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REPORT

A Late Archaic Burial from the Thursday Site, Utah

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In 1992, the salvage excavation of a burial located in central Utah was performed by archaeologists from the Bureau of Land Management. Radiocarbon AMS analysis of bone from the burial returned an age of between 70 B.C. and A.D. 220 (two sigma calibrated), placing the burial within the Late Archaic cultural period in the eastern Great Basin (Wilde and Tasa 1991). The paucity of reported human material from this period makes this individual an important contribution to the osteometric data set. The purpose of this paper is to report information obtained from this burial.

THE Thursday Site (42Md1053) is a large, multicomponent prehistoric site that encompasses part of the north shore of Sevier Dry Lake near the mouth of the Sevier River (Fig. 1). Artifact concentrations and cultural features are scattered over a three-mile arc with clusters occurring near river paleochannels and in association with deltaic deposits. The majority of the cultural features are circular, organic stains similar in size and appearance to those reported at Stillwater Marsh by Raven and Elston (1988) and in the Great Salt Lake Wetlands (Fawcett and Simms 1993). The large size of this site, along

with the temporal span of the cultural periods represented by the surface artifacts (Archaic-Formative), provides an opportunity to study cultural use of this environment during the Late Holocene.

Toward this end, a site evaluation involving survey, mapping, and limited testing of cultural features, geomorphology, and stratigraphy was begun in 1992 (Shearin 1994a). Preliminary results of macro- and microbotanical analyses of soil samples, correlated with radiocarbon analysis from cultural features and marsh stratigraphy, indicate vegetation changes from marsh to salt desert shrub over the past 2,000 years, as well as cultural exploitation of a variety of lacustrine plant and animal resources (Shearin 1995; Shearin et al. 1996).

The burial from the Thursday Site reported herein is in an area mapped as Holocene dunes on Oviatt's (1989) surficial geologic map of part of the Sevier Desert. Oviatt's map shows fine-grained lacustrine deposits to the east of the dune area where the burial is located, Sevier River alluvium to the north, and a large region of Holocene Sevier River delta sediments extending from the northwest to the southeast margin of the site. Exposed portions of this delta range in elevation from about 1,379 to 1,381 m. (4,524 to 4,532 ft.) above sea level. This apparent composite delta was probably deposited in association with two Late Holocene highstands of Sevier Lake, which are represented by beaches having crestal elevations of about 1,380 and 1,382 m. (4,527 and 4,535 ft.) (Oviatt 1988, 1989). Oviatt (1989) concluded that the higher beach was probably formed between about 3,000 and 2,000 years B.P. and that the lower beach was built sometime in the last 500 years. The elevation (1,381 m. [4,532 ft.]) and age (1,870 years RCYBP, see below), of the burial site support Oviatt's (1989) interpretation.

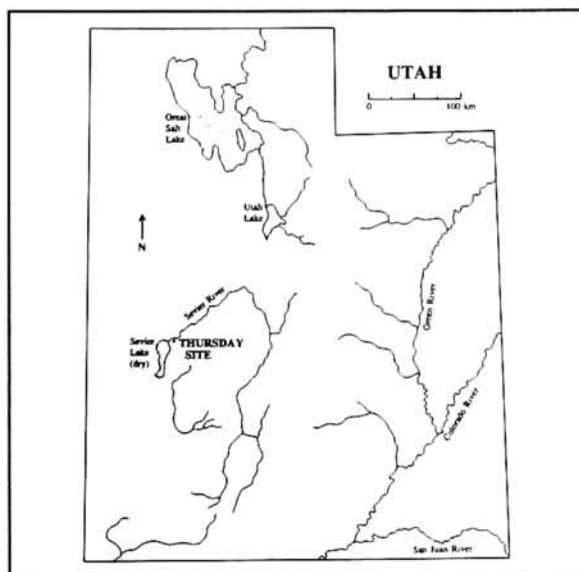


Fig. 1. General location map of the Thursday Site (42Md1053).

During the winter of 1992, new gullies were formed in dunes located at the north end of Sevier Dry Lake. One of these channels cut into a prehistoric burial pit and exposed the pelvic area and upper femora. The skeletal elements were visible on the southeast side of the erosional channel and were within 40 cm. of the modern ground surface. After consultation with Native American tribal representatives and appropriate state and federal agencies, the decision was made to remove the burial in order to prevent complete exposure and subsequent contextual damage from either natural causes or vandalism. Agreement was reached during the consultation process for limited study of the remains and for subsequent reburial (Shearin 1992).

METHODS

A one-meter square was used as the excavation unit, and horizontal provenience was established from the permanent site datum (Shearin 1994b). Since skeletal elements were exposed in the gully profile on the west end of the burial, it was possible to estimate depth from surface for

the origin of the burial pit. However, as a precautionary measure, excavation proceeded in 10-cm. increments until compact soil at the top of the pit was located. Excavated fill was screened using 1/8-in. mesh. Also, since the intention was to collect suitable skeletal elements for mitochondrial DNA (mtDNA) analysis, precautions were used by the excavators to prevent modern DNA contamination. This was accomplished by keeping the pit covered, wearing gloves during the excavation, and wearing sterile gloves in particular when collecting bone for mtDNA study.

Bone samples for mtDNA and radiocarbon analysis were placed in aluminum wrap and packed separately for transport. Soil samples for microbotanical, mollusk, and grain size analysis were collected from the modern surface, several places within the burial pit, and from two locations below the pit: Strata C and D, 100 cm. and 150 cm., respectively, from modern ground surface (Fig. 2). All excavated material was reinterred at the same location.

Samples for pollen analysis were processed using methods adapted for alkaline soils (Newman 1994). Mollusk classification was performed using the format outlined in Simms and Isgreen (1984) and the environmental habitat for each genus was noted (Simms and Isgreen 1984; Shearin et al. 1996). Additionally, the associated soil was classified according to a geomorphological standard based on grain size and percent of sand, silt, and clay (Sack 1995). The bone sample collected for radiocarbon analysis was sent to Beta Analytic, Inc., for accelerator mass spectrometry (AMS) radiocarbon analysis.

In choosing methods for the osteometric analysis, consideration was given to the fact that all skeletal material would be reinterred and would not be available for future study. Thus, standard measurement data sets suitable for comparison with Amerindians and prehistoric Great Basin populations were selected as the most appropriate methodology. Pelvic and skull

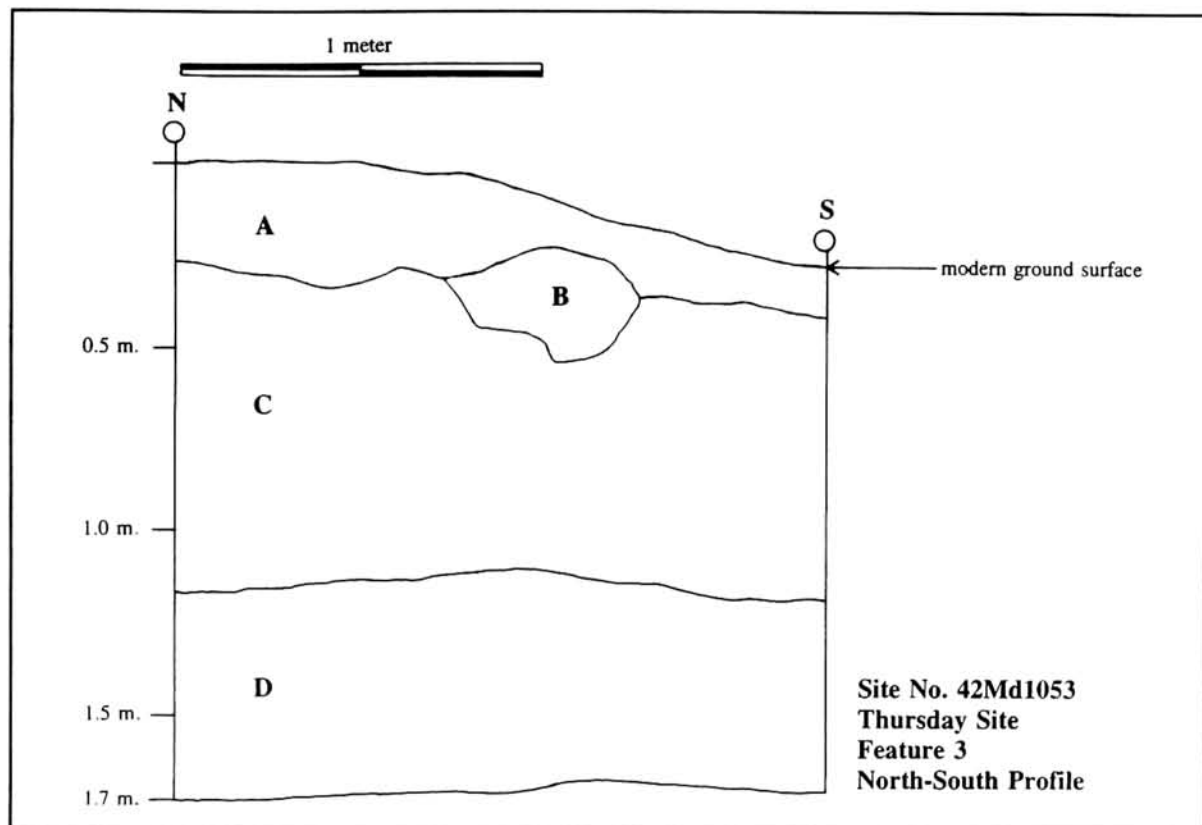


Fig. 2. Profile map of burial pit (B) and associated strata. Stratum A is the surface stratum; Strata C and D are laminated deltaic sediments.

attributes (Bass 1987), femoral midshaft circumference (Black 1978), and femoral and humeral head measurements (Krogman 1962) were used to obtain sex determination. Age assessment was based on analysis of the developmental stage of the pubic portion of the innominates (Katz and Suchey 1986), dental attrition (Ubelaker 1989) and the degree of suture ossification (Krogman 1962). Trotter and Gleser's (1958) stature estimates for Mongoloid males were used. The methodology provided in Bass (1987) was followed for cranial, postcranial, and non-metric traits in order to provide comparative information for physical attributes. Dentition was examined for evidence of wear, enamel hypoplasia and/or caries, as well as for periodontal disease.

In order to obtain the maximum amount of information from this prehistoric individual, mtDNA was extracted and characterized from two rib samples. Although mtDNA analysis is not currently a routine procedure for ancient skeletal material, it adds a uniquely informative method to archaeological inquiry (Wallace and Torroni 1992). When well-preserved human skeletal remains are uncovered at a site, it is possible to extract genetic material, or DNA, from ancient bone with the phenol-chloroform method. Specific, informative DNA sequences are then amplified for further study by the polymerase chain reaction (PCR). This technique is used to replicate, to quantitative amounts, segments of DNA containing specific sequences referred to as "genetic markers." In particular

combinations, these markers are group specific. For example, Amerindians (both contemporary and ancient) can be classified into four specific genetic groups or lineages (A, B, C and D [for complete characterization and technical details concerning the markers defining these lineages, see Stone and Stoneking 1993]) based on particular markers found in the sequence of mtDNA (Schurr et al. 1990; Torroni et al. 1993a, 1993b). Mitochondrial DNA is especially useful in this sense because it is inherited only through maternal cytoplasm. For this reason, mtDNA lineages, defined by specific genetic markers, allow limited determinations of ancestral/descendent relationships between human groups.

Ancient DNA, like all artifacts, suffers damage over time; however, given good skeletal preservation, enough intact DNA can usually be extracted and PCR replicated such that a suite of definitive markers can be obtained from a given individual. Due to the dry soil conditions at the Thursday Site burial, most of the skeletal material was in excellent condition and could potentially yield adequate amounts of analyzable DNA. Therefore, small portions of two samples were processed by amplifying mtDNA extracted from bone. This unknown, amplified mtDNA was then analyzed for genetic differences or similarities to known mtDNA based on the size of the molecule. The size of the unknown mtDNA is directly related to the presence or absence of definitive genetic markers, thus providing a means to determine the Amerindian genetic group of this particular ancient individual (O'Rourke et al. 1996).

RESULTS

Excavation of the burial site revealed an oval-shaped pit (85 x 64 cm.) filled with compacted silt and sand, with the individual interred face up in a flexed position with the head toward the east (Fig. 3). A small ball of white kaolin clay lay close to the left side of the mandible. Except for this kaolin ball, no other burial goods

were observed. No cultural material was recovered from the fill excavated from the burial pit. The deepest point of the burial pit occurred beneath the lower thoracic/lumbar region, where dark, organic soil was encountered, suggesting deposition from decay (Figs. 4 and 5). The position of the body would have allowed a decay pool to develop, and because vertebra T-5 through L-5 were either highly fragmentary or absent, it was assumed that the decay process (and/or bioturbation) destroyed these elements. The bones of both feet were affected by erosional processes and were either lost or located out of context.

Sex, Age, and Stature

The good condition of the remainder of the skeletal material allowed an accurate sex assessment of male (Loveland 1994). An age determination of 40 to 50 years was calculated using the methods of Krogman (1962), Katz and Suchey (1986), and Ubelaker (1989), and a stature of 164.59 ± 3.80 cm. (approximately 64 in.) was obtained using the methods of Trotter and Gleser (1958). This stature is typical of prehistoric Great Basin males (Andrews 1970; Larsen 1985).

Cranial Indices

Using the methodology provided in Bass (1987), selected cranial indices reflecting cranial configuration were derived. The results include: cranial index of 81.82, indicating brachycrany (broad or round headed); mean height index of 84.38, indicating that the height of the skull is large in relation to length and breadth; upper facial index of 55.32, indicating lepteny (slender or narrow face); total facial index of 89.36, indicating mesoprosopy (average or medium); nasal index of 43.64, indicating leptorrhiny (narrow nasal aperture); orbital index of 80.49, indicating chamaeconchy (wide orbits); and a palatal index of 109.68, indicating brachystaphyline (broad palate). An additional 23 cranial and 24

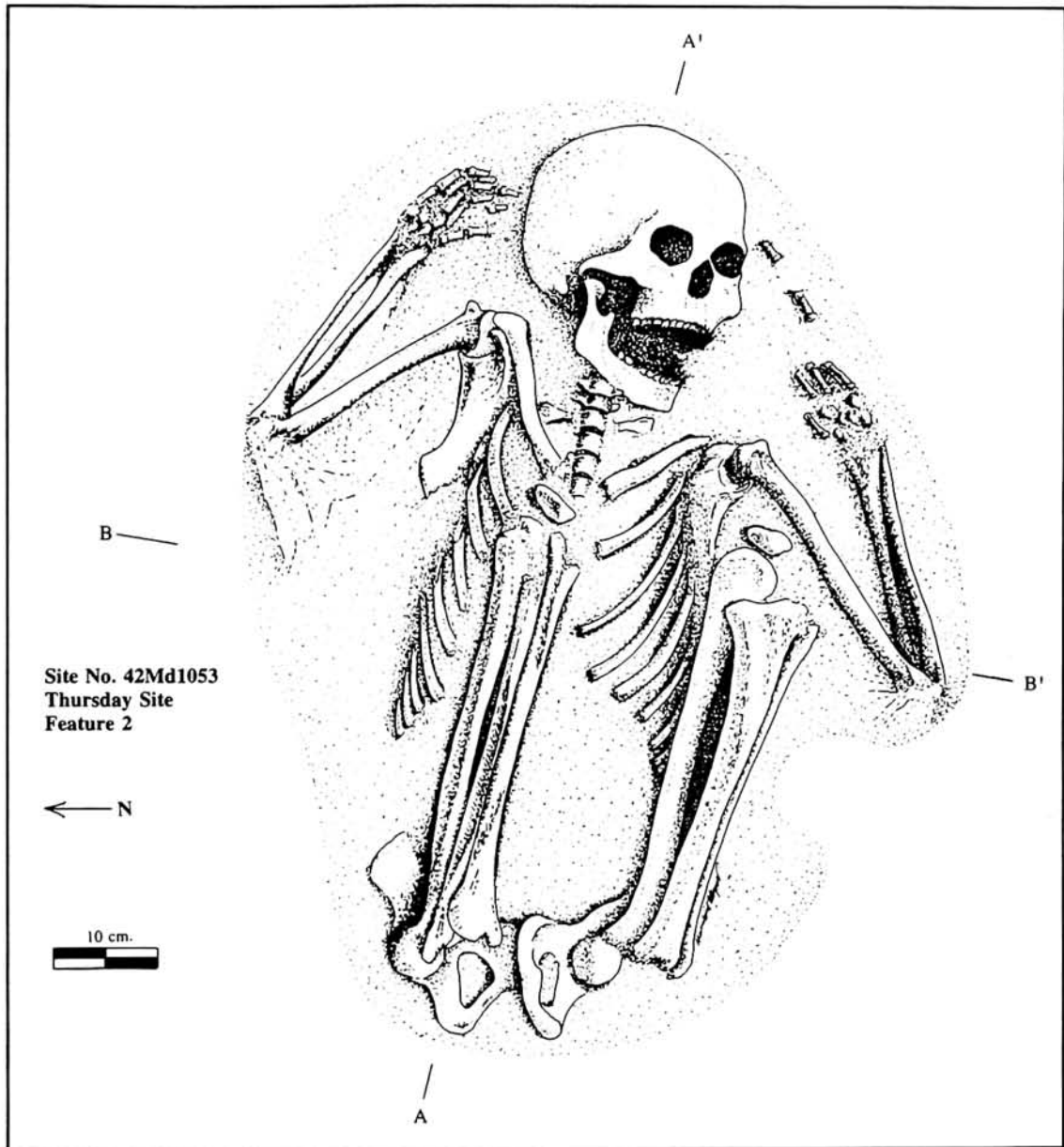


Fig. 3. Planimetric view of the burial pit. A-A' represents the location of the east-west pit profile and B-B' is the north-south profile location.

postcranial measurements were derived and are listed in Tables 1 and 2.

Pathologies

The skeletal elements were examined for evidence of pathological change; no anomalies

were observed. Additionally, there was no evidence of cranial deformation as is frequently noted in the later Fremont skeletons (Andrews 1977). The most serious condition noted was extremely worn teeth accompanied by severe periodontal disease (Fig. 6). No evidence of

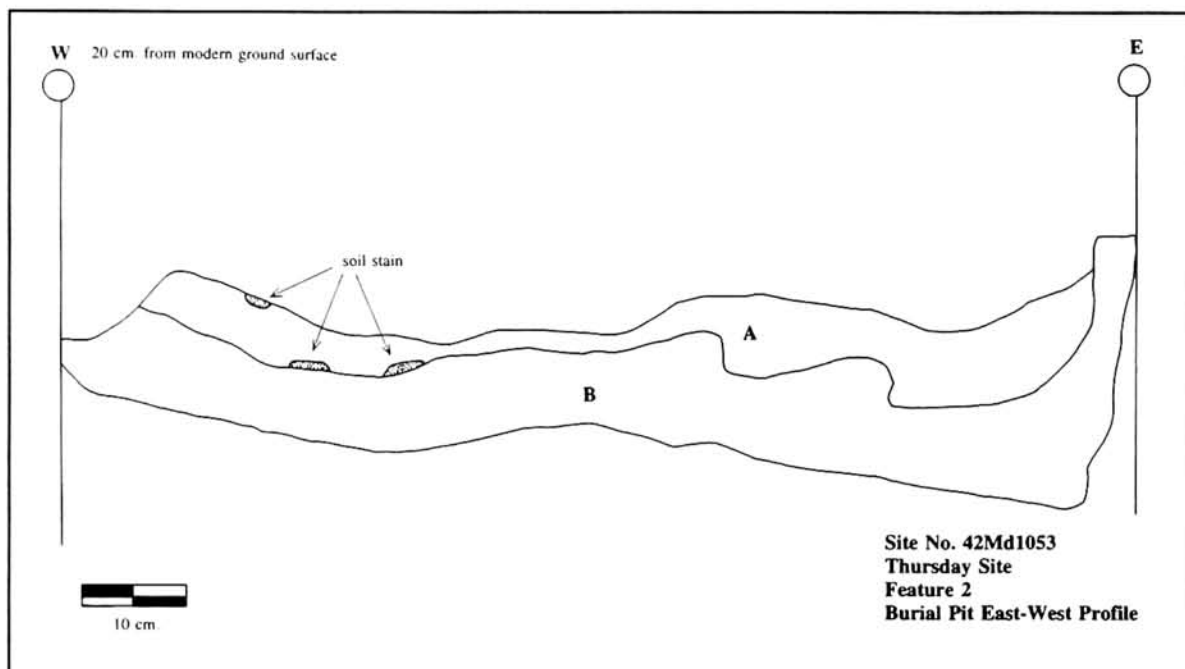


Fig. 4. Burial pit profile. Stratum A is distinguished from Stratum B only by color (light/dark brown).

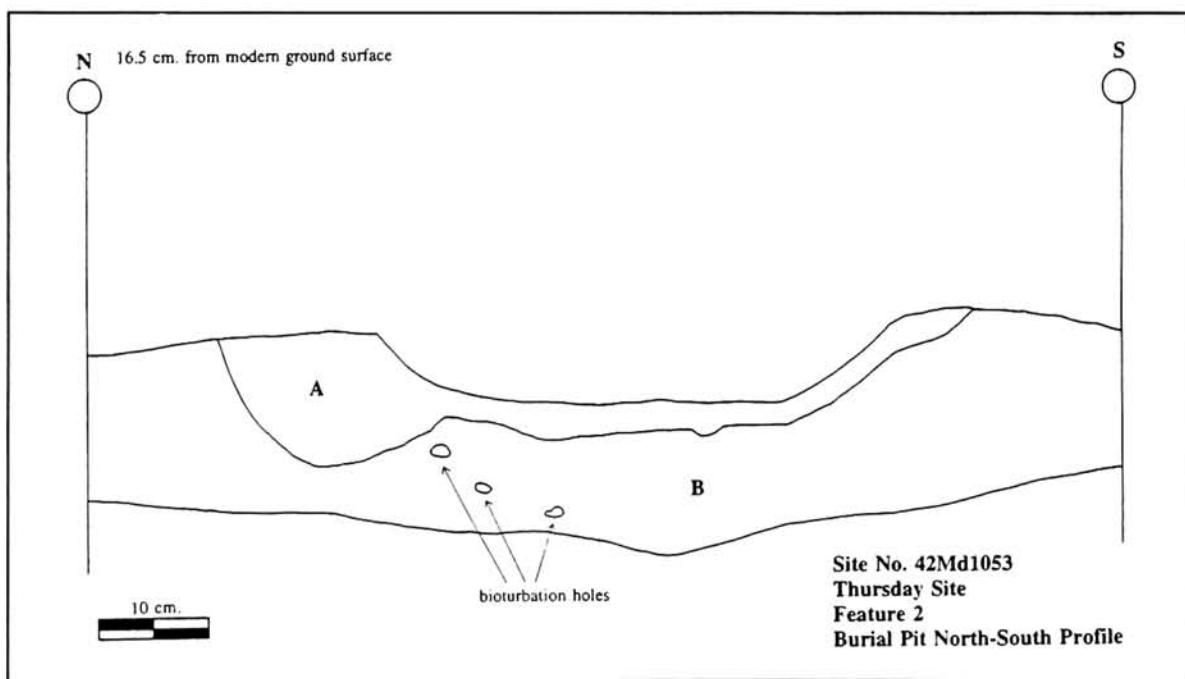


Fig. 5. Burial pit profile showing bioturbation in Stratum B.

Table 1
CRANIAL METRICS FROM THE THURSDAY SITE (42MDI053) INDIVIDUAL

Cranial Metric	Measurement (mm.)
Maximum cranial length	176
Maximum cranial breadth	144
Basion-bregma height	135
Endobasion-nasion	105
Endobasion-alveolon point	102
Endobasion-gnathion	120
Minimum frontal breadth	90
Bizygomatic breadth	141
Nasion-alveolon point	78
Nasion-gnathion	126
External palatal length	53
External palatal breadth	67
Nasal height	55
Nasal breadth	24
Minimum nasal breadth	9
Orbital height	33
Orbital breadth	41
Biorbital breadth	102
Symphyseal height	39
Bigonial breadth	101
Bicondylar breadth	122
Height of ascending ramus	63
Mandibular length	95

osteophytes or eburnation was observed in the Thursday Site individual, as was reported in the prehistoric skeletal material from the Stillwater Marsh area in Nevada (Brooks et al. 1990). Other dental observations included the amount of wear and the evidence of enamel hypoplasia and/or caries. Both mandibular first molars were lost antemortem, but all of the other teeth were present. Steep-angled wear from the buccal to the lingual surface on the maxillary first molars distinguished these teeth from the remaining teeth, which exhibited flat occlusal wear (Fig. 6). Brothwell (1972) and Butler (1972)

stated that severe wear on the maxillary first molars after age 40 frequently results in angled wear sloping toward the lingual borders. The bilateral antemortem loss of the mandibular first molars suggests that they were also under severe wear pressure. Thus, the diet of this individual probably included considerable coarse grit. There was no evidence of enamel hypoplasia, although such evidence may have been lost due to attrition. Small caries were observed on the occlusal surface of the right mandibular and right maxillary third molars and on the mesial surface of the left maxillary canine. An abscess

Table 2
POSTCRANIAL METRICS FROM THE THURSDAY SITE (42MD1053) INDIVIDUAL

Postcranial Metric ^a	Measurement (mm.)
Humerus Measurements	
Maximum length	308
Maximum midshaft diameter	21
Minimum midshaft diameter	17
Maximum head diameter	47
Circumference	63
Clavicle Measurement	
Maximum length	151
Femur Measurements	
Maximum length	428
Anterior-posterior midshaft diameter	27
Transverse midshaft diameter	25
Midshaft circumference	87
Maximum head diameter	45
Tibia Measurements	
Maximum length	357
Anterior-posterior diameter at nutrient foramen	36
Transverse diameter at nutrient foramen	24
Midshaft circumference	88
Radius Measurement	
Maximum length	251
Ulna Measurement	
Maximum length	274
Scapula Measurements	
Maximum height	181 (R)
Maximum breadth	105 (R)
Innominate Measurements	
Maximum height	204 (R)
Maximum breadth	151 (R)
Sacrum Measurements	
Maximum length	112
Maximum breadth	115
Fibula Measurement	
Maximum length	358

^a Measurements of left bone except where indicated with (R).

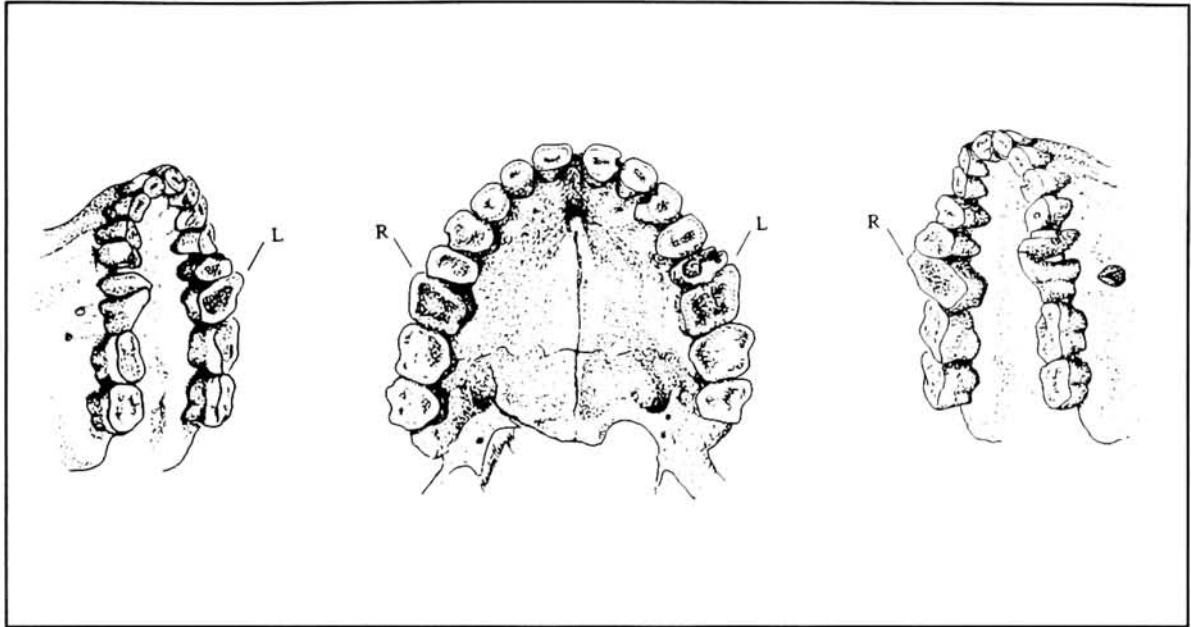


Fig. 6. Wear patterns on teeth; left (L) and right (R) views.

is evident at the base of the left maxillary and left mandibular first molars and may have been implicated in the loss of the left mandibular first molar. Alveolar bone resorption was noted on both the maxilla and the mandible, and calculus occurred on several teeth.

DNA Analysis

The examination of mtDNA genetic markers from the Thursday Site individual unequivocally identified him as belonging to Group B. The major lineage marker for Group B is a nine base pair (bp) deletion located in a short, noncoding region between the two active genes that code for mitochondrial cytochrome oxidase II and lysine tRNA genes (Parr et al. 1996). This deletion causes the amplified Group B mtDNA to separate as a smaller molecular fragment than molecules without the deletion when resolved in an agarose gel matrix. Three other markers, in association with the nine bp deletion, define Group B. These markers were also amplified and found to be present in the mtDNA from the Thursday Site individual (Parr et al. 1996).

Negative results were obtained when mtDNA amplification reactions were controlled for incidental modern DNA contamination.

Pollen Analysis

The microbotanical (pollen) analysis of soil samples provided information about the vegetation on the site surface, in the burial pit, and in the soil at 100 cm. and 150 cm. below the burial pit. While some of the plant spectra demonstrated marked differences between the samples, others had only minor differences. The surface sample of pollen contained about 40% chenopodium, 20% pine, 7% juniper, 6% greasewood, and 12% sagebrush. The burial pit soil contained less than 18% chenopodium, about 24% cattail monad, 26% pine, 5% juniper, 3% greasewood, and 8% sagebrush. Grass species comprised about 3% of the pollen in the surface soil sample, but was about 10% in the burial pit sample. When compared to surface soil, the two soil samples collected from below the burial pit had a 50% decrease in chenopodium, pine, juniper, greasewood, and sage. Almost half of all the

pollen identified from the samples below the burial pit was cattail monad (Newman 1994, 1995).

Faunal Analysis

The mollusks identified from the soil samples represented two gastropod genera, *Valvata* and *Lymnaea*. Both are air-breathing, freshwater types that generally live in the lake-margin zone of rooted vegetation, but *Valvata* are not as tolerant of stagnant or intermittent water conditions (Simms and Isgreen 1984; Shearin et al. 1996).

Sediment Analysis

All of the soil samples analyzed for grain size characteristics consisted primarily of sand-sized aggregates. Compared to the lower strata (C and D), the surface sample was less compact and lacked discontinuous laminations. Average grain size was slightly larger at the surface, where it was a fine sand, than in the two lower strata (C and D), where it was a very fine sand (Sack 1995). The two lower strata also had a higher percentage of silt and clay (12%) than the surface unit (7%).

Dating

The radiocarbon analysis on the bone sample produced good quality collagen. As a result, the AMS procedure returned an age of $1,870 \pm 70$ RCYBP (Beta-57396, CAMS-4145), with calibrated results at 2 sigma indicating 70 B.C. to A.D. 220 (Shearin 1994b).

DISCUSSION

Analyses of the Thursday Site burial have provided information about the health and genetic makeup of this Late Archaic individual, as well as information concerning the surrounding environment. When these data are combined with sample analysis results from test excavations located elsewhere at the Thursday Site, some inferences can be made about climate and

available resources during the Late Archaic period (Shearin 1995; Shearin et al. 1996).

The deepest soil samples were collected 100 cm. and 150 cm. below the burial pit and, except for the scarcity of mollusk shells and the more continuous lamination in Stratum D, the two samples were similar. Given the environmental preferences of the mollusk genera in these samples, the similar soil classifications, and the close proximity of Sevier Lake deltaic deposits at about the same elevation as the burial site (1,381 m. [4,532 ft.]), a deltaic origin for both samples below the burial pit is suggested (Sack 1995). The microbotanical identification of a high percentage of cattail monads in the strata below the burial pit fits this description of a lake-marginal environment.

The pollen spectra represented on the modern surface and in the burial pit show some differences from the lower soil samples. The inference is that these differences indicate that at the time of the burial, the climate was wetter and cooler than at present. Additional support for this climatic change is provided by the increased percentage of grass and cattail monads in the lower samples and the increased percentage of cheno-ams in the upper samples (Newman 1994). Comparisons between the burial pit pollen spectra and other soil samples taken at the same depth from other noncultural locations at the Thursday Site yielded similar results, suggesting that the pollen identified within the burial pit was not culturally influenced (Newman 1994, 1995; Shearin 1995; Shearin et al. 1996).

To date, the Thursday Site burial represents the only reported human skeletal remains attributed to the Late Archaic period from a wetland setting in the central or eastern Great Basin. A radiocarbon assay of $1,523 \pm 175$ RCYBP (CAMS-10219; corrected to A.D. 252 to 602) from one individual (No. 64 from 42Bo579) excavated during the Great Salt Lake Wetlands Project has been documented (S. Simms, personal communication 1995). Human remains from

this time period have been reported from the western Great Basin (Brooks et al. 1990), and skeletal measurements and stature predictions from the Thursday Site individual are within the expected range reported for males in that area.

Analyses of the Thursday Site individual indicate that he was middle-aged at death and, except for dental pathologies, apparently was in good health throughout life. Bone anatomy and structure were very good. The tooth wear pattern was similar to that reported for the Mosida Site individual, a Mid-Archaic Period male, located on the shore of Utah Lake (Janetski et al. 1992). This dental wear pattern indicates a coarse, gritty diet which could have been related to groundstone processing methods used for native plants and seeds, such as cattail, bulrush, pickleweed, and saltbush, as well as maize (Loveland 1994). These processing methods may have been similar to those used by the "cattail eaters" in the Stillwater Marsh area of Nevada (Fowler 1992).

Since some lacustrine resources, especially cattail pollen and root flour, contain starch and carbohydrates as well as protein (Fowler 1992), a diet largely dependent on these food products could have produced the dental caries and abscesses observed in the Thursday Site individual. Simms (1987) suggested a high calorie return rate per hour of work expended for cattail pollen, even higher than for several small game species (Fowler 1992). Since about 25% of the pollen spectra from within the burial pit at the Thursday Site was cattail monad, this resource was available in adequate amounts for utilization. However, faunal analysis from several cultural features tested at the Thursday Site indicate heavy exploitation of other lacustrine resources, such as muskrat and fish, during the Late Archaic period (Shearin 1995; Shearin et al. 1996). Thus, a broad spectrum diet could have supplemented the more stable resources.

It is also possible that maize horticulture may have been present at the Thursday Site dur-

ing the lifetime of this individual. Evidence for maize horticulture is present in the archaeological record at two sites that bracket the age of the Thursday Site individual (Wilde and Newman 1989; Wilde and Tasa 1991; Talbot and Richens 1994). However, there was no direct evidence of maize usage in this burial.

Mitochondrial DNA analysis performed on bone extract has placed the Thursday Site individual firmly within the Group B genetic haplotype, which fits well within the context of ancient Amerindians. The four haplotypes are present in contemporary Native American populations at frequencies of 29% (A), 27% (B), 20% (C), and 19% (D), with 5% unclassified (Bailliet et al. 1994). The Group B haplotype is also present in three ancient Amerindian groups analyzed to date, with frequencies of 20% (Anasazi); 10% (Oneota), and 60% (Fremont) (Stone and Stoneking 1993; O'Rourke et al. 1996; Parr et al. 1996). Although additional research using custom-designed genetic probes specific for differences and similarities between cultural periods and groups in the Great Basin are needed, the haplotype data from this single individual provides a beginning from which the Archaic period can be investigated (Shearin et al. 1989).

CONCLUSIONS

The discovery of a Late Archaic burial at the Thursday Site in west-central Utah has contributed new information about the health, genetic haplotype, and environmental conditions for this temporal period. The microbotanical, geomorphological, and osteological data from the burial strongly suggest that an environment rich in lacustrine/freshwater resources near the mouth of the Sevier River provided a broad spectrum of subsistence options. The mtDNA analysis performed on well-preserved bone has established the presence of the Group B Amerindian genetic haplotype. This genetic information is particularly significant since it represents the first mtDNA analysis from the Archaic period in

west-central Utah, predating other temporal periods and cultures in the Great Basin for which similar studies have been performed.

NOTE

1. Carol Loveland died on December 26, 1995.

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