The two main adaptations of the Cedar Mesa Basketmaker II are canyon floodwater farming in the Turkey Pen phase (circa 100 BC-AD 150) and mesa-top dry-farming, emphasized in the Grand Gulch phase (circa AD 200-400). The Turkey Pen phase is named for a well-known site in Grand Gulch. The Grand Gulch phase was defined by surveys and excavations on the mesa-top (Matson et al. 1988).

Turkey Pen; the tale of a test pit.

The first full field season of the NSF-funded Cedar Mesa Project was in 1972 (Matson et al. 1988, 1990). This multi-year project focused on surface survey, but we thought testing deposits preserved in a dry shelter would provide important environmental and dietary information. Lipe’s earlier surveys indicated that most of the mesa top sites were single component. He suggested the Turkey Pen site (Figure 1) had good

![Cedar Mesa as defined by the Cedar Mesa Project showing other sites of interest.](image)

Figure 1. Cedar Mesa as defined by the Cedar Mesa Project showing other sites of interest.

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potential for recovering dietary and environmental data from both the Basketmaker and P II-III occupations. Richard Wetherill had worked there in the 1890s, but abandoned excavation after digging seven feet into debris made too filthy by abundant dried turkey droppings.

We straightened up a side wall of one of the numerous looter pits and applied Junius Bird’s procedure of extracting a column of intact organic midden material for further analysis (Figure 2, Matson 2018). This involved isolating a block on three sides to allow control of the natural layers and access to removing each one intact. Screening of the side columns produced large collections of human coprolites and corn cobs.

The radiocarbon dates we obtained in the 1980s (Matson and Chisholm 1991) were somewhat ambiguous, but recent AMS dates on human coprolites and maize cobs place the midden between about AD 50 and 150, earlier than the mesa-top BM II. Only the topmost midden layer has a P II-III date.

Kate Aasen’s 1984 analyses of BM II human coprolites provided important results (Aasen 1984). Maize was the largest constituent of the coprolites which are similar to later Pueblo coprolites, with the possible exception that the Turkey Pen’s have more pinyon nut fragments (Figure 3). Reinhard’s later coprolite analyses from Turkey Pen (Reinhard 1988,1991) and Androy’s(Figure 4) from Boomerang Shelter in Butler

![Figure 2. Turkey Pen overview, stratigraphy, Bird’s approach and PII-III Structures.](image-url)
Wash produced similar results (Androy, 2003). Pepo squash is the other domesticate in all these analyses.

Battillo’s 2017 dissertation identified some of the consumed animals through their genetic signals in Turkey Pen human coprolites (Battillo, 2017). Her finding of a low occurrence of meat is re-inforced by Androy’s careful analysis of the faunal macro-remains in Boomerang coprolites. Battillo (2018) also identified the presence of abundant corn smut spores (Figure 4). Corn smut (huitlacoche) is used today in Mexican cooking to flavor maize-based dishes; Battillo also points out it may provide the amino acids scarce in a maize based diet.

Figure 3. Turkey Pen human coprolite macrofossil analyses.

Figure 4. Boomerang Coprolites, Turkey Pen Midden and Corn smut. Smut image from Battillo 2018.
The Turkey Pen midden analyses (Figure 4) by Lepofsky, Radomski and Cordas (as summarize in Matson 2006) are similar to coprolite analyses and support the importance of maize in the BM II period. These midden analyses were done after the coprolite fragments had been removed, and should be independent. Squash and banana yucca are notably more abundant in the midden. The yucca seeds and the squash stems and rinds were not eaten but occur in the midden.

An analysis of human hair carbon isotopes by Cooper et al. (2016) shows seasonal changes in the use of maize. Analysis of carbon isotopes of individual essential amino acids found in the hair also points the way for more detailed descriptions of diet.

Aasen’s 1984 analysis of several turkey coprolites also showed abundant maize macrofossils and pollen. This convinced us that the turkeys were domesticates. Later studies concluded that in BM II, they were rarely used for food but were important ritually and as a source of blanket feathers. In a 2010 PNAS article, Speller et al. (Figure 5) used ancient DNA analysis to identify a genetically distinctive Southwestern domestic turkey variety; BM II examples from Turkey Pen were the earliest.

Recently, a small tattooing implement (Figure 5) was identified from collections screened from a Turkey Pen side column (Gillreath-Brown et al. 2019). A thousand years older than any other good evidence of tattoos in western North America, it is a surprise given the absence of identified tattoos in BM II mummies or rock art.

In Science (2017) Swarts and others published a WGS -Whole Genome Sequence– analysis of 20 Turkey Pen corn cobs, providing a relatively complete genome for BM II maize (Figure 6). Adaptation to the longer days of the Upland Southwest had largely been completed by this time, some 2000 years after the
arrival there of maize. The genetics are also consistent with the idea that the maize arrived via a lowland route (Matson 1991). Floodwater farming at Turkey Pen is indicated by the sites location adjacent to the canyons alluvial deposits.

Turkey Pen Phase, outside of Turkey Pen

Turkey Pen was not the key site contributing to Wetherill’s discovery of the Basketmaker period; his Cave 7, in Upper Cottonwood Wash (Figure 1), has a more central place. Coltrain et al. (2012) analyzed carbon isotopes indicating a primarily maize diet from approximately 100 Cave 7 burials. The dates are a close match to Turkey Pen, although there are important questions about their distribution (Figure 7). Coltrain et al. saw this as an essentially continuous distribution over a relatively long period. However, Geib and Hurst (2013) provided convincing evidence that mass interments account for most, if not all, of the burials.

Coltrain and Janetski (2013) also dated and analyzed isotopes of ca. 50 BM II remains from other SE Utah canyons; they show that occupation concentrated in the same time period as Cave 7 and Turkey Pen with the same focus on maize. The Turkey Pen phase dates begin later than the those of Kidder and Guernseys Marsh Pass Basketmakers.

The “Dos Tanques, Dos Fuentes” locality 17 km southwest of Turkey Pen (Figure 1), had one of the very few good floodwater farming locations found in the CMP mesa top surveys (Matson 1994). Here, slickrock directed rain into a small farming area and provided several natural tanks. At 5600 ft., it is 300 ft. lower than Turkey Pen, and at the lower margin of the Pinon Juniper zone.

The Dos Tanques locality has a small (4 m diameter) deep (up to 80 cm) pit structure dating to the

Figure 6. Fig. 1 and Fig. 2 from Swarts et al. 2017.
Figure 7. Dates of Turkey Pen, Cave 7 and “SE Utah Canyons” compared. “KDE” is Kernel Density Estimate.

Turkey Pen time period (Figure 8). Excavated in 1992, it lacks the distinctive slab-lined entryway seen in later Western BM II houses. The Zero Plaza site in eastern Cedar Mesa (excavated by the U.of Utah in 1971, Hall 1973) has a similar “deep” pithouse with a similar date, and is in a somewhat similar setting. These two pithouses resemble those reported by Geib (2011) for this period from the Navajo Mountain region.

Figure 8. Dos Tanques, Dos Fuentes pithouse excavation and bifaces.
To date, there is no evidence of multi-household settlements in the Turkey Pen phase. However, the thickness of the Turkey Pen midden attests to an intensive occupation. Cave 7’s evidence that dozens of people were killed in a single conflict indicates large scale social units.

Turkey Pen’s midden provided clear evidence of maize-dominated BM II diets, and the presence of Pepo squash and domesticated turkeys. In 1991, Chisholm and I first demonstrated the dominance of maize in the BM II period, using Turkey Pen data and carbon isotope analysis of Cedar Mesa human remains (Matson and Chisholm 1991). The isotope results have since been confirmed by Coltrain and Janetskis in much more extensive analyses.

Grand Gulch Phase; Characteristics

Grand Gulch phase habitation sites are spread across the Cedar Mesa pinyon-juniper woodlands, shown in this plot of quadrats (Figure 9). The habitation sites are grouped into dispersed hamlets (Dohm 1994, Matson et al. 1988, 1990). The elevations of these quadrats and their distribution in dense P-J woodlands hardly overlaps with known Turkey Pen phase sites (Figure 10). The trend clearly shows a shift to mesa-top dry-farming at higher elevations.

Figure 9. Grand Gulch Habitation Quadrats.
Figure 10. Elevations of Habitation Quadrats and amount of Deep Soil Pinyon-Juniper on Habitation Quadrats

Tree-ring dates (Figure 11) indicating that ca. AD 200-400 is the main occupation period are supported by a modest number of less precise radiocarbon dates (Matson 1991, Matson et al. 1990). The Grand Gulch habitation sites are very distinctive with shallow pithouses having a sandstone slab lined entry way and often slab delineated wing walls (see Figure 14).

Limestone chunks (Figure 11) are generally present on Grand Gulch habitation sites. These likely were used for stone boiling maize. The heated limestone and water produce an alkaline solution making more available the essential amino acids, lysine and tryptophan, which occur in low quantities in maize. Creating an alkaline cooking environment, referred to as nixtamalization, is still the basis for making tortillas and tamales today. Recently published experiments in stone-boiling maize with heated Cedar Mesa limestone demonstrate that the alkali solution thus produced makes more lysine and tryptophan.

Figure 11. BM II Tree Ring Dates, Limestone example, and Elwood et al. Figure 2. LYS = lysine, TRP, tryptophan

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biologically available (Elwood et al. 2013). The occurrence of limestone at habitation sites indicates this procedure was widely used in the Grand Gulch phase. The lack of beans in the Southwest prior to BM III may have made nixtamalization an important factor in allowing a dense Grand Gulch population. The Turkey Pen population on Cedar Mesa likely was smaller because there were fewer suitable mesa-top and canyon floodwater farming areas.

As in the previous phase, the Grand Gulch phase has abundant evidence for conflict (Figure 12), including the occurrence of trophy heads in classic BM II rock art.

![Figure 12. Classic BM II Rock Art violence. Trophy heads from Sand Island(Matson photo), unlabeled pair from Geib (2015:F11-17), a,b & c, 2015:F11-30.](image)

Puebloan Pattern

Just as the Cedar Mesa Grand Gulch settlement pattern is very similar to the succeeding BM III and PII-III occupations, so is its population density. Our best estimate is about 900 Grand Gulch people (Figure 13 within the Cedar Mesa Project sampling frame, compared to about 1500 for the maximum model in the PII-III occupation (Matson et al. 1988, 1990). The BM III population appears to be about the same as the BM II.

The extensive dry-farming maize adaptation first seen in the Grand Gulch phase, is repeated in the later periods across the northern Southwest. The site layout pattern of this phase is also repeated in later periods. Grand Gulch habitation sites (Figure 14) have a pithouse with the entrance way pointing south or southeast; trash areas also south or southeast of the pit structure; and slab cists or external pits concentrated to the
Figure 13. Cedar Mesa estimates for Grand Gulch BM II, BM III and P II-III populations.

Figure 14. Cedar Mesa Grand Gulch Phase Houses.
north. This is the same general layout (Figure 15) as the “Prudden Unit” in Pueblo II and III (Prudden 1903), and is frequently seen in BM III. In the language of a few years ago, the household-based Anasazi Footprint”, of the Northern San Juan (NSJ) landscape, was first established in the Grand Gulch phase. Dispersed settlement patterns oriented around household units and hamlets with occasional larger community centers characterized the NSJ in P II and III.

Figure 15. The BM II, BM III and P II-III Household layout

Community centers in the form of small Chaco-related great houses appear on Cedar Mesa in late P II, but the area doesn’t experience the village-sized aggregates formed farther east in late P III (Lipe et al. 2012, Matson and Lipe 2013)

The periodic Puebloan expansions in the northern Southwest, first identified by Michael Berry 40 years ago, can be seen as periods when dry-farming of maize, first seen in the Grand Gulch phase, was feasible over larger areas (Berry 1982). The notably episodic character of Cedar Mesa culture history reflects these geographically larger fluctuations.
Conclusions.

Cultural landscapes based on dispersed settlement patterns of Puebloan type household units engaged in dry farming were first established on Cedar Mesa during the Grand Gulch phase. The maize genome was being adapted to Colorado Plateau floodwater farming environments by the Turkey Pen phase.

The early Cedar Mesa Project investigations documented similarities between the settlement locations favored in Basketmaker II and the later periods, suggesting similar reliance on maize. Now it appears the Puebloan landscapes were modified replications of the small scale domestic and large scale community patterns first mapped onto the landscape in the BM II Grand Gulch phase.

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