- 11) San Rafael Valley
- 12) Mogollon Village
- 13) Swarts Ruin
- 14) San Rafael Ranch
- 15) Pine Lawn Sites
- 16) University Indian Ruins
- 17) Homol'ovi

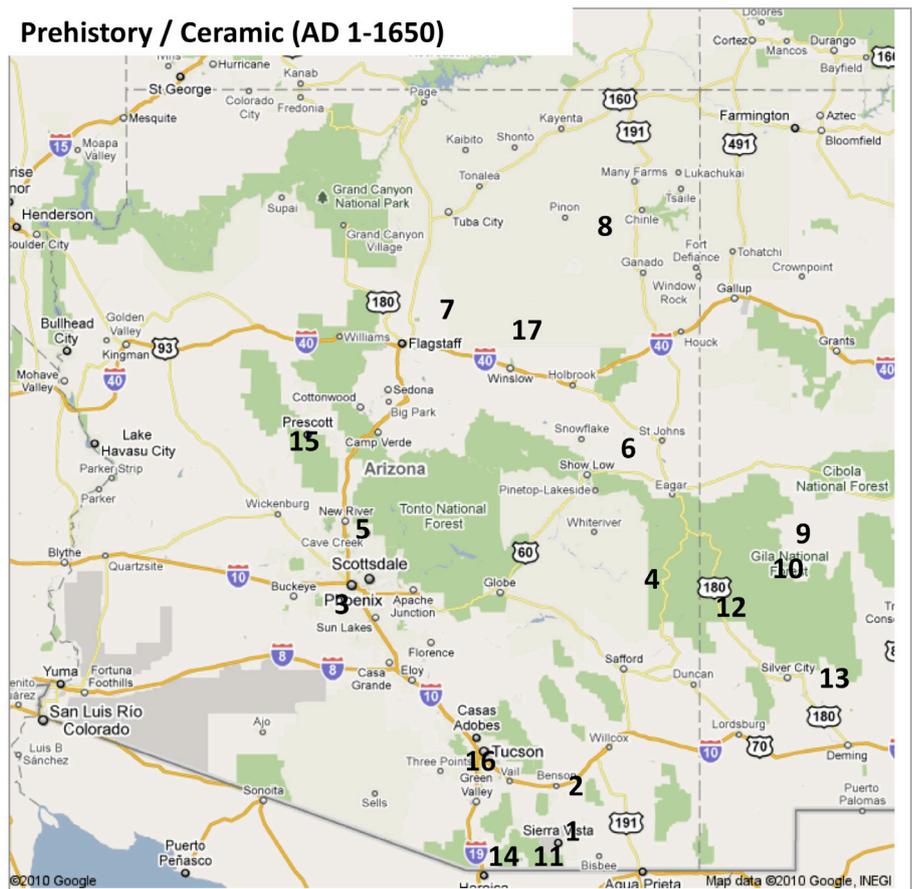


Figure 2. Map of prehistoric / ceramic period skeletal bison remains in Arizona and western New Mexico. Map by S. Wolff.

in to Arizona as the source of the bison bones then there would be only fragments of bison skeletal remains found in anthropological sites that contained large portions of bison meat, such as femurs and humeri, and not the nearly complete bison skeletal remains that were found.

Bison appear to not have been a common occurrence in Arizona. There were never more than two individuals found at any one site. Occasionally, the remains are treated specially, such as the bison burial at Babocomari Village (Di Peso, 1951). This nearly complete bison skeleton was painted and cremated, which suggests it may be a special or unusual specimens.

These appearances of bison in Arizona could be part of a seasonal migration movement. Bison seasonally migrate south to north (Di Peso, 1974; List *et al.*, 2007; Morrow, 2006). There is a documented herd in northern Mexico that migrated from Casas Grande, Mexico, to southwestern New Mexico, as recorded by Coronado, and again in the

last century in a modern herd of bison in the same location (Di Peso, 1974; List *et al.*, 2007).

Bison intrusions into Arizona correlated with cooler/moister periods in history. Using tree-ring paleoclimate reconstructions, cooler periods existed during AD 1110-1129, 1200, 1300-1400, and 1611-1625 (Johnson, 1981). The majority of bison remains in Arizona correspond to these time periods. The major limiting resource of bison is their demand for water from Pleistocene to present (Agenbroad & Hesse, 2004; Lott, 2002; Truett, 1996). During the prehistoric / ceramic archaeological sites, bison remains are found along waterways. Human habitation sites are also along water-ways and the appearance of bison in archaeological sites could be related to location of human habitation sites. Yet, it is also likely that bison followed these water sources into Arizona, such as at the three non-anthropological sites where bison remains were found (figure 2).

Historical Period (1650-1900)

There is no documentation or physical evidence of bison in Arizona from the historical period. There are several possibilities for why bison were not recorded in Arizona during this time period. First is the possibility that bison died out and become extinct in the area before the Spanish arrived in Arizona during the 1500s. Suggested reasons for the extinction of bison in Arizona before the Spanish arrived include climate change, predation by humans and non-humans, and / or disease (Truett, 1996). A second possibility is that the Spanish did not record bison or that the word bison has been mistranslated from historical documents. When the Spanish first saw bison they called them 'vacas', which translated to 'cattle'. Juan de Jaramillo wrote in the 1560s, "començamos A Entrar por los llanos done hay las Vacas," which translated to, "We began to enter upon the plains where there are bison" (Flint, 2003: 156). The same word was used for both bison and cattle in early Spanish documents, leading to problems in translation and understandings of the presence of bison in Arizona. Thirdly, bison skeletal remains may have been misidentified in the archaeological record. *Bos* and *Bison* skeletal elements are very similar, and even trained individuals do have trouble telling them apart.

Modern Era (1900-Present): Reintroduction

Bison were extinct in Arizona until the 1900s when people reintroduce bison to the state. The first reintroduction to the state was by C.J. Jones, also known as Buffalo Jones, between 1905 and 1907. He brought 125 bison to the Kaibab Plateau, in northern Arizona. These bison soon es-

caped from their enclosure and settled in Houserock Valley. In 1935, a herd of 130 could still be viewed by visitors (Bailey, 1935). There are records of at least five reintroductions of bison into Arizona (figure 3; table 2). The Arizona Game and Fish Department manages two of these bison herds for tourism and recreational sport hunters (Department of Game and Fish, 2009a). One of the herds is located at Raymond east of the Flagstaff, and the other is at Houserock Valley east of North Kaibab (Department of Game and Fish, 2009a). There are also modern herds of bison at the nearby Henry Mountains in southern Utah, and Fort Wingate in northwestern New Mexico (Truett, 1996).

Conclusion

Bison have been present in Arizona in fluctuating numbers throughout history. There is no substantive evidence suggesting that Arizona ever supported dense bison populations, but bison existed in marginal numbers consistently over time in Arizona. Bison, both extinct and modern, could be remnants of migrations of bison herds that traveled through the area. It is unlikely that bison meat and bones were traded into Arizona for human consumption, as shown by analysis of the skeletal remains. The appearance of whole individuals suggests that bison were in Arizona and not being traded into the area. Thus Bison bison remains at archaeological and non-anthropological sites may indicate a small indigenous population in Arizona.

Some of the earliest species of bison, such as *B. latifrons* and *B. antiquus*, made Arizona their home during the Pleistocene with other megafauna, when the climate was moister. After the extinction of the megafauna, including

MODERN ERA BISON RANCHES	TIME FRAME	CITATION
Houserock Valley (in Grand Canyon National Game Preserve)	1900s-until present	(Dary, 1974; Department, 2009a; Truett, 1996)
William W. Becker' Ranch (Seligman, AZ)	Unknown	(Dary, 1974)
Two Guns; Arizona Fish and Game Commission, Raymond Ranch (between Flagstaff and Winslow south of the Interstate).	Mid 1940s - Present	(Dary, 1974; Department, 2009a; Truett, 1996)
Rock Art Ranch	Present	(Adams, 2010)
Fort Huachuca	Ca. 1945 - 1950s	(Department, 2009b)

Table 2. Reintroduced bison herds in Arizona.

- Bison bison***
- 1) Houserock Valley (National Game Preserve)
 - 2) Fort Huachuca
 - 3) Two Guns Game and Fish / Raymond Ranch
 - 4) Rock Art Ranch
 - 5) William W. Becker's Ranch (Seligman)

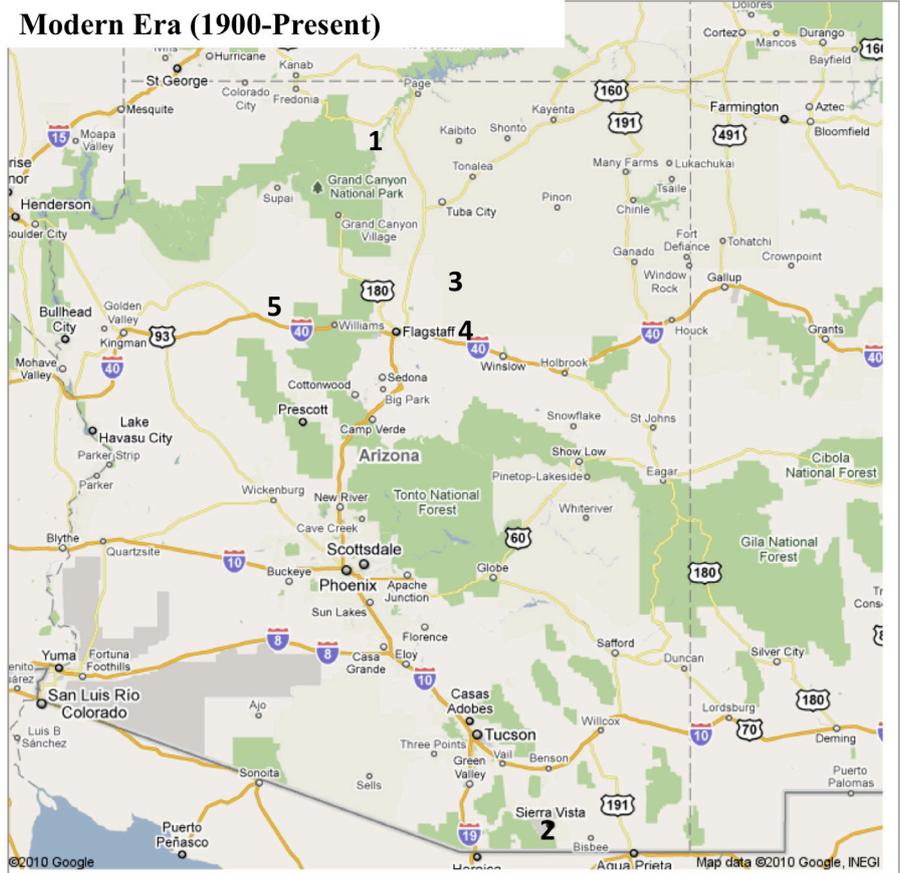


Figure 3. Map of the distribution of modern populations of bison in Arizona. Map by S. Wolff.

B. antiquus, Arizona became did not appear in the area for 10,000 years when bison recurred in sparse numbers from AD 1 until 1650. It is doubtful that bison lived in Arizona during the Spanish colonization in the 1500s and 1600s. Because of the bison are not mentioned in historical written records, it was commonly believed that bison biogeography excluded the American Southwest. The paleontological and archaeological evidence, though, contradicts this belief, and provides evidence of marginal appearance of the species within Arizona. Finally, bison are now again part of the Arizona landscape due to reintroductions by people.

The impact of this research are two fold. First, acknowledging the presence of bison in Arizona leads to new interpretations of archaeological sites. Bovid remains found in archaeological sites in Arizona were often assumed to belong to cattle, while there is a possibility that they could belong to bison. By recognizing the expanded biogeography of bison into Arizona, this provides support of bovid remains in archaeological sites not being exclusively cattle remains. This has great implications for the interpretation and dating of archaeo-

logical sites. Father Kino introduced cattle to Arizona in the late 1600s (Sheridan, 1988), and bovid remains found in archaeological sites prior to this time were assumed to be intrusive cattle remains from a later time. There is now a possibility that these "bovid" remains could represent bison.

The second implication is for the reintroduction of bison into Arizona (Truett, 1996), and whether bison should be labeled a non-native or native species (List *et al.*, 2007). How a species is labeled has a significant impact on the management strategies, and how the public views a species. Bison in the American southwest are currently labeled as non-native, but the above evidence supports the idea that *Bison bison* traditionally did roam and exist in Arizona, albeit in small numbers. Just across the border in Mexico, bison are considered a native species and protected by Mexican federal law, while in the American Southwest, bison are considered non-native livestock (List *et al.*, 2007). This designation could have a great impact in the management and classification of bison as a threatened or endangered native species and entitled to conservation and federal protection.

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Submitted: 12 December 2012

Published: 2 June 2013

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