THE REPRESENTATION AND WEATHERING OF HUMAN REMAINS

TAPHONOMY: WHAT ABOUT THE SMALL BONES, LONG BONES, AND CRANIAL BONES? A STUDY OF THE REPRESENTATION AND WEATHERING OF HUMAN REMAINS FROM THE BATTLE OF STONEY CREEK DURING THE WAR OF 1812.

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TITLE: Taphonomy: What About The Small Bones, Long Bones, And Cranial Bones? A Study Of The Representation And Weathering Of Human Remains From The Battle Of Stoney Creek During The War Of 1812

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Abstract

Disarticulated, commingled, and fragmented assemblages occur over a range of geographic and temporal contexts, yet the relationship between the representation and weathering of bone in these collections is unclear. Previous studies have produced inconsistent results and there is little elaboration discussing why the representation of large bones differ from small bones in archaeological collections containing commingled remains. The purpose of this research was to determine which bones were better represented, and if the representation correlated to the weathering of bone in the collection of human remains from the Battle of Stoney Creek, a War of 1812 site. The soldiers from the battle were likely buried in a mass grave; however, almost 200 years of extensive taphonomic disturbances created an assemblage that was disarticulated, commingled, and fragmented.

A database of the collection was used to gather information on bone fragment completeness recorded using the zonation method (Knüsel and Outram 2004), and weathering scores recorded using the scale by McKinley (2004). Results from the Z-statistic and Wilcoxon Rank-Sum statistic indicated that small bones (metacarpals, metatarsals, tali and calcanei) were better represented and less weathered than long upper and lower limb bones (femora, tibiae, fibulae, humeri, ulnae and radii) ($p=0.05$). The binomial distribution also determined that the crania were underrepresented in comparison to two cemetery sites; the West Tenter Street and Cross Bones burial ground ($p=0.1$).

There are a number of possible reasons for this expression of representation and weathering including the size, morphology, and density of bones, taphonomic disturbances, the burial environment (e.g., soil characteristics, the feather edge effect), and clothing. This study highlights the importance of preservation analyses in commingled, disarticulated, and fragmented collections. The findings from this research suggest that small bones may be better represented than the larger limb bones at sites with extensive taphonomic disturbances.

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Declaration of Academic Achievement

This is a declaration that Lia Casaca has completed the research discussed in this thesis. Dr. Megan Brickley, Dr. Tracy Prowse, and Dr. Andy Roddick have critically reviewed the content, and contributed to this document.

Introduction

The preservation of human remains is valuable information, because it is used to better understand the formation processes and cultural practices at archaeological sites. Assessing preservation is one of the first and most important steps involved in the analysis of human remains. Preservation refers to two important concepts: 1) the completeness of bone, and 2) the condition of bone (Stodder 2008). Recording the completeness of bone requires recording which portions of the bone are present and absent. Bone condition on the other hand, refers to visual aspects of the bone such as color, texture, hydration, weight, fragmentation, fragility, and the presence of soft tissue (Byers 2008:75-78). Taphonomic factors such as weathering and the burial environment may also influence the completeness and condition of bone, and in turn influences its representation. The representation of bone refers to the total frequency per bone of bone fragments in an assemblage.

The preservation of bone in archaeological collections is often linked to characteristics of bone size, shape, and density (e.g., Marean 1991). Large, long, and dense bones such as the femora are suggested as being well represented in collections (e.g., Adams and Konisberg 2008); however, these findings in the literature are inconsistent. At Moses Coulee Cave in Eastern Washington, the large, less spherical faunal bones were commonly fragmented, whereas the smaller, highly spherical, and dense bones were the least fragmented (Darwent and Lyman 2002). It is important to recognize that several factors may influence the preservation and representation of bone including the soil pH, soil texture, soil moisture, soil temperature, the type of material coverings in the burial environment, and the type of burial (e.g., Janaway 2002; Stodder 2008).

The type of burial may influence the representation and preservation of bone because the formation processes of mass graves are different than individual interments. A mass grave is a single burial containing six or more individuals buried in close proximity to each other (Skinner 1987). The relationship between representation and weathering becomes unclear when faced with commingled, disarticulated, fragmented, and taphonomically disturbed remains. Commingled human remains are common in archaeology and forensics in the context of mass graves, yet they may be underutilized, or their analyses may be limited to inventory documentation, or identification in the contexts of forensics (Ubelaker 2002; Varas and Leiva 2011). One potential reason for the suggested underutilization of these collections may be due to the disarticulated and mixed nature of commingled human remains and the extended length of time it takes to successfully analyze the remains. Commingling may restrict analyses because each bone fragment is treated as a separate individual.

The purpose of this research was to investigate the relationship between weathering and representation by using data from the collection of human remains from the Battle of Stoney Creek. The human remains from the Battle of Stoney Creek comprise a disarticulated, commingled, and fragmented collection from a mass grave (The Spectator 1908, Griffin-Short 1998, Elliott 2009). This research had three objectives: (1) to determine if the small bones (metacarpals, metatarsals, tali and calcanei) were underrepresented in comparison to the large long bones (femora, tibiae, fibulae, humeri, radii and ulnae), (2) if the severity of weathering correlated to the representation of bone, and (3) to determine whether the cranial bones were underrepresented in comparison to the minimum number of individuals estimates (MNI).

The short Battle of Stoney Creek took place the night of June 6th, 1813, during the War of 1812 between Great Britain, its Canadian colonies, and the United States of America. The battle took place on the area of land known as Smith's Knoll in Ontario, Canada. It was suggested that some soldiers from the battle were buried in a mass grave on Smith's Knoll more than 200 years ago (e.g., Elliott 2009). The collection from the Battle of Stoney Creek is unique because there are a few associated historical documents that list possible taphonomic activities that occurred at the site (such as farming, looting, exhumation, and animal activity). The taphonomic activities resulted in the damage to the bones, and a loss of context and provenience of the human remains in relation to each other. In 2011 the remains from the Battle of Stoney Creek were disinterred from the site and brought to McMaster University for the aim of learning more about the soldiers for the bicentennial celebrations. During that time, the remains were assessed and a database was created at McMaster University. The database contains information including the type of bone fragment, side, completeness, and weathering, in addition to diagrams, photos, and selected radiographs.

The completeness of each bone fragment was scored using the zonation method. The zonation method divides each bone into zones that are recorded as present or absent based on pictures and descriptions (Knüsel and Outram 2004). The zone with the highest frequency per bone and the total number of bone fragments was used to compare bones in order to determine which were better represented. Bilateral bone fragments were compared first and pooled if the two data groups were statistically similar (e.g., the left femora were compared to the right femora, and pooled to create the category femora). The bone fragment categories were then compared to each other and pooled accordingly into groups (e.g., the femora were compared to all other bones such as the tibiae and fibulae, and pooled into a group in which all the bones were represented similarly). The bone groups were then compared to each other to determine which were better represented in the collection.

The weathering of the bone fragments was recorded using a 7-point weathering scale developed specifically for human remains (McKinley 2004). The median weathering scores were calculated and statistics enabled the weathering scores of bones to be compared to one another. The weathering data were then summarized and presented alongside the representation data in order to address the second research objective.

To determine the representation of the crania, MNI estimates from the cranial bones were compared to the MNI of the collection (N=24) based on counts of the right radius (Brickley 2013). Cranial bone representation from the West Tenter Street site (dated to 101-400 AD) and the Cross Bones burial ground (dated to the early 1600s-1853 AD) both from London, England, were compared to the results from the Battle of Stoney Creek to determine if the representation patterns found in this study were typical in other skeletal collections.

Comparing the representation data to the weathering data in the context of taphonomic disturbances will enable new information to be learned and suggested about the collection. The results of this research may then extend beyond the collection from the Battle of Stoney Creek, to the fields of archaeology, forensics, and museum studies. This research will break down the representation and weathering data to summarize the findings per bone, for a glimpse of what extensively taphonomically disturbed archaeological collections may look like. The results of this research may be beneficial for forensic anthropologists and museum curation staff during the planning of excavations, and for the curation practices of disarticulated, commingled, and fragmented collections.

This thesis begins with Chapter 2 by presenting the background information on the War of 1812, and the Battle of Stoney Creek. Additional information such as the types of weaponry used, and past analyses of the collection are also discussed. Chapter 3 explains mass graves, the various types of mass graves, and the different ways to calculate the minimum number of individuals (MNI) estimates. Chapter 4 focuses on a discussion of taphonomy, preservation, and completeness. Taphonomic factors and their impact on the preservation and representation of human remains are discussed in detail including 'the feather edge effect'. Theoretically, the bodies at the center and deepest portion of a mass graves decompose more slowly (and are suggested to be better represented and less weathered) than the bodies at the periphery, creating a 'feather edge effect' (e.g., Mant 1950). In Chapter 5 I present the materials and methods section, including a discussion of the database, the zonation method, the weathering method, and the steps taken to collect the representation and weathering data. Data from the West Tenter Street and Cross Bones sites are also presented in Chapter 5, as well as background information on the statistics used to generate the results. Chapter 6 summarizes the results of the representation, weathering, and cranial bone data from the Battle of Stoney Creek, West Tenter Street, and the Cross Bones burial ground collections. Chapter 7 contains a discussion and interpretation of the results in the context of the previous literature on bone preservation in the archaeological record, while the key findings and conclusions are provided in Chapter 8. The research presented in this thesis focuses on the skeletal collection from the Battle of Stoney Creek, but will contribute to broader bioarchaeological discussions regarding bone representation, weathering, and taphonomy in disarticulated, commingled, and fragmented skeletal collections.

Chapter 2: The Smith's Knoll Sample

2.1 The War of 1812

The War of 1812 was a relatively small-scale war between the British Crown and America (Elliott 2012:59). As a researcher, it is important to be aware of who participated in the war and why, because it is likely that these individuals comprise the commingled, disarticulated, and fragmented collections like those excavated from the Battle of Stoney Creek. For more detailed information about the War of 1812 and each of the battles, the document by C.P. Lucas (1906), or publically accessible book by James E. Elliott (2009) are excellent sources.

The War of 1812 was caused by three principal events (Lucas 1906:2). The first was the rules of international commerce under the Jay Treaty, which regulated trade between America, the East Indies, Britain, and the rest of Europe (Hannay 1901:13-15; Lucas 1906:2). The second reason was Britain's insistence upon searching American trade ships, and forcing American seamen to join the Royal British Navy (Lucas 1906:2; Turner 2000:24; Elliott 2012:59). The election of James Madison as president of America in 1812 was the last event that some authors attribute to fueling the war (e.g., Morton 2012:321; Hatzenbuehler and Ivie 1980). Madison elected representatives into Washington, called the War Hawks, who lobbied for a war against Britain (Morton 2012:321; Hatzenbuehler and Ivie 1980). Madison declared war against Britain and its Canadian colonies on June 18, 1812, for "non-revocation of the Orders in Council, interference with American trade, practical blockade of American ports, imprisonment of

American seamen, and instigation of Indian hostilities against the United States" (Lucas 1906:4).

The United States of America assumed it would be victorious in the war because all of Britain's resources were required in Europe with the Napoleonic Wars (Elliott 2012:59). For this reason, British soldiers required help from the Canadian colony militiamen as well as Native warriors (Smith 2012:4; Turner 2000:29-30). The Canadian colony militia forced men to train for the army if they were between the ages of 16 and 60 (Smith 2012:80; Turner 2000:26). American soldiers who fought in the War of 1812 were thought to have been between the ages of 16 and 45 (Turner 2000:12). Men who served in the Canadian colony militia were farmers who either arrived from Britain with the promise of land and a new life, or had defected to Canada as Loyalists to the British Crown when the Revolutionary War began (Smith 2012:83). The Canadian colony militia was not as well trained, or as disciplined as the full-time British militia, which was why the colony militia were only used as support for short month-long periods (Turner 2000).

2.2 Weaponry in the War

Weapon injuries have been demonstrated to influence the rate of soft tissue decomposition due to the exposure of internal tissues. Larger weapons may cause more damage to the bones, potentially severing limbs, whereas the smaller weapons may not penetrate the cortical bone of the soldiers, and may not be recorded on the skeleton

(Smith et al. 2009:144-149; Lockau 2012:31). Unfortunately, the injuries that do not impact bone are lost in the archaeological record when the soft tissues decompose (Smith et al. 2009:149).

The type of injury is dependent on many factors such as the shape, direction, mass, velocity, and type of weapon used, among other factors (Smith et al. 2009:139). Depending on the severity of the injury, and the amount of internal tissue exposed, it is possible that the exposed wounds would attract insects and animals (Haglund 1997a; Haglund 1997b; Calce and Rogers 2007). It has been suggested that the deceased soldiers from the Battle of Stoney Creek were buried following the battle (Biggar 1873; Griffin-Short 2000; Elliott 2009). The open wounds may have attracted animals and insects to scavenge the soft tissues and bones between the death of the soldiers and their burial (Section 4.3.3).

2.2.1 Muskets, Rifles, Pistols, and Guns

The weapons in use during the War of 1812 are well documented, making it possible to identify the small and large arms used, and discuss their potential impact on decomposition of the human skeleton. The American and British soldiers used projectile weapons such as muskets, rifles, pistols, guns (known as “cannons”) and howitzers (Turner 2000). Sharp force trauma could have been inflicted by the use of bayonets, swords, sabres, dirks, and pikes. Native warriors used a weapon called a tomahawk, similar to an axe that could be thrown or used in hand-to-hand combat (Turner 2000:29).

The musket was the basic weapon used for both American and British armies (Turner 2000:133-137). The American militia used the musket model 1795 Springfield, which was five feet long, with a bayonet that was approximately 15 inches (Turner 2000:133-137; Elliott 2009:98, 256-258). The British often used the India Pattern musket Brown Bess model, with a 17-inch bayonet, or a less popular model called the Short Land Pattern musket (Turner 2000:133-137; Elliott 2009:256-258). The American and British militia also used rifles, which were more accurate, but took more time to load (Turner 2000:133-137). The gunpowder would line the rifles so quickly that they needed to be cleaned after a couple of rounds in order to be fired again (Turner 2000:133-137). This may have inhibited the use of rifles, limiting the amount of rifle projectile inflicted injuries. The American rifles models 1803 and 1807 were 33 inches long, and did not have a bayonet (Turner 2000:133-137). The most common British rifle was the Baker, and its bayonet was 23 inches long (Turner 2000:133-137). The projectile hand weapons may have punctured, penetrated, or shattered limbs, depending on the proximity of the weapon to the individual (Lockau 2012; Elliott 2009). Research by Lockau (2012) on the collection from the Battle of Stoney Creek has shown that bayonets and muskets produced traumatic lesions to the femora, fibulae, innominates, patellae, and scapulae. The sharp force trauma and musket trauma may have increased the rate of soft tissue decomposition and damaged the bones, likely influencing their representation in the collection.

2.2.2 Swords, Sabres, and Pikes

Swords, sabres, and pikes were also among the weaponry used in the War of 1812. American swords had straight blades, but did not have a standard length, design, or decoration (Turner 2000:133-137). On the other hand, the British swords had specific patterns for each rank. Dirks (similar to a dagger), and sabres (curved blades) were used as well as short swords called "hangers" (Turner 2000:133-137). Pikes may have been used during the Battle of Stoney Creek, but not by the Americans. American use of pikes was ceased after the Battle of York in April 1813 (Turner 2000:133-137). Pike blades ranged from 9 to 11 feet long (Turner 2000:133-137). The cavalry were not used very often in battle, but American cavalry soldiers would carry sabres and pistols, while the British would carry swords and sabres (Turner 2000:133-137). Based on previous analyses, the majority of lesions in the collection from the Battle of Stoney Creek were caused by sharp force trauma (Lockau 2012:135). It is possible that with a lot of force, the pikes and swords punctured and potentially severed bones while quickening decomposition because of exposure to the internal tissues.

2.2.3 Artillery Weapons

The most common artillery weapons for the American and British militia were guns for long range, and howitzers for short-range targets (Turner 2000:133-137). Ammunition included canisters or case shots (a tin case of small lead bullets), shell (a hollow sphere of powder for an explosive effect), and less commonly used was shrapnel (a shell filled with lead bullets and powder used only by the British Royal Artillery) (Turner 2000:133-137). The large projectile weapons may have had enough impact to damage the body, and sever a limb bone; although this would depend on the proximity to the victim as well as the type of ammunition used.

2.3 Soldiers in the Battle of Stoney Creek

Establishing a demographic profile of the Smith's Knoll soldiers from documentary sources helps to better understand the demographic parameters of the badly fragmented collection. In this case, the deceased British and American militia consisted of men (Griffin-Short 2000), possibly between the ages of 16 to 60 (Turner 2000:26; Smith 2012:80). The data from the list of casualties, and prisoners of war from Elliott (2009:260-265) narrows the age range and suggests the average age for both armies was 30, and the age range was 17-54 (N=228 recorded ages). The age range is important to acknowledge because of bone modeling and remodeling, and may have influenced the degree of bone fragmentation.

Generally, young men (and women) have a high turn over rate of bone, but when skeletal maturity is reached, bone modeling and remodeling are slowed (Robling et al. 2006). The slowed bone turnover is due to a number of factors such as hormone levels, mechanical stimuli, and calcium intake outlined in further detail by Nordin (1996), and Robling and collegues (2006). The slowed bone remodeling can lead to lower bone densities of older individuals, allowing their bones to be more prone to fracture (Nordin 1996), and taphonomic processes. This information is crucial to know because it suggests that the bones of older adults are more fragile, and although most of the soldiers were likely young men, the bones of older men may be represented as fragments in the collection from the Battle of Stoney Creek.

2.4 The Battle of Stoney Creek

The Battle of Stoney Creek near the Niagara Frontier (Figure 1) is often cited as being one of the most important strategic events in determining the outcome of the War of 1812 (Collins 2006:161; Turner 2000:71; Smith 2012:74).

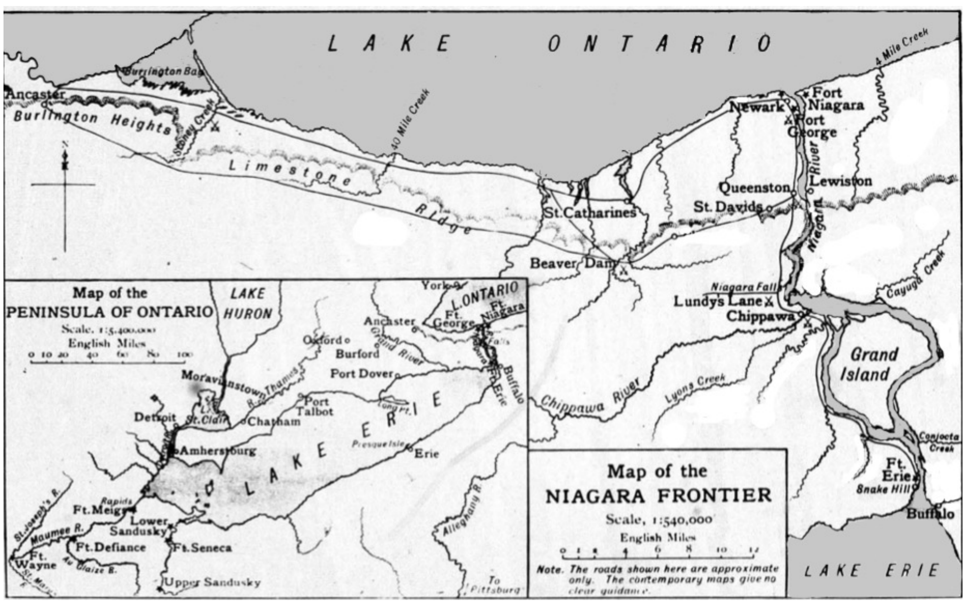

Figure 1: The Niagara Frontier (Lucas 1906:93)

The United States invaded the Niagara peninsula beginning with the capture of Fort George, forcing the British regiments to retreat West (Fryer 1986). The British Commander John Vincent, and Colonel Sir John Harvey retreated to Burlington heights along with reinforcements from Chippewa and Fort Erie, arriving at Burlington Heights at the end of May (Smith 2012:72-73). The American forces followed, and had set up camp on the Niagara escarpment on June 5th, 1813 (Fryer 1986:160). The escarpment where the Battle took place is called Smith's Knoll (Figure 2) after the marriage of the landowner's daughter, Louisa Gage, to Herim Smith (Griffin-Short 2000; Elliott 2009).

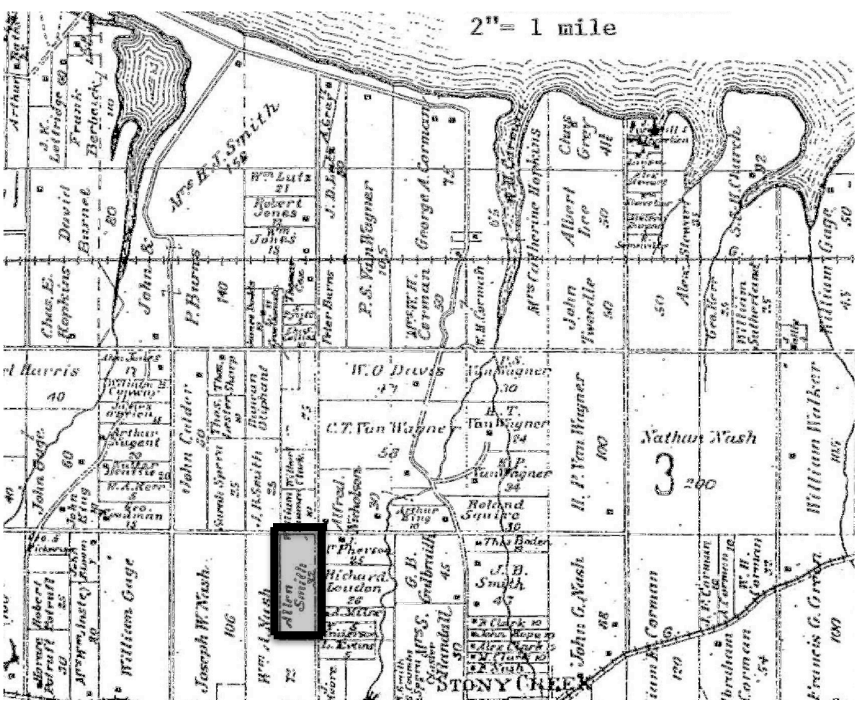

Figure 2: Map of Wentworth County (Stoney Creek) in 1903. The Knoll owned by Mr. Smith is shaded grey and outlined by a black rectangle. Photo from J.W. Tyrell Imperial Atlas Wentworth County 1903:66 (Griffin-Short 1998:21).

The American camp was disorganized since it was set up during the night (Fryer 1986:160; Cruikshank nd). The two American Generals, John Chandler and William Winder, set up their tents close to the Gage house (or the Battlefield house), built in 1795 and still stands today (Cruikshank nd; Collins 2006:162-163). For the Americans, the goal of the pending battle was to gain possession of Stoney Creek, and cut off Commander Vincent's communication with York (Lucas 1906:97;).

Scholars believe that Commander Vincent sent Colonel Harvey and a couple of other soldiers to spy on the American camp, to determine their exact position and how strong they were (Collins 2006:159-164; Turner 2000:69-71). The British troops were significantly outnumbered; around 1600 British soldiers versus around 3500 American soldiers, 250 cavalry and at least 8 large artillery field pieces (Hannay 1901:17; Smith 2012:73-74; Turner 2000:70). There are some accounts that state British soldiers Isaac Corman and Billy Green obtained the password to the American camp, and reported it back to General Harvey who decided they would attack the American camp that night (Collins 2006:159-164; Turner 2000:70). Commander Vincent and Colonel Harvey led approximately 700 British regiment soldiers to attack the unsuspecting American camp through the woods on the night of June 6^{th}, 1813 (Lucas 1906:97-98; Fryer 1986:161).

The Battle of Stoney Creek took place at night in darkness. It is unlikely the battle strategy proceeded as planned because the darkness caused confusion and disorder, producing slightly varied documented descriptions. Some accounts (e.g., Smith 2012:74) state that the American soldiers were taken by surprise; while others (e.g., Fryer 1986:161) state that the element of surprise was lost before the battle began. The two

American Generals, Chandler and Winder, were captured near the Gage house, and this prompted the American troops to retreat to 40 Mile Creek (now Grimsby) (Fryer 1986:163; Fredriksen and Burn 1989). During the attack, Commander Vincent went missing until the next day where he reconnected with his troops unharmed (Lucas 1906:99; Turner 2000:70). The British naval fleet under the command of Sir James Yeo came from Kingston, and forced the American soldiers to retreat further, to Fort George (Lucas 1906:100; Collins 2006:70-71).

The battle resulted in the capture of some American soldiers, as well as casualties on both the British and American sides (Hannay 1901:177). Although the accounts vary, the data suggest that the casualties for each army were more than 150 soldiers (Cruikshank nd; Slater 1899:31-33; Lucas 1906:99; Elliott 2009:144). The varying accounts make the exact number of soldiers killed on either side unknown, especially because the numbers of casualties were likely underreported (Elliott 2009:154).

After the Battle of Stoney Creek, the Americans almost gave up the Burlington area entirely and instead pursued Fort George (Collins 2006:161). The Battle of Stoney Creek was crucial in the War of 1812 because Upper Canada both resisted American control, and drove them out of the area.

2.5 An End to the War

Both Britain and America claim to have won the war, although neither really did. America aimed to take over Upper Canada (now Ontario), but failed to do so in part because of the pivotal Battle of Stoney Creek (Collins 2006:161). The Battle of Stoney Creek was decisive in changing the outcome of the war in favor of the British Crown (e.g., Collins 2006). After 30 months of war and neither party emerging victorious over the other, the Treaty of Ghent was drafted, and signed on December 24, 1814, marking the end of the war (Fryer 1986:176; Hannay 1901:396). The treaty declared peace between the two countries, and restored the boundaries of Britain and America, which were largely unchanged from before the war (Lucas 1906:246-260).

Many original buildings from the war still stand today, such as the Battlefield house in Stoney Creek. Recent monuments such as the lion monument, near the intersection of King Street and Battlefield Drive in Stoney Creek were erected in remembrance of the battle (Collins 2006:160-164). The Niagara Parks Commission is responsible for the Battlefield House and runs guided tours, a small museum, a gift shop, and presentations about the Battle of Stoney Creek (Collins 2006:163). In 1871 the Old Meeting House was torn down, and is now a modern church and cemetery at the corner of King Street and Centennial Parkway (Collins 2006:163). The site of Smith's Knoll is currently a tourist attraction, to inform the public about the War of 1812, and the influential Battle of Stoney Creek.

2.6 The Smith's Knoll Sample: Past Assessment, Excavation, and Analyses

The collection from the Battle of Stoney Creek is disarticulated, commingled, and fragmented, in part because of the history of the Smith's Knoll site and extensive taphonomic activity that occurred at the site. The first recorded discovery of human remains on the Knoll was in the 1880s when Alan Smith, the son of landowners Louisa and Herim Smith, was ploughing (Elliott 2009:217). There are claims that in 1889, phrenologist Peter Van Wagner unearthed a number of soldiers and took 22 crania for his lectures (Mills 1899; Griffin-Short 1998). The Smith family eventually sold the land to the Wentworth Historical Society, and in 1995 the land became the property of the Stoney Creek municipality (Griffin-Short 1998).

There was an archaeological assessment completed in 1998 (Borden number AhGw-132). Rita Griffin-Short from the RGS Archaeological Service was the project director for the assessment and the excavation in 1999. The purpose of the archaeological assessment was to test the area in order to locate the burial from the battle and remodel sections of the area into a park and wheelchair ramp (Griffin-Short 1998, 2000). From the site report it appears a datum was chosen and test pits (Trenches A-L), were excavated across the site (Figure 3) (Griffin-Short 1998). Other than screening soil (likely with 1/4' mesh), it is unclear from the site report what excavation methodology and other excavation tools were used for the assessment (Griffin-Short 1998).

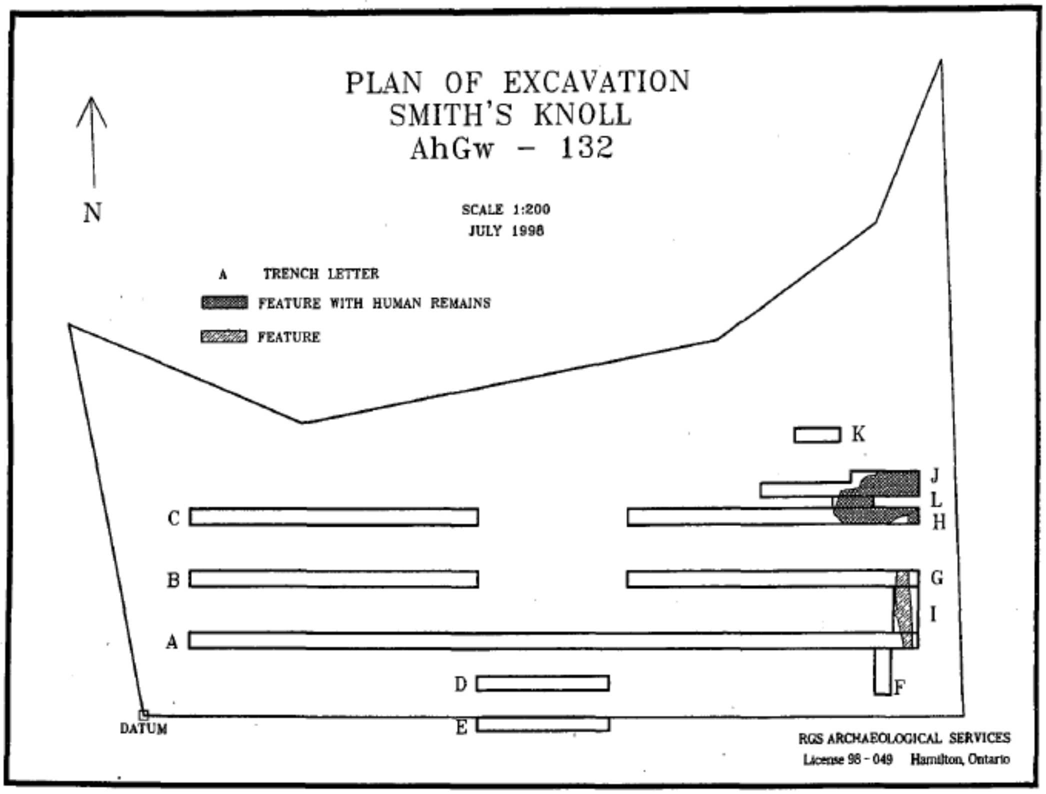

Figure 3: The Test Pits from the Archaeological Assessment in 1998. Note the image is drawn from a bird's eye view and the datum in the bottom left corner of the image (Griffin-Short 1998:20).

An analysis of the results from the assessment suggested that many of the trenches were disturbed, and contained mixed fill including domestic debris, faunal bones, artifacts, and human remains (Griffin-Short 1998). The amount of disturbance among trenches varied because some human remains were mixed with the animal bones and debris (e.g., Trench H), while other human remains were found under the mixed soil (e.g., Trench I) (Griffin-Short 1998). Clusters of human remains were recovered in Trenches J, H, and L, prompting recommendations to fully excavate the area and remove all of the human remains (Griffin-Short 1998, 2000). The trenches where bone was found were covered with plastic and backfilled with soil after the archaeological assessment was completed (Griffin-Short 2000). Covering selected trenches with plastic and soil fill may have been done in an effort to speed the excavation the following year.

The aim of the archaeological excavation was to delineate the extent of the burial pit, and remove all associated human remains (Griffin-Short 2000). Much of the soil back-fill was re-screened using 1/4' mesh (Griffin-Short 2000). Both trowels and shovels were used during the excavation (Griffin-Short 2000); however, it is unclear which excavation methodology was used, and whether soil was removed in natural or artificial levels. New trenches were opened in order to follow the contours of the burial pit (e.g., M, N, O, P, Q, S and extensions of Trench H in Figure 4) (Griffin-Short 2000). The excavation in 1999 added to what was recovered the year before: human bone, animal bone and other artifacts grouped into categories of: ceramics, clay pipes, domestic buttons, military buttons, glass, metal, and a miscellaneous category (Griffin-Short 2000). In both site reports there is no mention of bioturbation (the influence of insect or animal activity on the soil) at the site of Smith's Knoll (Griffin-Short 1998; 2000). The soil in the burial pit was disturbed, and this may be a reason why the possible effects of bioturbation (e.g., in the form of burrows) were not noted.

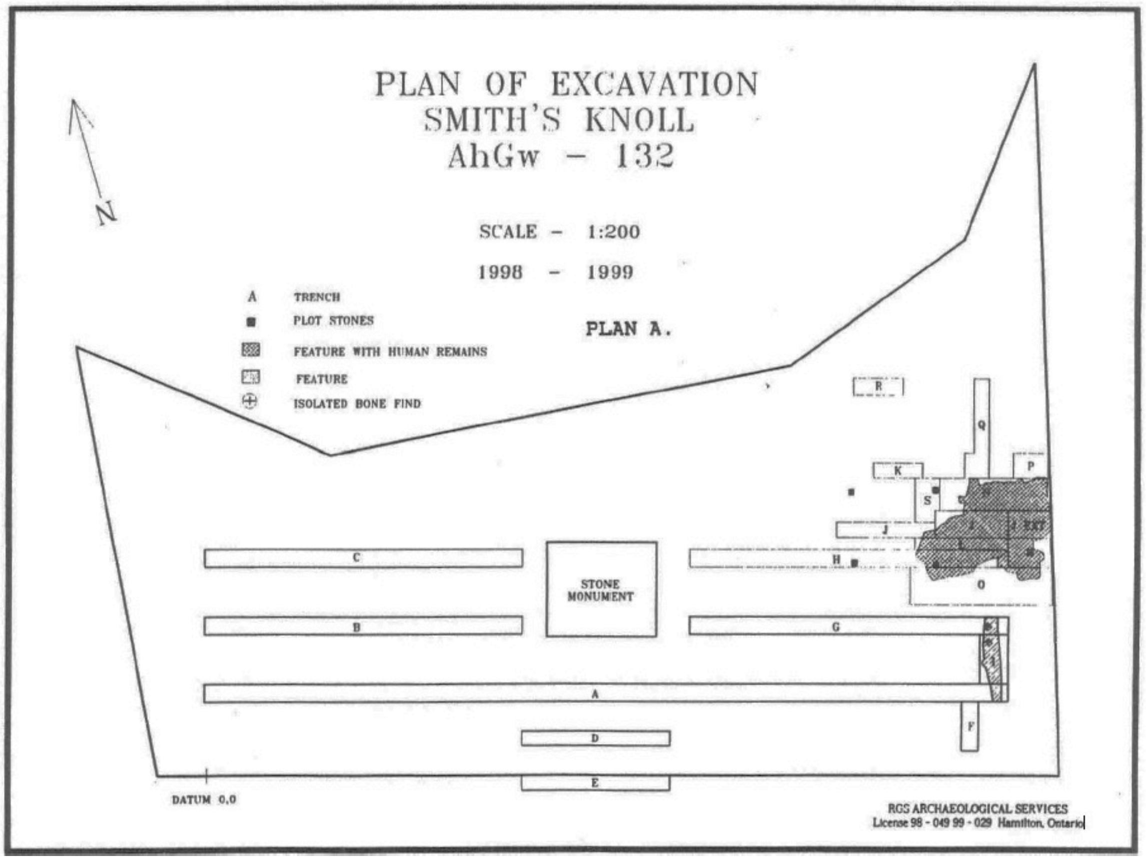

Figure 4: The Test Pits from the Archaeological Excavation in 1999. Note the image is drawn from a bird's eye view and the datum in the bottom left corner of the image (Griffin-Short 2000:18)

Soil texture is extremely important data to record from an excavation (Section 4.3.2). The soil type (e.g., sandy, clay) will regulate the movement of groundwater, microbial activity, and gases, all of which influence the rate of decomposition (Tibbett and Carter 2009). Clay soils slow the rate of decomposition (e.g., Carter et al. 2007), and were found at Smith's Knoll recorded in Figures 5, 6, and 7.

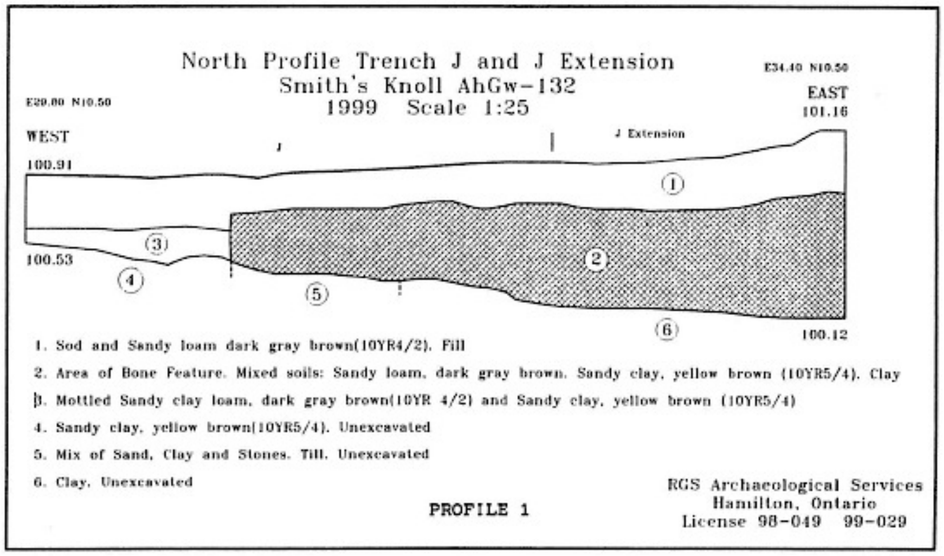

Figure 5: The North Profile Trench J and J Extension from the Archaeological Excavation (Griffin-Short 2000:107).

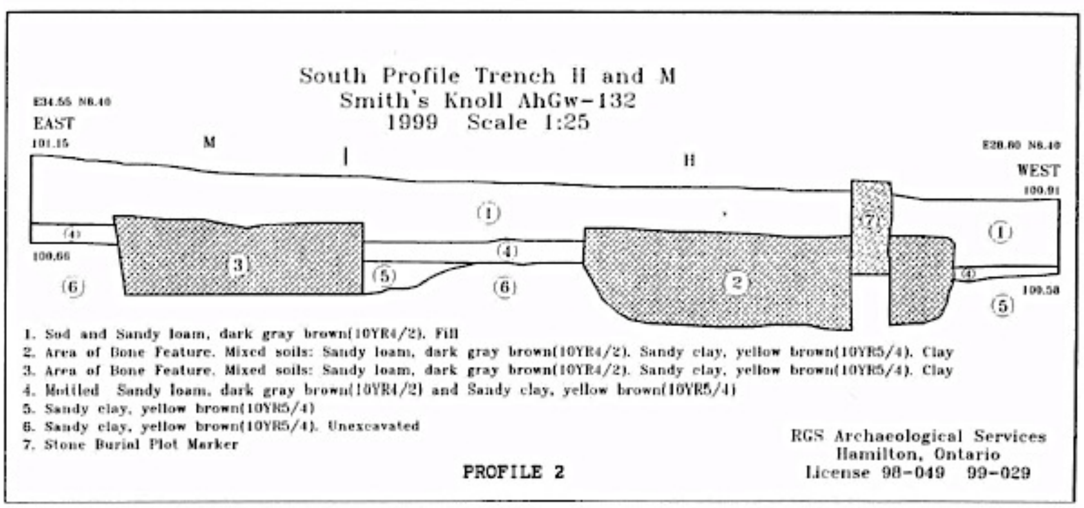

Figure 6: The South Profile Trench H and M from the Archaeological Excavation (Griffin-Short 2000:108).

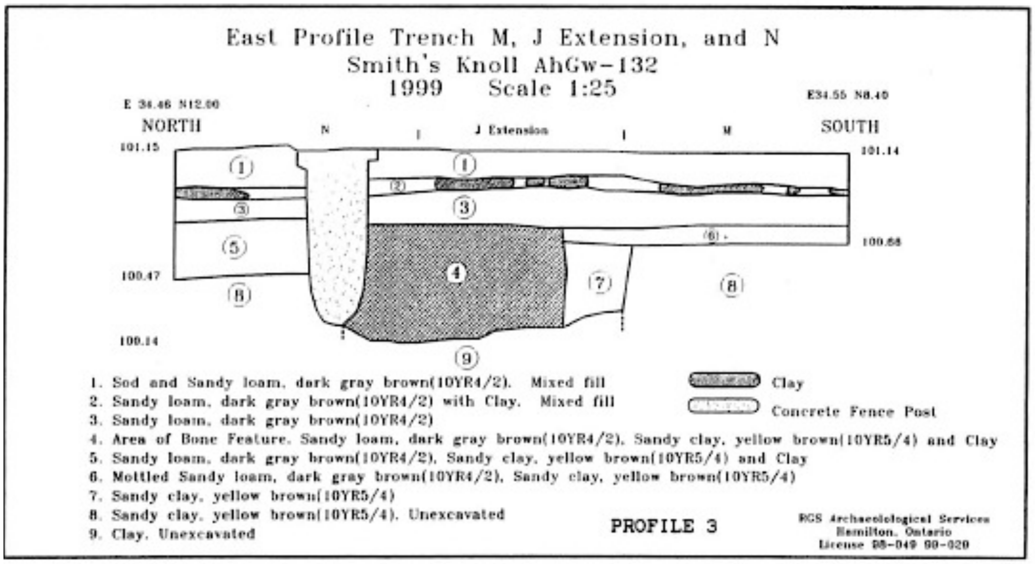

Figure 7: The East Profile Trench M, N, and J Extension from the Archaeological Excavation (Griffin-Short 2000:109).

After the excavation by RGS Archaeological Services in 1999, suggestions were made to further excavate the North and East boundaries of the property to definitively determine the extent of the burial feature (Timmons Martelle Heritage Consultants Inc. 2011). The second archaeological assessment took place in 2010 and established that the burial feature did not extend far beyond the immediate area, and the excavation in 1999 removed the majority of the human remains (Timmons Martelle Heritage Consultants Inc. 2011:69). The data from the archaeological assessments and excavation presented the full extent of the burial pit (Griffin-Short 1998, 2000; Timmons Martelle Heritage Consultants Inc. 2011).

Both the assessment and the excavation recovered numerous disarticulated human remains, animal bones, artifacts, and modern waste in a concentrated pit. The excavation data revealed that the grave outline was small and irregular with the human remains organized in clusters rather than individual discrete burials (Figure 8, Griffin-Short 2000). The clusters of bones imply the bones were disturbed after their formation in a mass grave.

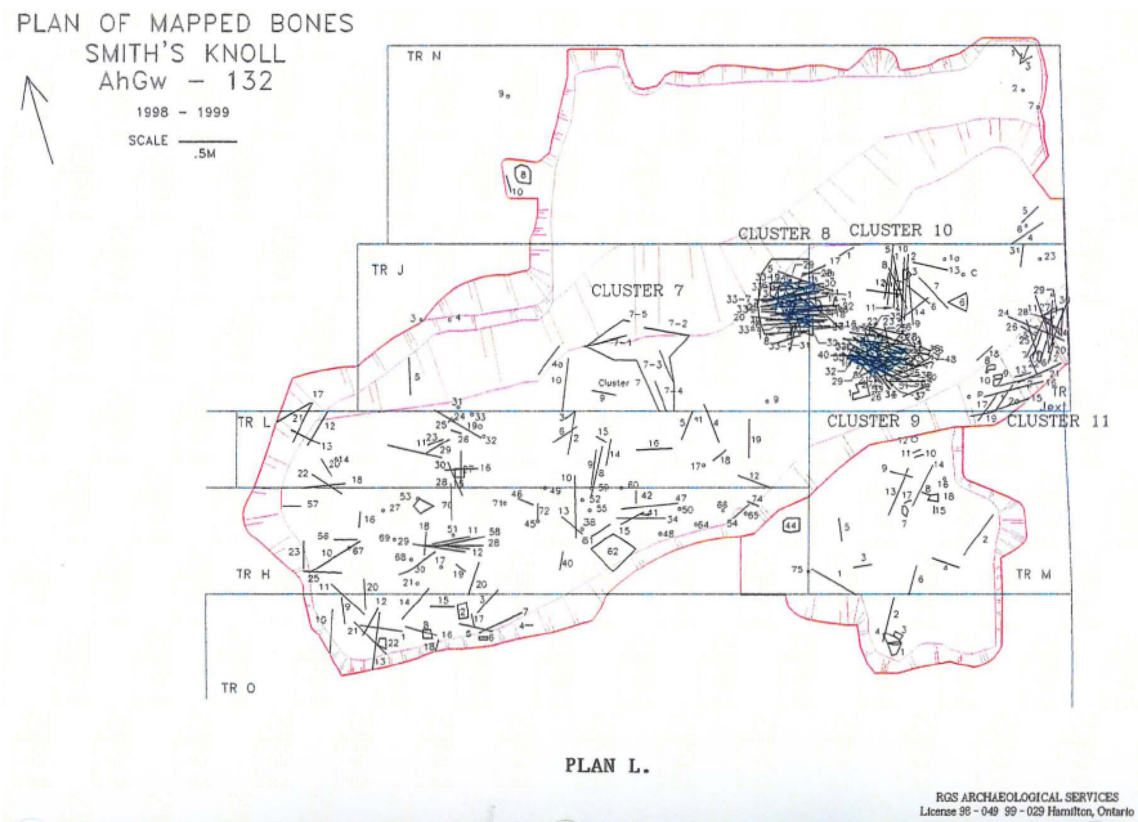

Figure 8: Plan of Smith's Knoll after the Excavation (Griffin-Short 2000:106). The red border is the burial outline. TR refers to the trenches that were excavated, CLUSTER refers to the clusters of bone, and the straight lines and numbers represent bones.

It has been suggested that a mass grave was present at Smith's Knoll (The Spectator 1908, Griffin-Short 1998, Elliott 2009). These suggestions are based on references to a grave, as opposed to graves on Smith's Knoll (The Spectator 1908), and

"…a long trench in which forty friends and foe lie sleeping…" (Elliott 2009:218). However, other accounts suggest that the soldiers were buried in single interments (e.g., Biggar 1873). The MNI from the collection was 24 based on the right radius, suggesting that at least 24 soldiers were buried on the Knoll. In order to estimate how much space the 24 individuals would physically occupy in the grave outline, data from the archaeological assessments and excavations (Griffin-Short 1998, 2000; Timmons Martelle Heritage Consultants Inc. 2011) were used to best reconstruct the grave outline.

Wooden stakes and string were used to recreate the grave outline on a flat grassy area (Figure 9a). Once the grave outline was reconstructed, 24 volunteers were instructed to lie down within the area (Figure 9b). The number of volunteers was chosen based on the MNI recovered from the Knoll, which is a conservative approach because the number of buried soldier was almost certainty higher. The volunteers were both men and women with an average height of 5'4''. The height of each volunteer was recorded, and the average was calculated in order to ensure the sample was as conservative as possible. Volunteers were instructed to lie down in an extended position, keep their arms by their sides, and ensure they made physical contact with the volunteers adjacent to them. These instructions were given in an effort to reconstruct the grave with all 24 volunteers, and to determine if there was enough physical space for a mass burial, or individual burials. An analysis of the results from the experiment suggests that the dimensions of the grave circumference were not large enough for all 24 individuals to be buried without physical contact. Even in semi-flexed positions, the majority of volunteers made physical contact. Therefore, in order to fit all 24 individuals in the area, they would have had to be situated close to one another and some individuals would have to be overlapping others. Furthermore, only six out of the 24 individuals needed to be making physical contact in order for the burial to be considered a mass grave. The experimental reconstruction of the grave offers additional evidence to support the suggestion that the soldiers from the Battle of Stoney Creek were originally placed in a mass grave.

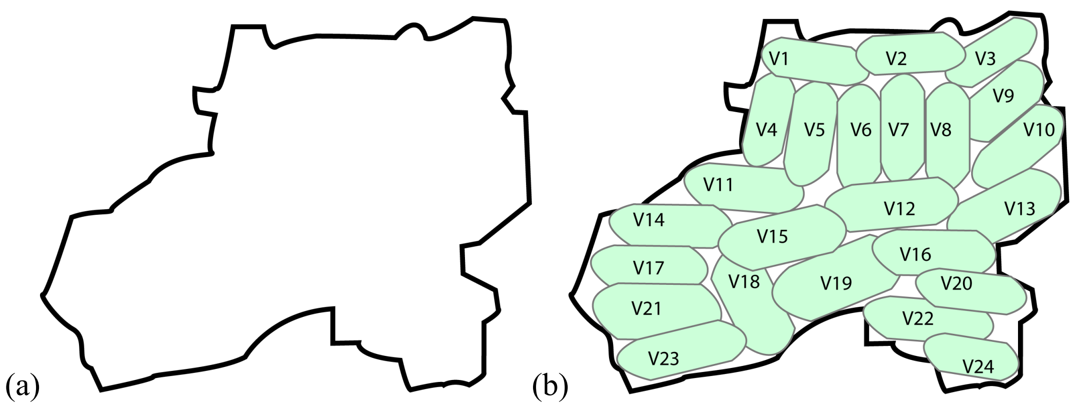

Figure 9: (a) the Dimensions of the Grave Reconstructed, (b) the Volunteers Lying in the Reconstructed Grave Area. V1-24 stands for the volunteer number (from 1-24). Note that all adjacent volunteers made physical contact.

Mass graves are often produced from battlefield sites worldwide. Examples of soldiers that were buried in mass graves on an associated battlefield include the Battle of Aljubarrota in Portugal in 1385 (Cunha and Silva 1997), the Battle of Towton in 1461, the Spanish Civil War from 1936-1939 (Renshaw 2010), and the Battle of Kupres in the mid-late 1990s from the wars in Bosnia and Herzegovina (Primorac et al. 1996). The burial of deceased soldiers in mass graves was common because there was often a lack of time and resources in order to bury large numbers of soldiers individually (Pfeiffer and Williamson 1991).

It is uncommon for battlefield sites to produce single burials, although they do occur. The Battle of Little Bighorn took place on June 25th, 1876, and it is one of the unique cases where most of the deceased soldiers were buried in individual graves (Fox 1993:73). Soldiers from the Battle of Little Bighorn were buried in haste where they fell, largely in individual shallow graves (N=34). Due to the shallow nature of the individual burials, they required restructuring in the years following the battle, and any exposed skeletal elements were buried together in a mass grave (Scott et al. 1989; Fox 1993:73).

From a review of all of the available evidence, it is very likely that at one point, at least some of the deceased soldiers were buried in a mass grave at Smith's Knoll. However, we do not know how much time passed before the area was taphonomically disturbed. The triangulation of evidence includes documentary accounts following the battle (The Spectator 1908, Griffin-Short 1998, Elliott 2009) that are supported by an experimental reconstruction as well as burial patterns from other battlefield mass grave sites. It is very likely that at least six of the 24 deceased soldiers from the Battle of Stoney Creek were interred in a mass grave, and made physical contact. Over their almost 200 year interment, we know the bones were disturbed by looting, farming, a possible exhumation, possible animal and likely insect activity, archaeological assessments and an excavation. The disturbances resulted in a burial outline containing mixed soil and disarticulated, commingled, and fragmented human remains in clusters along with faunal bones, artifacts, and modern garbage (Griffin-Short 2000). Evidence of the disturbances and clusters of bones indicates that the original burial context and provenience was lost, but it does not discount that there was a mass grave at the knoll.

Following the 1998 assessment, the human remains from the mass grave at Smith's Knoll were sent to Clare McVeigh, who was a PhD student at McMaster University at the time. In 1999, all of the human remains were sent to Dr. Maria Liston at the University of Waterloo for further osteological analysis. Dr. Liston's assessments included the age, sex, stature, pathology, trauma, and overall health of the human remains. After Dr. Liston's analysis, the human remains were stored at Stoney Creek in a stone monument.

In 2011, the human remains were removed by the City of Hamilton, and brought to Dr. Megan Brickley at McMaster University for a re-analysis, to provide additional information about the human remains for the bicentenary anniversary. A total of 2,701 identifiable fragments were inventoried into a Microsoft Excel database. Age-at-death determinations from 16 individuals ranged from young adult to middle adult according to the age categories from Buikstra and Ubelaker (1994). The age-at-death results are listed in Table 1 and were determined by analyzing the innominates (Brickley et al. 2014, in review). Additional analyses were completed during the re-analysis, including two Master's theses by Laura Lockau and Matthew Emery. The thesis by Laura Lockau (2012) focused on the prevalence of musket trauma, sharp force trauma, and fractures from the human remains from the Battle of Stoney Creek. Matthew Emery's thesis (2012) used stable isotopes to determine diet, geographic origin, and long-term residency from a sub-sample of the same collection.

Table 1: Approximate Age at Death of Soldiers from the Battle of Stoney Creek (Brickley et al. 2014, in review). Three individuals could not be assigned an age, therefore the total number of individuals is 16, not 19.

Age Category	**Approximate Range of Age at Death**	**Number of Individuals**
Adolescent	12-20	3
Young Adult	20-35	7
Middle Adult	35-50	4
Adult	20+	1
Old Adult	50+	1
Total	-	16

Over the summer of 2012, the human remains were returned to the stone monument at Smith's Knoll. What remains of the disarticulated, commingled, and fragmented collection is the extensive database at McMaster University created by Dr. Brickley and her students. The data I gathered are exclusively from the database, and was supported by the Master's theses mentioned, as well as the site reports from 1998 and 2000.

Chapter 3: Mass Graves and the Minimum Number of Individuals (MNI)

3.1 Mass Graves

There are many ways in which a body can be buried, ranging from an individual interment to a mass grave. Mass graves are not limited to time or space; they occur worldwide and throughout the archaeological record (Komar 2008). Mass graves are complicated to define, excavate, record, and research because the skeletal remains found are often disarticulated, commingled, and fragmented.

There is no consensus for the definition of a mass grave in either the bioarchaeological or the forensic anthropology literature (Haglund et al. 2001; Komar 2008). Extensive work on mass graves by Mant (1950) led him to suggest that mass graves could be defined as two or more bodies buried in contact with each other (Mant 1987:72; Jessee and Skinner 2005). Mant's definition was not widely accepted after its introduction, and is still not widely accepted today (Jessee and Skinner 2005). A more widely accepted definition of mass graves that will be used for this research indicates that the single mass grave must contain at least six individuals in close proximity with one another (e.g., Skinner 1987:268; Haglund et al. 2001:57).

Although commingling is a forensic and archaeological reality, little attention has been paid to it in the literature, possibly because commingled mass graves are more difficult to excavate and assess in comparison to individual interments (Ubelaker 2002; Adams and Byrd 2006; Varas and Leiva 2011). For the context of this research, disarticulated refers to an interred individual who is not in anatomical position. Mass graves can pose a significant problem for physical anthropologists because the commingling of remains limits the questions a researcher can ask about the past (Haglund 2002). Commingling refers to the mixing of remains (Ubelaker 2002; Hennessey 2008), and may be due to natural processes such as water flooding and animal activity (Haglund Sorg 2005; Gardner 2005), or cultural processes such as construction and looting (Stodder 2008; Varas and Leiva 2011). Fragmentation refers to bones that are not complete, and may not be identifiable (Outram 2001; Byers 2008). Each taphonomic process is discussed at length in Chapter 4, and may contribute to the degree a collection is commingled, disarticulated, and fragmented.

Disarticulation, commingling, and fragmentation tend to disassociate individuals, thereby hindering our ability to answer specific questions about an individual or the skeletal sample in general. An important goal in forensic cases involving mass graves is determining the positive identification of individuals, and is reflected by the recent forensic literature and conference topics (e.g., Klinkner 2012; University of Manchester 2013). The positive identification of individuals in a mass grave is more difficult and sometimes impossible, because bones are not associated to one another (Skinner 1987). Extremely specific questions about individuals in a disarticulated, commingled, and fragmented assemblages may be challenging, if not impossible to answer (Vollen 2001).

3.2 Types of Mass Graves

The skeletal preservation in mass graves is variable across time, and across geographic areas. Mass graves and commingling may occur in a variety of contexts due to different formation processes (Rugg 2000) such as: ossuaries (e.g., Gruspier 1999:60; Papathanasiou et al. 2000), plague cemeteries (e.g., Margerison and Knüsel 2002), situations of war and genocide, or interpersonal and ritualized violence (e.g., Pfeiffer and Williamson 1991; Walker 2001). In order to better understand how each mass graves context is different, further details will be provided in the sections to follow. The creation of a mass grave may also be intentional or unintentional, as in the case of natural disasters. Natural disasters, such as Pompeii (e.g., Sica et al. 2002; Di Bernardo et al. 2009) often contain a random sample of individuals from the population. Intentional mass graves may purposefully exclude individuals who do not share the same traits. For example, an individual who died naturally may not be included with those who died from a plague in a plague pit.

3.2.1 First Nations Ossuaries in North America

One type of mass grave that will be expanded upon in this section are ossuaries specific to North America. Ossuaries are typical First Nations burial practices and are common in Canada and the United States, often involving large deposits of disarticulated commingled individuals (Ubelaker 2002). An ossuary is a communal burial pit comprised of multiple individuals from primary, secondary, and tertiary sites of deposition. For clarification, a primary burial is the first site of deposition; a secondary burial is the second site of deposition, and so on (Tuller et al. 2008). First Nations ossuaries are especially unique because of the rituals involved with the burial, including Feasts of the Dead for the Huron, and reduction processes that involve the removal of soft tissue from bones.

Some First Nations villages such as the Huron-Wendat at the Kleinburg Ossuary (approximately dated to 1600 A.D.) held ceremonies called Feasts of the Dead every 8-12 years to honor the deceased individuals (Jackes 1977; Pfeiffer 1979; Smith 2010; Casaca 2011). The individuals who died within the past 8-10 years were removed from their primary, secondary, or tertiary burials (Jackes 1977). Movement from one burial deposition to another may cause remains to become more disarticulated, commingled, and fragmented (Williams and Crews 2003). After the deceased were taken from their interments, many were culturally modified through reduction processes. The reduction process may have involved scaffolds, which reduce the quantity of soft tissue through weathering (Smith 2010:6). Then, the living community would deflesh the remaining soft tissue from the bones and rebury the deceased in an ossuary (Smith 2010:2). Researchers should be aware that small cut marks are likely to be present around the ligaments and tendons of bones from the reduction process. This is important in order to differentiate the cut marks from other processes, such as cannibalism or rodent activity.

First Nations ossuaries, such as those of the Huron-Wendat do not include individuals who died from unnatural or violent deaths (Smith 2010:7). Infants are also not represented in ossuaries, and were often buried near roads, or under longhouse floors so that their spirits could be reborn into the bodies of a women passing by (Lewis 2009:32-33; Smith 2010:7). There are also some publications that have addressed paleopathology (e.g., Kidd 1954; Pfeiffer 1984; Casaca 2011) and health (e.g., Gruspier 1999) in Ontario ossuaries.

3.2.2 Plague Pits

Another type of mass grave is a plague pit. A plague refers to a sudden disease outbreak with a high mortality rate (Scott and Duncan 2004; Washer 2010). Different from an ossuary or mass grave in the context of war, plague pits are formed out of a pragmatic effort to bury large numbers of individuals at once (Margerison and Knüsel 2002).

The bubonic plague is an example of deadly, infectious disease beginning in Europe in 1347 A.D. (DeWitte 2010). The bubonic plague was caused by the microbe *Yersinia pestis* and produces characteristic buboes on the body of the infected individual (Crawford 2007:85-95). The second pandemic, or outbreak known as the Black Death killed approximately 25 million people worldwide (Raoult et al. 2013; Crawford 2007:104), and produced large assemblages at sites such as the Royal Mint site, and St. Helen-on-the-Walls in England (Margerison and Knüsel 2002; DeWitte 2010). The large mortality rate made it difficult to bury individuals separately, so the graves in these cemeteries were in close proximity to each other, overlapping, and cutting into older burials (Margerison and Knüsel 2002). New preliminary evidence may suggest that though many individuals were buried haphazardly, some may have been given normative funeral rites possibly based on cultural beliefs, and geographic location (Atkin 2013). Disease has a huge impact on society, inhibiting the ability of a population to follow normal burial practices, such as individual interments in recognized cemeteries. Disease stresses the social and political structures of society, and may be one of the potential reasons for the creation of mass burials in times of social unrest.

3.2.3 War or Violence

Mass graves are common in situations of genocide and warfare. According to the United Nations, genocide is the intent to destroy a national, racial, or religious group by killing members, causing serious mental or bodily harm, intentionally influencing the conditions of life, preventing the births of infants, and forcibly removing children from the group to another (Theriault 2010). The Armenian genocide in 1915 involved the displacement and persecution of Armenians, resulting in a mass grave at Ras al-Ain, Syria (Ferllini and Croft 2009). Mass graves produced out of genocide, such as Ras al-Ain, often contain adult and juvenile males and females, a population and sex distribution which is uncommon in mass graves produced out of war (Ferllini and Croft 2009). Genocide is an extremely complex topic, largely related to the political climate in an area, and for this reason, it will not be discussed further in this thesis. There are many publications on genocide worldwide for additional information, most recently in Bosnia and Herzegovina (e.g., Bax 1997; Vollen 2001; Williams and Crews 2003; Vahakn 2004; Levene 2004; Riley Sousa 2004; Stanton 2004; Warren 2007; Klonowski 2007; Steele 2008; Ferllini and Croft 2009).

The final type of mass grave discussed are those resulting from military battles or war. One of the earliest, most detailed mass grave exhumations was after World War II (Haglund et al. 2001). The deaths of over 4,000 Polish prisoners of war were investigated to confirm rumors that the Nazi government had executed Polish officers (Haglund et al. 2001; Juhl and Olsen 2006). More recently, mass grave excavations have taken place in Japan and Asia to recover war dead (Haglund et al. 2001).

Mass grave collections from the Battle of Aljubarrota in Portugal in 1385 (Cunha and Silva 1997), the Battle of Uppsala in Sweden in 1520 (Kjellström 2005), the Spanish Civil war from 1936-1939 (Renshaw 2010), and World War II cemeteries in Germany, Romania, and Russia (Popa 2013) all have similarities among them. Mass graves from war include individuals who died at a single event, from similar causes such as projectile or sharp force trauma (Kjellström 2005). The goal in war is unique: the assemblages are formed out of violence (Walker 2001) through injuring or killing another individual in order to advance specific military goals, such as the capture of a city or defensive position. The types of injuries will depend on factors such as the weapons used and their force (Section 2.2).

The demographic profiles of mass graves from war contexts are often young adult males because of enforced military enrolment (Walker 2001; Kjellström 2005; Pfeiffer and Williamson 1991:169). For the War of 1812, the British and American militia forced men to enlist in the army beginning at 16 years of age (Smith 2012:80; Turner 2000:12, 26). War often involves the movement of soldiers geographically; therefore, mass graves from war contexts may contain individuals from different countries (Popa 2013). In forensic contexts, the frequent lack of documentation makes it difficult to positively identify individuals from war in a mass grave. Positive identification may be possible through means such as DNA analysis, if it is available (Primorac et al. 1996). It is important to note that the goal of bioarchaeological research is not normally to positively identify individuals. The tasks of the bioarchaeologist may include reconstructing the lifestyle or diet of remains from archaeological sites as well as assessing age, sex, or ancestry. In order to address these questions especially in the context of mass graves, it is necessary to sort, match remains, and produce a minimum number of individuals count first (L'Abbé 2005).

3.3 Minimum Number of Individuals (MNI) in Mass Graves

Mass graves are complicated assemblages and it may be difficult to assess how many people comprise the collection. Currently, Bradley Adams, Lyle Konigsberg, and John Byrd are the leading researchers in the development of methods to determine the minimum number of individuals (MNI) estimates. The MNI is an estimate of the minimum number of individuals recovered in an assemblage based on repeating elements or element features (Adams and Konigsberg 2008). The MNI calculation was first applied in paleontology, and then in zooarchaeology (Nikita and Lahr 2011). The MNI estimate is useful because it is easy, and its purpose is to avoid duplicate elements, so that an individual is not counted twice (Adams and Konigsberg 2008). The most common way to calculate the MNI is by first sorting the elements by bone, then by side, then counting and recording the largest number (Adams and Konigsberg 2008). If bones are fragmented, the frequency of a prominent osteological feature may be used instead of a complete bone (Adams and Konigsberg 2008).

One of the problems with MNI is that the estimate does not reflect the original, true population size (Adams and Konigsberg 2008). The MNI calculation is dependent on the recovery of an assemblage, so it will always be an underestimate of the original population (Adams and Konigsberg 2008). Most archaeological assemblages (e.g., of human remains, lithics, or pottery) represent a sample of the original population. Also, the MNI calculation does not account for data loss from taphonomy resulting in the recovery of less than 100% of an assemblage (Adams and Konigsberg 2008). The Lincoln Index (LI) and the Most Likely Number of Individuals (MLNI) estimates discussed in Sections 3.3.2 and 3.3.3 do account for data loss from taphonomy.

The MNI was calculated for a number of the elements in the collection from the Battle of Stoney Creek and are listed in Table 2. Dr. Megan Brickley from McMaster University calculated the MNI for the cranial elements in the collection by identifying the bones, siding them, and recording the reoccurring features. The MNI from the cranial elements was much smaller (N=11) than the MNI for the collection (N=24) based on the right radius (Brickley 2013). One of the questions this research aims to address is whether the cranial bone MNI estimates are significantly lower than the MNI from the radius. If the crania are statistically underrepresented, it may be due to destructive taphonomic processes such as looting and farming (Chapter 4).

Table 2: MNI in the 2011 Smith's Knoll Sample (Brickley 2013)

Bone	**Side**	**MNI generated in 2011**
Femur	Left	22
Femur	Right	20
Tibia	Left	21
Tibia	Right	22
Fibula	Left	12
Fibula	Right	11
Humerus	Left	21
Humerus	Right	20
Ulna	Left	22
Ulna	Right	23
Radius	Left	21
Radius	Right	24
Scapula	Left	20
Scapula	Right	17
Patella	Left	12
Patella	Right	13
Mandible	-	13
Crania - Occipital bone	-	11
Innominate	Left	20
Innominate	Right	19
Clavicle	Left	14
Clavicle	Right	18
Calcaneus	Left	17
Calcaneus	Right	13
Metatarsal - 5th	Right	15

3.3.1 Pair-Matching

Other variations of the MNI estimate (the Lincoln Index (LI) and Most Likely Number of Individuals (MLNI)) are dependent on pair-matching bone elements. Pair-matching involves associating bilateral bone elements to one individual, which may be difficult in commingled and fragmented collections (Byrd 2008). There have been numerous publications on pair-matching methods (e.g., Snow 1948; Byrd and Adams 2003; Adams and Konigsberg 2004; Adams and Byrd 2006), and the three most basic methods are based on shape, joint articulation, and size (Byrd 2008).

Matching bilateral bones can be done by visual pair-matching, or by taking measurements of the bones, and statistically comparing their shape for significance (Byrd 2008). To compare articulating joints, the breadth of the articulation is measured and tested for significance (Byrd 2008). Pair-matching by size is done by taking multiple measurements on the bones and comparing them statistically (Byrd and Adams 2003; Byrd 2008). Inaccurate pair-matching may inflate LI and MLNI calculations, and should not be undertaken if collections are extensively fragmented (Adams and Konigsberg 2008), as with the collection from the Battle of Stoney Creek.

3.3.2 Lincoln Index (LI)

The Lincoln Index (LI) is another way of calculating an MNI estimate. The LI was first used by zooarchaeologists in population studies of living animals (Adams and Konigsberg 2008). A benefit of using the LI is that it can inform researchers about original population estimates, and accounts for small degrees of data loss due to factors such as taphonomy (Adams and Konigsberg 2004; Adams and Konigsberg 2008). The LI is calculated based on pair-matching bilateral bones where L is left, R is right, and P is the number of matched elements from the same individual into the formula (Adams and Konigsberg 2008):

$LI= LR/P$.

One problem with calculating the LI is that it may not be precise when there is low skeletal recovery, and when there are small sample sizes (Adams and Konigsberg 2004). Incorrect pair matching of bones may also introduce bias (Adams and Konigsberg 2004).

3.3.3 Most Likely Number of Individuals (MLNI)

The Most Likely Number of Individuals (MLNI) or maximum likelihood estimate is similar to the LI (Adams and Konigsberg 2008). The MNLI estimate is unique because it was developed in order to account for the bias from the LI (Adams and Konigsberg

2008). The MLNI is presented as a whole number without rounding up, from the calculation:

$$MNLI = \frac{(L+1)\,(R+1)}{(P+1)} - 1$$

where L is left, R is right and P is the number of pair-matched elements from the same individual (Adams and Konigsberg 2008). The MNLI estimate has the advantage of being a more accurate calculation than the MNI, even if bone recovery is poor (Adams and Konigsberg 2008). Bias may also be introduced to the MNLI estimate if there is incorrect pair matching (Adams and Konigsberg 2004).

Experts Adams and Konigsberg (2004, 2008) suggest that the LI and MLNI not be used if bones are extremely fragmented. Unfortunately, mass graves are often fragmented, limiting the use of pair matching, LI, and MLNI estimates. The collection from the Battle of Stoney Creek was not pair-matched because it was so highly fragmented.

Chapter 4: Taphonomy: Preservation and Completeness

4.1 Taphonomy

Taphonomy is an important concept and its effects should be addressed at any site whether archaeological or forensic. To discuss the taphonomic processes that occurred at Smith's Knoll, we must first understand what taphonomy encompasses and why it is so important. The definition of taphonomy has received a lot of attention over the past few years (e.g., Lyman 1994; Lyman 2010; Marín-Arroyo et al. 2012). Taphonomy was coined by the Russian paleontologist I.A. Efremov (1940:85) as "…the study of the transition (in all its details) of animal remains from the biosphere into the lithosphere…". Originally, the term taphonomy referred to the two stages of biostatinomy and diagenesis (Lyman 2010). Biostatinomy includes the events occurring from an organism's death until its final deposition, whereas diagenesis involves the processes that occur from an organism's final deposition until recovery (Lyman 2010). An example of a diagenetic change is the exchange of ions from the soil in the burial environment to the bone (Gill-King 1997). Like most terms, the definition of taphonomy has changed over time, with a more recent, focused emphasis on *understanding the processes* that influence an organism or collection of organisms (Lyman 2010, Behrensmeyer 2000). Taphonomy has grown into an interdisciplinary field and has been incorporated into archaeology, forensic anthropology (Haglund and Sorg 2005), zooarchaeology (Marín-Arroyo et al. 2012), and others. Lyman (1994; 2010) cautioned archaeologists on their improper use of the term, emphasizing that taphonomy refers to both natural *and* cultural processes influencing an assemblage. Lyman further highlights that taphonomy uses once living organisms (e.g., skeletons or seeds) to learn about an assemblage, while the formation of the archaeological record is concerned with both living and non-living organisms (e.g., lithics or pottery) (Lyman 2010:12).

Taphonomic processes directly influence the preservation, representation, and completeness of bone elements, producing unique collections. Taphonomic factors include decomposition, weathering, diagenesis, soil characteristics, animal activity, and mortuary programs (Stodder 2008). Understanding the process of decomposition is essential to this research because the rate of decomposition depends on a number of factors, and may impact the preservation, and completeness of bone elements. Weathering, diagenesis, soil type, soil temperature, and soil pH have an effect on the decomposition of bone, and may make bone more prone to postmortem fractures and warping. The collection of human remains from the Battle of Stoney Creek is very fragmented, and this may be due to the exposure of bones to the sun, wind, and rain. Animals may break bones, quicken decomposition, digest, or displace small bones, which may account for an underrepresentation of certain bones in archaeological collections. The mortuary program refers to how, where, and why individuals were buried, as well as intentional and unintentional modifications. Better understanding each of these taphonomic effects will help to contextualize why some bones may be over or underrepresented, and which bones may be more weathered.

4.2 Preservation and Completeness

Preservation refers to two separate concepts: the completeness and the condition of bone (Stodder 2008). Differentiating between completeness and the condition of bone are important because they are separate components of this research. Completeness of bone refers to the amount of bone present. The condition of bone refers to the visual quality of the bone, and can result in the fragmentation of a bone. The representation of bone is also known as its total frequency in an assemblage, and is influenced by both bone completeness and condition. This research aims to first determine whether small bones are underrepresented in comparison to long bones, and second, to determine which bones were more weathered.

The most commonly used scale for the completeness of human remains is outlined in the 'Standards for Data Collection from Human Skeletal Remains' (Buikstra and Ubelaker 1994:6-8). The scale is out of three, a score of one is given if the bone is between 75 and 100% complete, a score of two if the bone is between 25 and 75% complete, and a score of three if the bone is less than 25% complete (Buikstra and Ubelaker 1994:6-8). The scale developed by Buikstra and Ubelaker (1994) is straightforward, but may be confusing once a collection is no longer available for study. There may be confusion if a researcher gave a bone a score of two, but did not include a drawing to specify the areas that were present. Future researchers who do not have access to the bone would not know which areas were present, or if the bone was closer to 25% or 75% complete. For this reason, it is common for researchers to use their own scale of completeness (e.g., Walker et al. 1988; Knüsel and Outram 2004; Byers 2008). Other possible reasons for using a different scale of completeness may include extensive fragmentation of bones, commingling of bones, a collection from a mass grave, or using a more specific scale for a forensic investigation (with a more detailed recording of how complete the bones are).

The condition of bone includes aspects of bone color, texture, hydration, weight, condition/fragmentation, fragility, and the presence of soft tissue (Byers 2008:75-78). Preservation is often measured as good, fair, poor, absent, or not applicable in the case of subadults (Byers 2008:149). It is accepted that subadults are underrepresented in the archaeological record, possibly due to poor preservation (Lewis 2009:20-22). Lewis (2009:23-24) discusses reasons for the possible poor preservation of infant remains such as the size, density, and fragility of bones (especially regarding the fontanelles) of the crania in infants and young children. It should be noted that the burial environment, and taphonomic factors such as the atmospheric temperature, and the influence of fauna can enable the bones of infants and juveniles to be better preserved than adults (Lewis 2009:24).

Some researchers use and define their own stages of preservation (e.g., Walker et al. 1988, Gordon and Buikstra 1981; Mays 1991; Bello et al. 2006; Stojanowski et al. 2002), do not define the stages of preservation (e.g., Kjellström 2004), or do not complete analyses of bone preservation at all (e.g., Pfeiffer and Williamson 1991). Not including a preservation analysis may be due to multiple reasons such as: the analysis does not fit with the project focus, time constraints, funding constraints, or a limited number of investigators. Assessing the condition of bone on a standard scale allows researchers to compare bones across collections, and to determine if the same bones are over- or underrepresented. Furthermore, it gives researchers the opportunity to address why certain bones are better represented, and their potential reasons. The condition of bone in this study was recorded in the database by using the weathering scale developed by McKinley (2004). The scale assesses the erosion of bone, and the zonation method (Knüsel and Outram 2004) records bone completeness.

Studies investigating the condition of bone began in zooarchaeology with the work of Brain (1976). Brain (1976) found that the survival of goat bones was based on the durability of the bone, and its size. Marean (1991) also hypothesized that size, shape, and density of bone would influence the degree of bone fragmentation (cited in Darwent and Lyman 2002). Preservation studies in osteology found that density was an important factor determining the survivability of bone elements; unfortunately, such studies omitted the smaller bones such as the carpals and metacarpals (e.g., Willey et al. 1997; Galloway et al. 1997).

From the data provided by Waldron (1987), the petrous portion of the left temporal, the left proximal femur, the left third metacarpal, the sciatic notch, and the auricular surface were the most represented bone elements at the West Tenter Street Site. When looking at the upper and lower limb bones, Willey and colleagues (1997), and Galloway and colleagues (1997) found that the denser shafts preserved better than the epiphyses of bones. At another site, Darwent and Lyman (2002) found that the larger less spherical faunal bones had an increased tendency to be fragmented, and the smaller, more spherical, and dense bones were the least fragmented. Given these conflicting data regarding which bones (upper, lower, larger, or smaller) are more likely to preserve, more research is needed to investigate the representation of bone. This research is specifically designed to assess representation and weathering issues in a skeletal sample, and provide such information from a collection that is commingled, disarticulated, and fragmented.

4.3 Factors that Impact Preservation and Completeness of Bone

4.3.1 The Natural Process of Decomposition versus Differential Decomposition in Mass Graves

A variety of factors impact preservation and completeness, and are particularly relevant to the collection from the Battle of Stoney Creek. The first process that occurs after death is the decomposition of the body. Decomposition occurs on a continuum, and is a complicated process because it can be affected by a multitude of factors (Pinheiro 2006). Decomposition is divided into distinct stages, the number and characteristics of which can vary depending on the researcher (e.g., Rodriguez and Bass 1983; Galloway et al. 1989; Love and Marks, 2003; Aufderheide 2011). The general decomposition process however, is straightforward, and begins at death with algor mortis, livor mortis, and rigor mortis (Janaway 1996).

Algor mortis refers specifically to the body's internal drop in temperature after death (Clark et al. 1997; Marks et al 2009). During algor mortis, the internal temperature of the body will be similar to the ambient temperate (Geoff 2009). Livor mortis also known as lividity or hypostasis, refers to the pooling of blood in the body because circulation has stopped (Geoff 2009). Blood will settle to the lowest parts of the body due to gravitational pull (Marks et al. 2009). Rigor mortis is the conversion of adenosine triphosphate (ATP) into adenosine diphosphate (ADP) and lactic acid, which lowers the pH of cells (Geoff 2009). The result is the stiffening of the muscle tissues and rigor beginning one to two hours after death and lasting around 84 hours, until the muscles relax (Marks et al. 2009; Geoff 2009). It is important to note that algor, livor, and rigor mortis occur independently of each other, but their extent and rate is dependent on environmental factors such as temperature (Clark et al. 1997)

Autolysis is the degeneration of tissues and the postmortem necrosis of the body's cells caused by the digestive fluids in the intestinal tract (Byers 2011:95). Autolysis is identifiable by pale skin and possible skin slippage (Love and Marks 2003). Putrefaction is caused by the internal decay of soft tissues and organs occurring in the late stages of autolysis (Gill-King 1997) when microorganisms grow and damage internal tissues such as the intestinal tract (Byers 2011:95). The bacteria contained in the intestinal tract proliferate and destroy other tissues, resulting in the release of gases that bloat the body (Byers 2011:95). Under normal circumstances, the tissues that decompose first are those of the digestive tract, then the heart, lungs, kidney, bladder, brain, nervous tissues, muscles, and finally, the connective tissues (Gill-King 1997). Severe injuries and infections may quicken soft tissue decomposition (Stodder 2008). The decay process furthers the soft tissue decomposition by exposing what is left of the internal tissues (Galloway et al. 1989). After skeletonization has been reached (where more than half of the skeleton is exposed), the body undergoes extreme decomposition (Galloway et al. 1989; Byers 2008:116-118). Extreme decomposition is the exposure of the skeleton to the surrounding environment, and may result in damage to bone (Galloway et al. 1989; Byers 2008:1116-118). Complete decomposition may take a couple of months to years in length (Galloway et al. 1989; Byers 2008:116-118). The rate of decomposition, and length of time of time to reach the extreme decomposition stage is dependent on factors such as general atmospheric temperature (Rodriguez 1997; Komar 1998; Carter et al. 2010), soil moisture and pH (Rodriguez 1997; Carter et al. 2010), soil temperature (Prangnell and McGowan 2009), insect activity, animal activity (Aufderheide 2011), depth of burial (Rodriguez and Bass 1985), the burial type, as well as orientation of bodies in a single burial pit (Mant 1950). The stages of decomposition are the same in both individual burials and mass graves; however, the rate of decomposition varies depending on the factors listed above.

It is important to understand how bodies in a mass grave decompose (Mant 1987:72) because rates of decomposition are different when comparing individual burials to mass graves (Komar 2008; Haglund 2002). Individuals interred in deeper levels of soil (Rodriguez and Bass 1985; Rodriguez 1997), and in the center of mass graves decompose more slowly than those closer to the surface of the soil and on the outer periphery of the grave, called the ‘feather edge effect’ (Mant 1950:33; Haglund 2002; Haglund and Sorg

2005; Jessee and Skinner 2005). The feather edge effect occurs because of two different environments in the mass grave. The first environment occurs between the bodies and the soil matrix. Contact between the two encourages decomposition because of the porosity and percolation of the soil (Haglund 2002). The second synergistic environment is produced between the decomposing bodies in the mass (Haglund 2002). It has also been suggested that the degree of soil compaction results in less damage by animal and insect activity (Haglund 2002). Mant (1950) noted that in mass graves, preservation was better where bodies were in contact, and in the center of the mass because they decomposed in a separate environment from the soil. Acknowledging that the process and rate of decomposition may differ in mass graves is important because there was a mass grave buried on Smith's Knoll for an unknown length of time. Burial in a mass grave according to the feather edge effect suggests that the bones of the skeleton may be represented and preserved differently. The degree of preservation may depend on the original orientation of the corpses within the mass grave where the bones at the center and deepest portion of the mass grave should theoretically be better preserved.

4.3.2 Weathering, Soil Texture, Soil pH, and Diagenesis

Weathering is the physical destruction of bone over time (Stodder 2008). Living bone, often referred to as green bone, is composed mostly of collagen (30%) and hydroxyapatite (70%) (Stodder 2008). Living bone is yellow and greasy from contact with body fats and fluids, but when bone is exposed to elements like the sun, it dries out

(Byers 2011:67). Known as bleaching, bone becomes ivory, off-white in color, and may crack and/or flake (Behrensmeyer 1978; Rogers and Calce 2007; Janjua and Rogers 2008; Byers 2011:67). Other factors that impact weathering include the wind, temperature, soil type (Morris 2013:12), and rain (Collins et al. 2002). Weathering is a process, and it is common for a bone element to exhibit more than one type of weathering on different areas (Prassack 2011).

Bone weathering characteristics may be used to better understand the conditions of the burial site (Behrensmeyer 1978), and to compare bone elements from other sites (e.g., Tappen 1994; Ross and Cunningham 2011). A 6-point weathering scale was developed by Behrensmeyer (1978) based on her study of faunal bones from the Amboseli Basin in Kenya. The scale ranges from 0 (no evidence of weathering) to 5 (fragmented splinters, and fragilility due to weathering) (Behrensmeyer 1978). Behrensmeyer (1978:160) also found that the bones of small animals weathered more quickly than the bones of larger animals, which she attributed to a "size-related bias". Gill-King (1997) suggested that the surface area of larger bones allows for more interaction with environmental factors; therefore, large bones would provide more information on weathering patterns (Janjua and Rogers 2008). A recent study by Cunningham and colleagues (2011) on juvenile pig bones noted differing weathering patterns between the vertebrae, the ribs, and the tubular bones such as the metacarpals, metatarsals and phalanges. Cunningham and colleagues (2011) found the articular facets of the vertebrae and ribs were more likely to weather, versus the cortex of the tubular bones due to the more fragile structures of the juvenile vertebrae and ribs.

Identifying patterns of weathering on different bones like the studies mentioned impact other analyses, such as completeness, sex determination, and age determination. Different stages of weathering influence the condition of bone, and damage the surfaces of bones used for age and sex determinations (e.g., the auricular surface, pubic symphysis, and other features of the innominate) (e.g., Todd 1920; Lovejoy et al. 1985; Rogers and Saunders 1994). Therefore, damaged or absent bone features/or bones hinders the ability of researchers to accurately determine age or sex. Weathering analyses from the collection of human remains from the Battle of Stoney Creek may provide new information about the patterning and degree of weathering in disarticulated, commingled, and fragmented skeletal collections.

The weathering scale developed by Behrensmeyer (1978) is useful, and has been reprinted in texts such as Buikstra and Ubelaker's (1994:98-99) 'Standards' volume; however, faunal bone is different than human bone. Human bone and animal bones differ anatomically, structurally, histologically, and in terms of bone density (Watson and McClelland 2013), so it may not be appropriate to use a weathering scale that was developed for faunal remains. For this reason, an alternative scale for recording surface preservation, erosion, and abrasion of human bone was used to record the weathering of bones from the Battle of Stoney Creek (following McKinley 2004). The weathering scale by McKinley (2004) is not discussed in this section because it was part of the methodology used by Dr. Brickley and her co-workers. For this reason the scale by McKinley (2004) is discussed at length in the Materials and Methods Chapter, Section 5.2.2.

Soil texture is factor that influences the rate of decomposition and in turn, the preservation and completeness of bone. Soil textures have been established to affect the rate of decomposition because the soil type regulates the movement of ground water, microbial activity, and gases (Tibbett and Carter 2009). Soil textures are grouped by the size of particles, and the classification system is publically available and widely used by archaeologists (Government of Canada 2013). Clay soil has been known to inhibit decomposition (Carter et al. 2007), because it has the lowest rates of gas diffusion between the body and soil, and enables the survival of anaerobic microbes (less efficient decomposers than aerobic microbes), slowing decomposition in comparison to other soil types (Tumer et al. 2013).

The exchange of ions between bone elements and their variable environments is a chemical process that occurs during diagenesis (Gill-King 1997). The purpose of the remaining sub-section is to provide a brief overview of soil acidity, microbial attack, and the general process of diagenesis. For more information, the publications by White and Hannus (1983), Collins and colleagues (2002), and Hedges (2002) expand upon the complexities of diagenesis, and specific types of ion exchanges.

Diagenesis of bone (and decomposition by extension) occur through (1) the slow loss of collagen, (2) the diagenetic change of apatite, and (3) microbacterial activity (Collins et al. 2002; Collins pers. comm. 2012). The amount of collagen lost depends on time, temperature, and soil pH (Collins et al. 2002). The diagenesis of apatite depends on the hydrology of the burial environment, and the amount of microbial attack is dependent on pH (Collins et al. 2002). The pH scale measures acidity and alkalinity on a scale of 0-

14, 7 being neutral and 1 being highly acidic (Environment Canada 2013). Using buried skeletal remains, Gordon and Buikstra (1981) found that as the soil pH decreases and becomes more acidic, the destruction of bone increases. Maat (1993) also found that highly acidic soils (with a low pH) dissolve the minerals in bone. Alkaline soils (with a high pH) may also produce diagenetic and weathering effects on bone because the salt in the soil crystalizes on the cortical surface (Behrensmeyer 1978).

The extreme seasonal cycles in Canada over the course of a year change the chemistry of ground water (Stodder 2008), which reacts with buried and unburied bone through an exchange of ions (Behrensmeyer 1978). The seasonal cycles also cause damage to buried bone in contact with groundwater, but its exact diagenetic effects are not completely understood (Hedges 2002). The study of diagenesis is a growing field, and despite diagenetic effects, researchers are still able to deduce information about antemortem diseases, the age of bone, dietary patterns, (Gill-King 1997), and the surrounding burial environment (Fernández-Jalvo et al. 2010).

4.3.3 Animal Scavenging

Animal activity can have a profound impact on bones. During the decomposition process, animals often scavenge the body for food if it is accessible, and eat the soft tissue and bone marrow of the body (Marín-Arroyo and Margalida 2012). Different animals produce different marks on bone (Patel 1994; Haglund and Sorg 1997a; Haglund and

Sorg 1997b; Byard et al. 2002; Cáceres et al. 2013), which may resemble trauma to an inexperienced observer (Spradley et al. 2012). The most commonly reported animals to scavenge a body postmortem are coyotes, dogs (Haglund and Sorg 1997a), and rodents (Haglund and Sorg 1997b), all of which can be found in Ontario. Knowing the types of postmortem modification these animals can produce on human bone is important to this research because it may have affected the scattering, and completeness of bone.

Rodents that produce gnawing marks on bone include gerbils, mice, squirrels, and rats (Haglund 1997b). Gnawing marks on bone are distinctive small straight parallel grooves, channels, or furrows with a flat floor (Johnson 1985; Byers 2008:393). Rodent incisors are constantly growing, so to shorten and sharpen their teeth and supplement their calcium intake, rodents often gnaw on bone (Haglund 1997b; Byers 2008:393). Rodents are also known to displace small bones like those of the hands and feet, and even take them to their nests (Haglund 1997b), which may produce an underrepresentation of small bones.

Medium sized canids, such as dogs, coyotes, and wolves have powerful jaws, producing extensive damage to bone (Haglund 1997a). Haglund and Sorg (1997a) documented the four most common types of carnivore markings on bone based on the original work of Binford (1981), and Haynes (1980, 1982). Puncture marks are described as collapsed, relatively circular depressions that penetrate the bone (Haglund 1997a; Byers 2008:389-392). Pits refer to indentations from teeth that have failed to penetrate the bone's surface (Haglund 1997a). Scoring are slips of a tooth or teeth across compact bone (Haglund 1997a), often following the bone's contour (Eickhoff and Herrmann 1985).

Furrows are deep scoring that often penetrates into the marrow cavity on the ends of long bones (Byers 2008:391; Haglund 1997a). Canid modification may produce fractures, or further fragment bone, impacting the completeness and preservation of bone in collections.

A substantial amount of new research has been collected on potential animal scavenging patterns, and how they scatter human remains (e.g., Steadman and Worne 2007; Moraitis and Spiliopoulou 2010; Spradley et al. 2012). Carnivores will often scavenge and disarticulate the human body in stages, roughly based on the degree of decomposition and ease of detaching limb bones (Haynes 1980; Haynes 1982; Haglund et al. 1989; Haglund 1997; Kjorlein et al. 2009). Carnivores often spread remains away from residential, high traffic human activity areas (Kjorlein et al. 2009). Unlike rodents, carnivores are large enough to swallow and partially digest smaller bones as well. The digested bones will exhibit corrosive damage from the animal's digestive tract (Moraitis and Spiliopoulou 2010; Lloveras et al. 2012), and may make identification more difficult. Scavenging by canids is limited by the length of time the body is available to be scavenged. The recorded stages of canid scavenging are listed in Table 3 (Haglund 1997a).

Table 3: Stages of Canid Scavenging (from Haglund 1997a:368).

Stage	Condition of Remains	Range of Observed Postmortem Interval
0	Early scavenging of soft tissue with no body unit removal	4 hours-14 days
1	Destruction of the ventral thorax accompanied by evisceration and removal of one or both upper extremities including scapulae and partial or complete clavicles	22 days-2.5 months
2	Lower extremities fully or partially removed	2-4.5 months
3	All skeletal elements disarticulated except for segments of the vertebral column	2-11 months
4	Total disarticulation with only cranium and other assorted skeletal elements or fragments recovered	5-52 months

Animal activity can alter decay rates, change the decomposition sequence (Galloway 1997), further damage bone, and scatter human remains (Stodder 2008). Some researchers have attributed the underrepresentation of bones to possible animal activity (e.g., Gill-King 1997; Haglund 1997b). The amount of animal activity may have also had an impact on the representation and weathering of the collection of human remains from the Battle of Stoney Creek.

4.2.4 Cultural Activity: Intentional and Unintentional

Human activity, whether intentional or not, can modify a bone assemblage. Human practices like farming, looting, and archaeological excavation may not have intended to produce damage to bone, but do so regardless. Such activities are categorized as unintentional human modification (Stodder 2008). Ritual behavior, disarticulation, or processing bones can cause deliberate damage to the bone for a specific purpose or end goal, classified as intentional modification (Stodder 2008). Human modification of bone can take many forms, and it is important to be able to differentiate between them, so that sound conclusions about an assemblage can be made. The most common and well-known modifications are discussed below, some of which may have occurred at the Battle of Stoney Creek, and others that can be ruled out based on their characteristic features.

Unintentional human modification of an assemblage can occur through means such as looting, farming, or excavation methodology. Looting or grave robbing is illegal, and involves intentional stealing of artifacts and/or bone elements from graves (Parker-Pearson 1999:188; Kelley et al. 2011). Looting can fragment bone elements, destroy the provenience and context of the assemblage, and may be responsible for missing bones and/or artifacts (Green and Doershuk 1998; Gill and Chippindale 2002; Kelley et al. 2011). It has been suggested that the site was looted for military memorabilia in the years after their burial, which likely damaged the bones from the soldiers buried on Smith's Knoll in Hamilton, Ontario (Mills 1899; Griffin-Short 1998; Griffin-Short 2000). Only recently have government laws began to be established to prohibit the vandalism and theft of human remains and artifacts in Ontario.

There are a number of governmental regulations concerning the donation, deposition, cremation, vandalism, and theft of human remains and artifacts in Ontario (e.g., The Anatomy Act R.S.O. 1990, The Cemeteries Act S.O. 2002, The Ontario Heritage Act R.S.O. 1990). The Cemeteries Act for Ontario was revised in 2012, and is now known as the Funeral, Burial, and Cremation Services Act (2002). According to the revised Act, disturbing a known burial site or artifacts associated with human remains is illegal and is punishable by law (Service Ontario e-Laws 2002). In the case an unknown burial site is disturbed, the police or coroner must be contacted immediately (Service Ontario e-Laws 2002). Cemeteries in Ontario are registered and also have specific rules and regulations they must follow such as the preparation of a lot for burial, preparation for cremation, and the legal scatter of human remains. Further information is provided in the Funeral, Burial, and Cremation Services Act (2002).

Farming or construction can also damage assemblages. Documented information regarding the extent of unmarked burial grounds can be lost over time, and during land development the burials may be disturbed. According to historic records, the bones from the Battle of Stoney Creek were discovered when Alan Smith was farming the area (Section 2.6). Haglund and colleagues (2002) state that farming can cause minimal to extensive damage of skeletal elements, depending on the type of machinery used, the depth of the burial, age of the burial, and whether the bones were exposed to the surface after they were farmed. These factors heavily influence the degree to which bones are fractured by vertical and/or horizontal displacement (Haglund et al. 2002). Cultivation practices may increase the rate of decay, weathering, fracture, and dispersion of bones (Halgund et al. 2002), which may account for the underrepresentation of bones. Farming was practiced at Smith's Knoll, so it likely displaced and fractured bone elements, impacting their representation and overall weathering.

Research suggests that the type of excavation methodology (Tuller and Đurić 2006), and the experience of excavation staff may impact the completeness and representation of skeletal elements (Haglund 1997a; Waldron 1987; O'Meara 2014 pers. comm.). Tuller and Đurić (2006) found that the 'stratigraphic' excavation method was more efficient than the 'pedestal' method because it is more controlled and better maintains context and provenience in mass graves. The stratigraphic excavation method involves removing bodies and artifacts in reverse order, from the top of the grave downwards (Tuller and Đurić 2006). The pedestal method removes soil around each body for individual pedestaling effects (Tuller and Đurić 2006), causing the excavation floor to be unleveled. The archaeological assessment and excavation undertaken to exhume the human remains from the Battle of Stoney Creek occurred in 1998 and 1999; however, it is only recently that guidelines and standards for detecting and excavating mass graves in forensics and archaeological contexts have been suggested (e.g., Skinner et al. 2003, Steele 2008, Kalacska et al. 2009). Some guidelines include transparency of the recovery, and extensive documentation of the excavation (Skinner 1987; Steele 2008).

Experience of the staff or volunteers conducting the excavation also has an impact on the condition and number of bone elements and/or artifacts recovered (Waldron 1987; Haglund 1997a; Dibble et al. 2005; Stodder 2008; O'Meara 2014 pers. comm.). The theory behind the excavation technique, learning what to look for during an excavation, and practice using the excavation technique (among other tasks) takes time to learn. For this reason, staff or volunteers with little to no experience excavating may unknowingly, accidentally damage bones and artifacts (Stodder 2008), or overlook them completely. Recent unpublished research suggests that the recovery of bone elements may be correlated to the experience of the excavators (Don O'Meara pers comm 2013; 2014).

Some of the staff on the archaeological assessment and excavation for the Battle of Stoney Creek were junior archaeologists; although they were supervised by experienced archaeologists (Griffin-Short 2000). The set-up of experienced and possibly inexperienced staff may have successfully facilitated a positive environment for learning, and minimally fragmenting, or overlooking bones. For more information on the archaeological assessment and archaeological excavation, see Section 2.6.

Intentional cultural activity also has an impact on representation, and includes ritual activity, disarticulation, and processing. There is a limited amount of information on the intentional cultural activity regarding the deceased soldiers from the Battle of Stoney Creek. For this reason, it is crucial to be aware of the possible types of intentional modification. Ritual activity used in the context of this research includes the ways which people are buried according to traditions or beliefs. For example, many people today are embalmed, dressed, and buried in coffins, placed in mausoleums, or buried in the ground. Embalming a body preserves the soft tissues and slows decomposition. Coffins and mausoleums may protect the body from animal scavenging, and extend the time before the body is exposed to insects, but Mant (1987) found that wooden coffins actually accelerate the rate of decomposition when in the ground. Each decision and action towards the deceased impacts the preservation of the body, and the rate of decay. It is unlikely that coffins were used at Smith's Knoll because there was no evidence in the form of coffin hardware or coffin wood found during the excavation (Griffin-Short 2000). Some cultures also bury individuals differently based on their biological sex (McAnany et al. 1999), or beliefs (Ogilvie and Hilton 2000). In New Mexico, people believed to be witches were executed, and their bodies were inflicted with ritual violence (Ogilvie and Hilton 2000). The direction and position of the deceased may also be dependent on beliefs; supine and extended with the head facing West for Christians (McAnany et al. 1999), while for Islamic burials it is customary for the individual to be placed on his/her side, with the body facing Mecca (Burns 1998). It has been suggested that the deceased soldiers from the Battle of Stoney Creek were collected the same day (Elliott 2009), and the soldiers were buried without coffins (Griffin-Short 2000).

Purposeful disarticulation and processing of bodies may be undertaken for various reasons, including the preparation for a secondary burial. Oftentimes, the bones from Native American ossuaries exhibit small cut marks from the soft tissue removal and the dismemberment process (Willey and Emerson 1993; Emily Holland 2011 pers comm; April Hawkins 2011 pers comm). Marks made from dismemberment can be differentiated from other marks such as those produced by cannibalism. For example, cut marks from cannibalism are often located on areas of large muscle origins and insertions (Stodder 2008; Stodder and Reith 2011; White 1992). Two of the most well known cultures that practiced human sacrifice and cannibalism were the Mayans and Aztecs respectively (Harner 1977; Ingham 1984; Tiesler and Cucina 2006). Dismemberment due to ritual practice, or cannibalism would influence the decomposition of the body, as well as the completeness and weathering of bones. When recovered, the human remains from the Battle of Stoney Creek were disarticulated, commingled, and fragmented. However, it is unlikely that the bodies of the soldiers were reduced, as cut marks on the bones and commingling were later attributed to battle wounds, and other taphonomic factors such as farming activity (Lockau 2012).

Intentional and unintentional cultural modifications affect an assemblage and may be documented in the ethnographic and/or historic data, or left up to the researcher to assess on the bones. Evidently, present and past human activity plays an important role in the representation, weathering and potential modifications of bone in collections and should be acknowledged by researchers.

Chapter 5: Materials and Methods

5.1 The Database at McMaster

The collection of human remains from the Battle of Stoney Creek was catalogued with the goal of producing a database with detailed information about each bone fragment (N=2,701) (Lockau 2012:71). Data were recorded in Microsoft Excel spreadsheets, and converted into a database using Filemaker Pro 2011 software (Lockau 2012:71). The thesis by Laura Lockau (2012) provides a detailed list of the steps taken to record each fragment.

The type of information recorded in the database includes: the bone, side, a Smith's Knoll category number, zone presence or absence to determine completeness, fragment size in millimeters based on the categories of Knüsel and Outram (2004), age, sex, traumatic lesions (antemortem, perimortem musket injuries, perimortem fractures, postmortem trauma), weathering (from McKinley 2004), pathological lesions (e.g., presence of new bone formation), and an 'other' column for information of interest such as individual variation (Lockau 2012:71-75). Fragments that could not be identified were recorded in a separate database (N= 1,744), and placed into the following categories: large or small long bone, vertebral column and sacrum, cranial or mandibular fragment, and flat bone (Lockau 2012:75-76). The unidentifiable fragments were not included in the research gathered for this thesis.

A series of photos were also taken for each identifiable bone. The photos have the category number, scale, and side (left or right) documented. The identifiable fragments also have a recording form including a drawing of the element (either a standard outline, or a freehand drawing), which areas were present, and any other data such as potential trauma, postmortem damage, and pathological lesions. The recording forms were scanned and sorted electronically along with the database, photos, and other analyses such as x-rays, micro-CT scans, and digital microscope photos.

The project members involved in observing and recording information were all trained in osteology, and part of the Anthropology Department at McMaster University. The observers included Laura Lockau (Master's student at the time), Ana-Maria Dragomir (Senior undergraduate student), Madeleine Mant (Doctoral student), Rebecca Gilmour (Doctoral student), and Dr. Megan Brickley. Lilianna Watamaniuk (Doctoral student) coordinated the creation of the database. Each researcher initialed the entries they assessed in the Microsoft Excel database.

5.1.1 Background: The Zonation Method

The zonation method for human remains was adapted by Knüsel and Outram (2004) and was used to record completeness for the bones from the Battle of Stoney Creek in 2011. The method was modified for humans from Dobney and Rielly's (1988) zonation method for faunal remains (Knüsel and Outram 2004). The zonation method for human remains is a method to record completeness (e.g., Outram et al. 2005; Knüsel and Outram 2006; Stodder 2008) but has only been used by a few authors (e.g., Benson and Whittle 2007).

The zonation method was used because it allows for a more comprehensive, accurate record of highly fragmented, commingled, and disarticulated human remains (Knüsel and Outram 2004). Each element is divided into numbered sections or zones, which are marked as present or absent (Appendix A). If a small fragment of a zone is present, the whole zone must be marked as present (Knüsel and Outram 2004). The number of zones depends on the morphology of the bone (e.g., bone type), and can range from three to 15 zones (Knüsel and Outram 2004). The completeness of bone without zones as per Knüsel and Outram (2004), were recorded in 25% intervals (Lockau 2012:73). These bones recorded in intervals were the carpals, tarsals (except the tali and calcanei), coccyx, and patellae. The teeth were also not scored using the zonation method.

5.1.2 Background: Weathering Score

The 7-point abrasion and erosion scale presented by McKinley (2004:15-16) allows for the recording of surface preservation of human bone. The scale was used for the collection from the Battle of Stoney Creek because it is specific to the changes on human rather than animal bone (e.g., Behrensmayer 1978). Each bone fragment was assessed for weathering, and included in the database. Different parts of a bone may exhibit more than one weathering stage, and should be specified upon recording (McKinley 2004:15). Bleaching and other discolorations of bone should be recorded as additional information on the recording forms (McKinley 2004:15). Table 4 summarizes the weathering stages from McKinley (2004).

Table 4: Erosion and Abrasion Stages (McKinley 2004:15-16)

Grade	Description
0	The bone surface morphology is clearly visible, appears fresh and without modifications.
1	Slight surface erosion, may be patchy. Includes light root etching.
2	Extensive surface erosion more than grade 1. Deeper root etching than grade 1.
3	Erosion or root etching has affected most of the bone's surface. The general morphology of the bone is maintained, but some features of the bone may be masked by erosion.
4	The entire bone's surface is affected by erosion, but may not be uniform across the surface.
5	Heavy erosion across the entirety of the bone's surface with some modification of cortical profile.
5+	Grade 5 but with more extensive erosion and modification of cortical profile.

5.2 Data Collection

5.2.1 The Zonation Method

After downloading the most up-to-date version of the database from the computer at McMaster University, it was saved as working and original versions. Steps were taken to organize the working version of the database, and save progress daily on multiple platforms. The methods of data collection, as well as the statistical methods used, were determined in consultation with Dr. Brickley, and Dr. Balakrishnan, the Chair of the McMaster Mathematics and Statistics Department.

Manual sorting of the database included cutting and pasting cells according to each *bone* (e.g., femora, tibiae, etc.). Each bone was copied on a different spreadsheet except for the metacarpals, metatarsals, carpals, and tarsals, which were organized on the same spreadsheet. The filter option in Microsoft Excel was then used to verify that the total number of fragments listed in Table 5 were correct. The total number of fragments in Table 5 refers to the total number of fragments for the right and left sides, and number (e.g., rib 1, 2, etc.) if applicable, per bone.

Table 5: Total Counts of Bone Fragments per Bone from the Battle of Stoney Creek

Bone (as entered in database)	**Total Number of Fragments**	**Verified (Y = yes)**
Femora	99	Y
Tibiae	89	Y
Fibulae	82	Y
Humeri	74	Y
Ulnae	61	Y
Radii	61	Y
Scapulae	84	Y
Ribs	496	Y
Sterna	6	Y
Sacra	17	Y
Coccyx	1	Y
Patellae	26	Y
Mandibles	32	Y
Maxillae	25	Y
Cranial Fragments	163	Y
Innominates	129	Y
Vertebrae	436	Y
Clavicles	42	Y
Metacarpals and Metatarsals	245	Y
Carpals and Tarsals	112	Y
Tali	37	Y
Calcanei	45	Y
Phalanges	283	Y
Teeth	50	Y

After the total number of fragments were verified by double checking the data, the data columns not related to this research were hidden. The columns were hidden rather than deleted in event they needed to be accessed in the future. The columns that were not hidden included the ‘Smith’s Knoll Category Number, Element, Side, Weathering, and Zones’. In the case of the metacarpals, metatarsals, carpals and tarsals, the additional columns that were not hidden included the ‘Number, and Hand or Foot’.

The next step was separating the bilateral bones *by side.* The bones were grouped by side: bones that could not be sided, left bones, and right bones. Unsideable bones belong to either a left or a right side, but were not able to be confidently assigned to either group. Unsideable bones may be fragmented, and therefore have few features to aid in their identification. Unsideable bones were omitted from this research because combining them with either the left or the right sides would skew the data and bias analyses. The organization was standardized for each spreadsheet to allow for easier comparisons across bones. Bone side was marked by 'L' for left, 'R' for right, or 'L?' for likely left, 'R?' for likely right, and '?' for unsideable. If a bone was recorded as 'L?' or 'R?' it was assigned to either the 'L' or 'R' group. Bones recorded as 'L?' or 'R?' were not excluded from the database or divided into another group in an effort to maintain large sample sizes for statistical analyses.

Phalanges were excluded from this research because they were not sided, or assigned a digit number. The teeth were also omitted from this research because the zonation and weathering methods could not be applied to them. The cranial bones and maxillae were later excluded from the representation analyses because each bone was only assigned one zone instead of multiple zones (Knüsel and Outram 2004). This means that the number of bones recorded as 'present' (P) or 'present?' (P?) are the same as the total number of bones observed. For example, the left parietal bone has one zone, and even if a small fragment of the bone is present, the entire zone is marked as present. If there were 6 left parietal zones marked as present, the total number of bones would also be 6. The use of one zone per bone creates an overrepresentation of the bone frequency. For this reason, the cranial bones and maxillae were excluded from this analysis.

After successfully separating each bone fragment by side, a refined total number of bone fragments were produced, provided by Table 6. The sum of each row in Table 6 is listed in Table 5. The total numbers of bone fragments were verified using the filter option, and the original copy of the database was compared against the working version. Total counts were verified again to ensure all elements were accounted for.

Table 6: Total Number of Fragments per Bone per Side from the Battle of Stoney Creek

Bone	**Total Number of Fragments (if not a bilateral element)**	**Total Number of Fragments: Left**	**Total Number of Fragments: Right**	**Total Number of Fragments: Unsideable**
Femora	-	42	40	17
Tibiae	-	30	36	18
Fibulae	-	29	32	21
Humeri	-	28	31	15
Ulnae	-	27	31	3
Radii	-	24	31	6
Scapulae	-	36	29	19
Ribs	-	110	103	283
Sterna	6	-	-	-
Sacra	17	-	-	-
Coccyx	1	-	-	-
Patellae	-	12	13	1
Mandibles	32	-	-	-
Maxillae	25	-	-	-
Cranial Fragments	163	-	-	-
Innominates	-	48	44	37
Vertebrae (Cervical)	87	-	-	-
Vertebrae (Thoracic)	186	-	-	-
Vertebrae (Lumbar)	133	-	-	-
Vertebrae (Unidentifiable)	30	-	-	-
Clavicles	-	14	20	8
Metacarpals	-	29	35	48
Metatarsals	-	39	50	44
Carpals	-	24	21	0
Tarsals	-	33	27	7
Tali	-	17	17	3
Calcanei	-	19	15	11

The most efficient way to tally the zones present or ‘P’, was to do it separately from zones classified as likely present or ‘P?’. After researching the best formulae to tally the counts of present (P) and likely present (P?) per zone per bone in Microsoft Excel, the COUNTIF function was used and entered as follows:

=COUNTIF(range 1: range 2, “P”)

=COUNTIF(range 1: range 2, “P?”)

The COUNTIF formulae were entered on each spreadsheet separately for the left side and the right side. The formula for ‘P’ was entered first across all zones, then ‘P?’ in the line below. All Excel formulae work for uppercase and lowercase letters in the spreadsheet. This was important to know when tallying ‘P’ and ‘P?’ because they were recorded in the database as both upper and lowercase letters. It was time consuming to manually enter the formula repetitively, so if a bone had a total number of elements less than 5, the prevalence of ‘P’ and ‘P?’ was counted.

The last sheet that was organized and assessed was the ‘metacarpals, carpals, metatarsals, tarsals’ spreadsheet because the extra columns of data (number, hand or foot) made them more time consuming, and difficult to sort. The bone fragments were organized first by bone: metacarpal, metatarsal, carpal, tarsal, talus, and calcaneus. They were then organized by hand or foot, then by side, and lastly by number if applicable (Table 6).

After the COUNTIF formulae were entered, the sum of “P” and “P?” formula was used:

=SUM(cell 1 + cell 2)

The SUM function was used in all cases unless one of the numbers was 0 or 1, in which case the numbers were added manually. The final calculated totals were verified by checking the COUNTIF formulae for ‘P’ and ‘P?’, the sum formulae, and verifying the mental arithmetic. This step was important in making sure the final calculations in Table 6 were correct. Appendix B lists the numbers of ‘P’ and ‘P?’ per bone, per side, per zone.

To clarify, representation was determined by using the zone with the largest tally of present or likely present and comparing that number to the total number of bone fragments. Essentially, this creates a fraction where the numerator is the largest zone present (the sub sample), and the denominator is the total number of bone fragments (the statistical population). Data needed to be gathered and calculated this way because the collection is disarticulated, commingled, and fragmented; therefore, each bone fragment needed to be treated as a separate individual. Using the largest number from the zone present or likely present for the same bone and side (e.g., zone *x* from the left femora) ensures that the representation data are not being duplicated for that element and side. The z-statistic was then used to normalize the data so that bones could be compared in a statistically sound manner (Section 5.3.1)

5.2.2 Weathering Method (McKinley 2004)

The student researchers assessed weathering by comparing bone fragments to the pictures and text from McKinley (2004), and assigning a score. A score was given for *each* bone fragment, and recorded in the database. Sometimes in the database, two numbers would be listed as the score because the bone fragment resembled traits from both scores. Instead of including both numbers, or taking the average of both numbers, the larger one was chosen instead of the smaller. The larger number was chosen because it represented the most severe damage on the bone fragment, and it made further data collection and comparison less complicated. The mean, median, and mode were calculated in Excel to determine the weathering distribution of each bone (e.g., femora, tibiae, etc.). The three calculations together offered a better picture of the dataset, allowing a decision to be made in consultation with Dr. Balakrishnan to use the Wilcoxon Rank-Sum statistic (Section 5.3.2). The weathering scores per bone were uploaded to Minitab 16, and produced close to one thousand comparisons, listed in Appendix C.

5.2.3 Cranial Bone Representation in the Battle of Stoney Creek

In order to determine if the cranial bones were underrepresented in the collection from the Battle of Stoney Creek, the MNI was used. The MNI from each of the cranial bones (Table 7) were entered into Minitab 16 and compared against the MNI for the collection. The MNI for the collection is 24, based on the most frequently occurring sided element, the right radius. The MNI of 24 acted as the expected value. The binomial distribution was used to compare each cranial MNI value to the expected value of the collection. The data from the West Tenter Street site (dated to 101-400 AD in London, England), and the Cross Bones burial ground (dated to the early 1600s until 1853 in

London, England) were also gathered and assessed, to compare to the cranial representation patterns from the Battle of Stoney Creek. Both sites were chosen because the site reports were publically available, and the raw data for each site was accessible. These comparisons are useful in determining whether similar patterns of cranial representation are seen at different geographical sites, and at different time periods.

Table 7: Cranial Bones and MNI from the Battle of Stoney Creek

Cranial Bone	MNI
Left Parietal	6
Right Parietal	7
Occipital	11
Right Temporal	7
Left Zygomatic	7
Right Zygomatic	9
Left Palatine	4

5.2.4 The West Tenter Street Site

The West Tenter Street site was a Roman cemetery and comprised at least 120 interment and cremation burials (Whytehead 1986). The burials were not all individual or discrete entities because a number of burials cross-sectioned other interments (Whytehead 1986:101-102). The excavation concentrated on specific areas, therefore the collection only represents a sample of the larger cemetery.

Due to a number of circumstances, there is no MNI estimate from the West Tenter Street site. In order to determine an expected value similar to the MNI estimate from the Battle of Stoney Creek collection, the sum of the non-cremated burials were totaled. The individuals from the West Tenter Street site were grouped into age categories such as infant, juvenile, and adult; or an age range if it was possible to estimate one. Of the non-cremated burials, only the adult individuals were included in the total expected value, and an exception was made to also include the age category of 15-19 year olds. The youngest official age of soldiers during the War of 1812 was 17 (Elliott 2009:260-265), so the West Tenter street age category of 15-19 was included in an effort to make the collections more comparable. The total expected value of non-cremated individuals from the West Tenter Street site data was 88 (Whytehead 1986; Waldron 1987).

The number of recovered cranial bones are listed (Waldron 1987); although, the bones and features are slightly different than those that were recorded from the collection from the Battle of Stoney Creek (in Table 7). The totals in Table 8 (Waldron 1987) assume that the bones were identified, sided, and counted correctly. Each value in the total column indicates the bone was present and was separate from the other entries, just as the bones from the Battle of Stoney Creek were. The total column is similar to the MNI column from Table 7. The binomial distribution statistic will determine whether the cranial bones from West Tenter Street are significantly underrepresented ($p=0.1$) in comparison to the expected value of 88 individuals.

Table 8: Cranial Bones from West Tenter Street

Cranial Bone	Total
Left Frontal	36
Right Frontal	38
Left Parietal	29
Right Parietal	29
Left Occipital	35
Right Occipital	38
Left Occipital Condyle	41
Right Occipital Condyle	43
Left Petrous Portion	59
Right Petrous Portion	53
Left Mastoid	52
Right Mastoid	50
Left Zygomatic	42
Right Zygomatic	41
Left Maxilla	46
Right Maxilla	50

5.2.5 The Redcross Way, Cross Bones Burial Ground

The Cross Bones burial ground was excavated for the purpose of extending the London underground (Brickley et al. 1999). The location of the Cross Bones burial ground was known from documents that also stated the area was one of six extensions of the original burial grounds for St. Saviour's parish (Brickley et al. 1999). Evaluations, excavations, and watching briefs of the Cross Bones burial ground took place from 1992 until 1997 (Brickley et al. 1999). A total of 148 burials (less than 1% of the site) were excavated because they were directly disturbed by the placement of the new underground (Brickley et al. 1999). Dissection of entire bodies did occur before their interment;

however, there is no reason to believe that the crania were preferentially removed and would therefore be intentionally underrepresented (Brickley et al. 1999). The Cross Bones burial ground was included in this research because of access to previously published data and inventory forms.

Documentary evidence provided by Brickley and colleagues (1999) suggests that all burials were uniform, with no distinguished area for separate parish burials or other groups. In the 1600s, the burial ground was thought to be reserved for the poor; particularly single women and supposedly prostitutes from brothels (Brickley et al. 1999). However, skeletal sex determination revealed that males, females, and juveniles were buried at the site, and the estimated skeletal ages ranged from birth to old adult (Brickley et al. 1999). For the purpose of this research, only the cranial data from those aged 16 and older were used because it is a similar age range to the soldiers from the Battle of Stoney Creek and the data used from the West Tenter Street site. After narrowing the age range and using available adult inventory forms, the total expected value, similar to an MNI estimate of the Cross Bones burial ground decreased from 148 to 44. The cranial bone data were gathered based on previously collected pictorial inventory forms and are listed in Table 9.

Table 9: Cranial Bones from the Cross Bones Burial Ground

Cranial Bone	**Total**
Frontal	40
Left Parietal	40
Right Parietal	40
Left Temporal	41
Right Temporal	40
Left Zygomatic	35
Right Zygomatic	33
Left Maxilla	33
Right Maxilla	34
Occipital	40

5.3 Background: The Statistical Analyses

5.3.1 The Z-Statistic

The z-statistic is more commonly known as the test for the equality of proportions, and is used to test hypotheses. The z-statistic was used to determine if the total zone presence and representation was different between bones. To apply the z-statistic, one needs to choose a confidence level, and have two variables. For this research, the confidence level was 95%, and the two variables were the presence and absence of a zone (from the zonation method). The z-statistic compares two groups with two different totals, and normalizes the totals to see if the difference or similarity between the groups is statistically significant based on the chosen confidence level. The z-statistic accounts for *two types of normalization* in this research: the total number of bone fragments per bone type (e.g., 40 left femora and 42 right femora from Table 6), and the number of bones in the body (e.g., two femora versus 7 cervical vertebrae per individual). The z-statistic should be used for group totals over 30, but it can be used for groups with smaller totals. The formula for the z-statistic is listed below, where B1 is bone one (the first comparison), B2 is bone two (the second comparison), P is total presence (largest frequency of the zone marked as present), and T refers to total number of elements (the total number of bone fragments). When the two variables are compared using the z-statistic, the data may be respectively pooled if there is no statistical difference between the groups.

$$\text{z-statistic} = \frac{\dfrac{BP1P}{B1T} - \dfrac{BP2P}{B2T}}{\sqrt{\dfrac{B1P + B2P}{B1T + B2T}\left(1 - \dfrac{B1P + B2P}{B1T + B2T}\right)\left(\dfrac{1}{B1T} + \dfrac{1}{B2T}\right)}}$$

H_o: Representation of B1 = B2 at a 5% level of significance

H_1: Representation of B1 ≠ B2 at a 5% level of significance

∴ at 95% level of significance, reject H_o and accept H_1

The z-statistic is also unique and useful for comparing large quantities of data because it is easy to identify statistical differences without having to compare all the bones to each other. Using shapes to denote groups, groups □ and ■ are compared, and groups □ and Δ are compared. The results indicate groups □ and ■ are statistically similar and groups □ and Δ are statistically different. Without comparing groups ■ and Δ, we know they will be statistically different because □ is similar to ■. Continuing this example, if group ◘ is also compared to □, or ■ and is similar to either, the data will be statistically different from group Δ. This 'snowball effect' of statistical significance is important to understand for this research.

5.3.2 The Wilcoxon Rank Sum Test

The Wilcoxon rank sum is a nonparametric statistic used to compare two population medians. The Wilcoxon rank sum test is applicable to any distribution (normal or not; one-tailed or two-tailed), so long as the two samples are random, independent, and the probability distribution for the samples chosen are continuous (The University of Auckland New Zealand 2000; McClave and Sincich 2009). The Wilcoxon rank sum test was used to compare the weathering of bone fragments to determine if one bone type was more weathered than another (e.g., the femora versus the tibiae). The first step of the statistic is to combine and rank the observations from both samples (McClave and Sincich 2009). The observations are ranked from the smallest (rank 1) to the largest (rank x). The sum of the ranks are then calculated per sample where Sample A is 11 (1+4+6), and Sample B is 10 (2+3+5):

e.g., Observation:	3.4	3.6	4.1	4.8	5.2	6.0
Sample (A or B)	A	B	B	A	B	A
Rank	1	2	3	4	5	6

The sum of the ranks and the population medians are then compared using the Wilcoxon rank sum statistic. The significance of the comparisons depends on the confidence level chosen (The University of Auckland New Zealand 2000; McClave and Sincich 2009). Minitab 16 was used to generate the output in Appendix C at a confidence level of 95%; therefore, p-values were only significant when they were less than 0.05.

5.3.3 The Binomial Probability Distribution

The binomial distribution was used to compare the expected value or MNI for the collection to the MNI from the cranial bones, to determine the representation of crania. The confidence levels commonly used in statistics are 99%, 95%, and 90% because they all have high accuracy because they are close to a perfect value of 100%. A 99% confidence level presents only the *most* significant 1% of data, and excludes all other data in the sample. The 95% confidence level is most often used because it still has high accuracy, but does not exclude the 4% of significant data that the 99% confidence level does (Figure 10). For this research question, a 90% confidence level was chosen. This confidence level was chosen to maintain a high accuracy while still allowing all of the significant data to be expressed.

‘Normal Distribution’

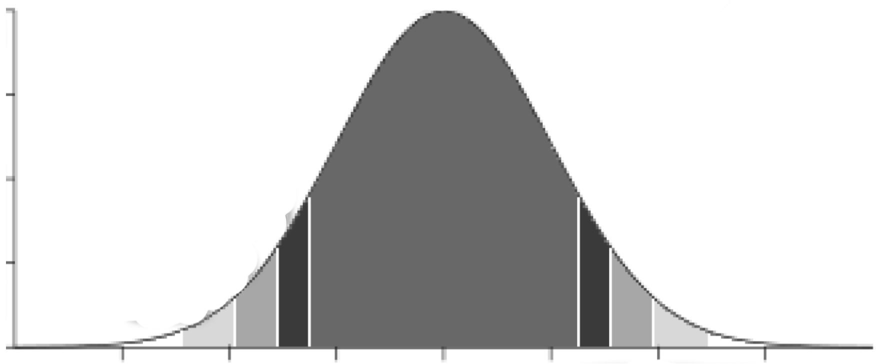

Figure 10: This Figure Presents a Normal Distribution Where the Grey Scale Shows the Different Confidence Levels on the Upper and Lower Ends of the Distribution. Image adapted from the University of Glasgow (n.d.).

The binominal distribution is set up as a table where the first column, *x* is the number of trials from 1-*x.* For this research the number of trials was the cranial MNIs (from Tables 7, 8 and 9). The probability of success was represented in the second column p(*x*). For this research the probability of success was the comparison between the cranial MNI and the MNI for the collection based on the confidence level of 90% (McClave and Sincich 2009:196-201). Each site (from the collection from the Battle of Stoney Creek, West Tenter Street, and the Cross Bones burial ground) was compared individually in Minitab 16. Significance was determined when the MNI estimate came close to, but did not exceed the p-value of 0.1 in the p(*x*) column.

Chapter 6: Results

The results from this research are organized into three major sections. The first section begins by outlining the representation of pooled bones, comparing the groups to each other, and highlighting which bone groups were over- or underrepresented based on the z-statistic results. Section 6.2 combines the representation data (using zone and bone fragment totals), the weathering data (using the weathering scores), and presents the results together. For consideration, the complete table of weathering comparisons is included in Appendix C. Appendix D is a shorter version of the previous appendix, listing only the significant weathering comparisons. Section 6.3 presents the cranial bone representation and weathering data from the Battle of Stoney Creek in comparison to the results for the West Tenter Street and Cross Bones burial ground sites to allow for further discussion in Chapter 7.

6.1 Pooling and Bone Representation

In the field of statistics, if two data groups are statistically similar they may be combined, commonly referred to as pooling. Pooling is more time efficient when statistically comparing large amounts of data. For this research, the z-statistic was used to assess the largest zone frequency marked as present and the total number of bone fragments per bone group (Section 5.3.1). For example, zone 8 had the highest frequency of present/possibly present for the left femoral fragments (N=25) and zone 3 had the highest frequency for the right femoral fragments (N=23) (see Table 10 for a summary of the data, and Appendix B for reference to the zones represented). These zone frequencies and total bone fragments (N left femora= 25/42, N right femora= 23/40) were then systematically compared to each other and assessed for similarity using the z-statistic at a 95% confidence level. Table 10 lists all the bilateral bone comparisons and Table 11 lists the comparisons of the vertebrae to each other.

Table 10: Z-statistic Comparisons of the Highest Zone and Total Bone Fragments for the Bilateral Bones from the Battle of Stoney Creek

Bone	**Left Zone P/ Total Fragments**	**Right Zone P/ Total Fragments**	**z-statistic**	**Significant (Y/N)**
Femora	25/42	23/40	0.185	N
Tibiae	19/35	24/36	-1.06	N
Fibulae	21/29	18/32	1.312	N
Humeri	23/28	24/31	0.45	N
Ulnae	23/27	24/31	0.752	N
Radii	21/24	27/31	0.044	N
Clavicles	14/14	19/20	0.849	N
Scapulae	19/36	17/29	-0.471	N
Ribs	90/110	87/103	-0.515	N
Metacarpals	28/29	32/35	0.842	N
Metatarsals	32/39	45/50	-1.089	N
Tali	17/17	17/17	0	N
Calcanei	19/19	15/15	0	N
Innominates	26/48	26/44	-0.475	N

Zone P/Total Fragments refers to the highest number of bones present (P) or possibly present (P?) from the zones out of the total number of bone fragments. Left and Right refer to the left and right sides for the bilateral bones. Significance is listed as Y for yes, the comparison is significant because the z-statistic is larger than +1.65, or less than -1.65. N stands for an insignificant comparison.

Table 11: Z-statistic Comparisons of the Highest Zone and Total Bone Fragments for the Vertebrae from the Battle of Stoney Creek

Bone Comparison	**Zone P/ Total Fragments**	**z-statistic**	**Significant (Y/N)**
C Vertebrae T Vertebrae	44/87 107/186	-1.076	N
T Vertebrae Lu Vertebrae	107/186 96/133	-2.682	Y

Zone P/Total Fragments refers to the highest number of bones present (P) or possibly present (P?) from the zones out of the total number of bone fragments. C, T and Lu refer to cervical, thoracic and lumbar vertebrae respectively. Significance is listed as Y for yes, the comparison is significant because the z-statistic is larger than +1.65, or less than -1.65. N stands for an insignificant comparison.

If there was no statistically significant difference between the right and left sides of the same bone, they were pooled together. For example, the right and left femora were calculated as being similarly represented (z=0.185) (Table 10). For this reason, the zones from the right and left femora were pooled, and the total number of bone fragments for the right and left sides of the femora were pooled. Using this method, all bilateral bones such as the femora and tibiae were pooled (Figure 11). Then the bone categories were compared to each other and pooled accordingly (Figure 11). For example, the femora, tibiae, and fibulae were pooled together as one bone group because there was no statistical difference between them (Table 12). For a discussion why some bone groups were not compared to each other (e.g., the cervical and lumbar vertebrae, please refer to Section 5.3.1).

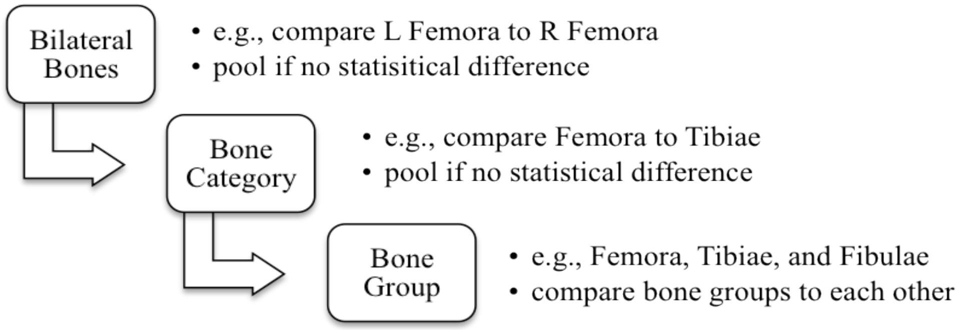

Figure 11: An Example of the Progression of Comparisons for the Representation Data

Successful pooling reduced the number of group comparisons from 35 to 10 for the representation data. The final bone groups are provided by Table 12 and Figures 12 and 13. The bolded numbers in Table 12 represent the sum of the pooled bones separately for the largest zone present, and the total number of bone fragments per group.

Table 12: Final Groups of Pooled Bones and their Totals

Group Number	**Bone**	**Side**	**Total Number of P/P? (from zones with the highest value)**	**Total Number of Bone Fragments (excluding unsideable bones)**
	Femora	R+L	48	82
	Tibiae	R+L	43	71
	Fibulae	R+L	39	61
1	-	-	**130**	**214**
	Humeri	R+L	47	59
	Radii	R+L	48	55
	Ulnae	R+L	47	58
2	-	-	**142**	**172**
3	Clavicles	R+L	**33**	**34**
4	Scapulae	R+L	**36**	**65**
5	Ribs	R+L	**177**	**213**
6	Vertebrae	C+T	**151**	**273**
7	Vertebrae	Lu	**96**	**133**
	Metacarpals	R+L	60	64
	Metatarsals	R+L	77	89
	Tali	R+L	34	34
	Calcanei	R+L	34	34
8	-	-	**205**	**221**
	Sterna	-	4	6
	Sacra	-	11	17
	Innominates	R+L	52	92
9	-	-	**67**	**115**
10	Mandibles	L	**13**	**32**

Side is listed as either L for left, or R for right. C, T and Lu refer to cervical, thoracic and lumbar vertebrae respectively. The Total Number of P/P? (from zones with the highest value) lists the highest zones present or possible present. The Total Number of Bone Fragments (excluding unsideable bones) lists the total number of bone fragments. The bolded numbers indicate the sum of P/P? and the sum of the total number of bone fragments for each group.

The 10 groups from Table 12 were compared and a z-statistic was generated for each comparison. Table 13 shows the results of the comparisons per row at a 95% confidence level. Table 13 was organized so that the most significant comparisons (larger than +1.65, or less than -1.65) are listed first, and continuing in descending order. The bolded cell in the 'Significance' column of Table 13 indicates the comparison was significant. The bolded cells under the 'Pooled Bones' columns indicates that the bone groups were better represented than the bones groups in the same row. The most notable patterns from Table 13 include the representation of the small bones (metacarpals, metatarsals, tali and calcanei), long upper limb bones (humeri, radii, and ulnae), long lower limb bones (femora, tibiae, and fibulae) and vertebrae (cervical, thoracic, and lumbar). The small bones are consistently and significantly better represented than the bones listed in the same row, which include the long upper limb bones, long lower limb bones, and vertebrae.

Table 13: Z-statistic Significance for Pooled Bone Groups

Group #	**Pooled Bones**	**Group #**	**Pooled Bones**	**z-statistic**	**Significance (Y/N)**
6	C+T Vertebrae	8	Metacarpals, Metatarsals, Tali, Calcanei	-9.223	Y
8	Metacarpals, Metatarsals, Tali, Calcanei	10	L Mandibles	7.983	Y
1	Femora, Tibiae, Fibulae	8	Metacarpals, Metatarsals, Tali, Calcanei	-7.933	Y

8	Metacarpals, Metatarsals, Tali, Calcanei	9	Sterna, Sacra, Innominates	7.641	Y
4	Scapulae	8	Metacarpals, Metatarsals, Tali, Calcanei	-7.274	Y
5	Ribs	6	C+T Vertebrae	6.488	Y
2	Humeri, Radii, Ulnae	6	C+T Vertebrae	5.766	Y
5	Ribs	10	L Mandibles	5.369	Y
7	Lu Vertebrae	8	Metacarpals, Metatarsals, Tali, Calcanei	-5.255	Y
1	Femora, Tibiae, Fibulae	5	Ribs	-5.137	Y
2	Humeri, Radii, Ulnae	10	L Mandibles	4.993	Y
5	Ribs	9	Sterna, Sacra, Innominates	4.917	Y
1	Femora, Tibiae, Fibulae	2	Humeri, Radii, Ulnae	-4.668	Y
3	Clavicles	6	C+T Vertebrae	4.684	Y
3	Clavicles	10	L Mandibles	4.985	Y
4	Scapulae	5	Ribs	-4.62	Y
2	Humeri, Radii, Ulnae	9	Sterna, Sacra, Innominates	4.408	Y
3	Clavicles	4	Scapulae	4.284	Y
3	Clavicles	9	Sterna, Sacra, Innominates	4.23	Y
2	Humeri, Radii, Ulnae	4	Scapulae	4.2	Y
1	Femora, Tibiae, Fibulae	3	Clavicles	-4.143	Y

7	Lu Vertebrae	10	L Mandibles	3.384	Y
2	Humeri, Radii, Ulnae	8	Metacarpals, Metatarsals, Tali, Calcanei	-3.268	Y
6	C+T Vertebrae	7	Lu Vertebrae	-3.268	Y
5	Ribs	8	Metacarpals, Metatarsals, Tali, Calcanei	-3.098	Y
3	Clavicles	7	Lu Vertebrae	3.087	Y
5	Ribs	7	Lu Vertebrae	2.421	Y
4	Scapulae	7	Lu Vertebrae	-2.354	Y
7	Lu Vertebrae	9	Sterna, Sacra, Innominates	2.303	Y
2	Humeri, Radii, Ulnae	3	Clavicles	-2.218	Y
1	Femora, Tibiae, Fibulae	7	Lu Vertebrae	-2.172	Y
1	Femora, Tibiae, Fibulae	10	L Mandibles	2.152	Y
3	Clavicles	5	Ribs	2.118	Y
2	Humeri, Radii, Ulnae	7	Lu Vertebrae	2.038	Y
9	Sterna, Sacra, Innominates	10	L Mandibles	1.771	N
6	C+T Vertebrae	10	L Mandibles	1.576	N
4	Scapulae	10	L Mandibles	1.367	N
1	Femora, Tibiae, Fibulae	6	C+T Vertebrae	1.205	N
3	Clavicles	8	Metacarpals, Metatarsals, Tali, Calcanei	0.935	N
1	Femora, Tibiae, Fibulae	4	Scapulae	0.771	N

6	C+T Vertebrae	9	Sterna, Sacra, Innominates	-0.534	N
1	Femora, Tibiae, Fibulae	9	Sterna, Sacra, Innominates	0.438	N
4	Scapulae	9	Sterna, Sacra, Innominates	-0.374	N
2	Humeri, Radii, Ulnae	5	Ribs	-0.288	N
4	Scapulae	6	C+T Vertebrae	0.01	N

Significance is marked by bolded cells outlining the 'Significance' column and the better represented bone group cell is also bolded. C, T and Lu refer to cervical, thoracic and lumbar vertebrae respectively. L refers to bone side, left. Significance is listed as Y for yes, the comparison is significant because the z-statistic larger than +1.65, or less than -1.65. N stands for an insignificant comparison.

6.2 General Representation and Weathering of the Skeleton

Upon comparing the representation and weathering results for the same bones, it became apparent that the underrepresented bones are not always badly weathered. Figure 12 visually displays the median weathering scores per bone on the skeleton, allowing for an easier display of patterns. Figure 13 displays the representation of bone based on their frequency from Table 13 and Section 6.1. The frequencies from Table 13 were generated by dividing the largest number of zones present by the total number of bone fragments. From the comparison of Figures 12 and 13, it is evident that weathering does not seem to be consistently correlated to the representation of bone. For example, the right radius has a high weathering score frequency (between four and five), yet the bone is well represented (between 80-90%) in the collection (Figures 12 and 13). It is important to remember that the individual weathering scores per bone fragment were used to generate the median weathering score per bone. The weathering severity per bone fragment (the score from 0-5+ using McKinley 2004), their median, and their *rank* using the Wilcoxon rank sum statistic determined if bones were more weathered at a 95% confidence level.

The representation and weathering results must be compared against each other with caution. The representation data was gathered using fractions, and the sample sizes may be smaller than the weathering sample sizes. The weathering data was gathered by determining the median of all bone fragments (excluding the unsideable bone fragments), so the results are reflective of most of the collection. For example, the representation data from the pooled right and left femora were 48/82 (Table 12), where 48 was from the highest zone present (the sample taken) and 82 was from the total number of bone fragments (from the larger statistical population). The weathering data used information from all bone fragments, so the sample was often larger (N=82 for the femora). The data would have been more comparable if the weathering scores from *only* the zones with the highest total were used. In terms of the femora example, the weathering sample would have been 48 instead of 82 and be more comparable to the representation data (but less reflective of the collection as a whole). This means that some of the differences between the representation and weathering data may be reflective of the sample sizes.

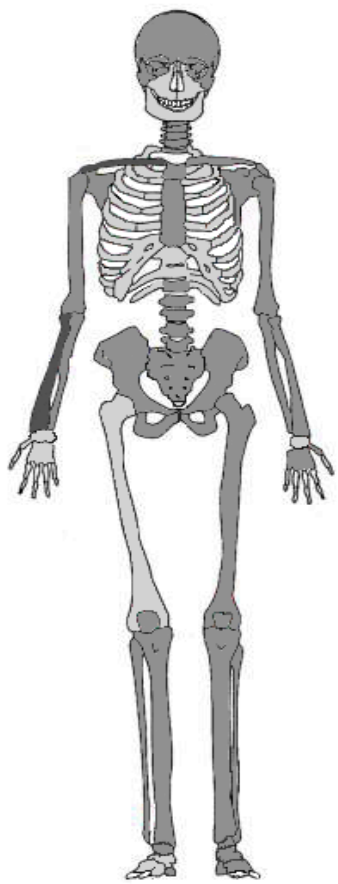

Figure 12: Weathering of Bone

Color	Weathering Score
	not scored
	1-1.9
	2-2.9
	3-3.9
	4-5+

Weathering score is illustrated as the median per bone. Figure shows the weathering score patterns, not the statistical difference of weathering scores between bones.

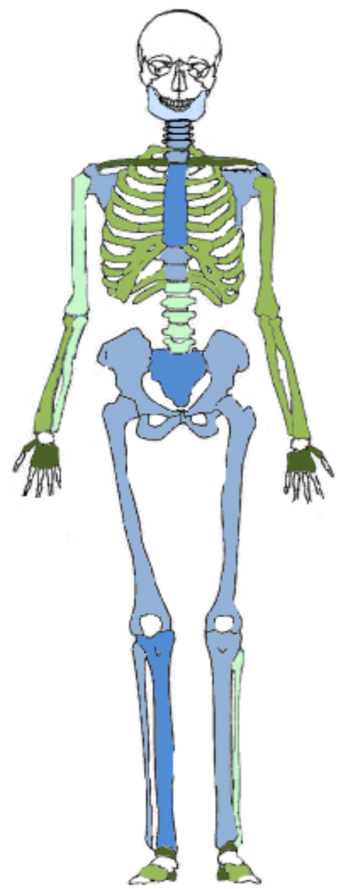

Figure 13: Representation of Bone

Color	Representation Frequency (%)
	not scored
	0-50%
	50-60%
	60-70%
	70-80%
	80-90%
	90-100%

Representation frequency (%) calculated by dividing the largest zone present by the total number of bone fragments. Figure does not show statistical significance between bones.

6.2.1 Representation and Weathering: Long Lower Limb Bones (Femora, Tibiae, Fibulae)

The femora, tibiae and fibulae were represented similarly in the collection from the Battle of Stoney Creek (Table 12). Significant differences in weathering between bones were calculated using the Wilcoxon rank sum statistic at a 95% confidence level (Section 5.3.2), therefore p-values are statistically significant when they are less than 0.05. Bones could not be pooled by type or by side for this part of the analysis, and were instead compared individually. Analysis of the weathering data found that the fragments from the right and the left femora were weathered similarly (p=0.3518), as were those from the right and left tibiae (p=0.9850), and the right and left fibulae (p=0.5601). Interestingly, each of the lower limbs were represented the same; however, the fibulae were significantly more weathered than the femora and tibiae. Even though the fibulae had a median of 2, when they were compared to all other bones from the collection the fibulae were consistently more weathered (Appendix D, Table 14). This means that the fibulae had a lot of statistically significant comparisons (left fibulae N=29, right fibulae N=24) and they were always the bone that was more weathered (determined by the weathering score per bone fragment, median of the sample, and rank using the Wilcoxon rank sum statistic) (Table 14).

6.2.2 Representation and Weathering: Long Upper Limb Bones (Humeri, Radii, Ulnae)

The right and left humeri, right and left radii, and right and left ulnae were represented similarly in the collection from the Battle of Stoney Creek, using the z-statistic at a 95% confidence level (Table 13). As with the bilateral lower limb bone fragments (Section 6.2.1), the bilateral upper limb bone fragments (right and left humeri, p=0.3763; right and left radii, p=0.2761; and right and left ulnae, p=0.6803) exhibited similar weathering. However, the left humeri (median of 2), left and right radii (median of 2 and 3 respectively), and right ulnae (median of 2) were consistently more weathered than the lower limb bone fragments (Table 14). This was a noteworthy observation considering the highest MNI for the collection came from the right radius. The consistently more weathered radii were also the best represented for the MNI estimate, which raises the possibility that weathering may have made a minimal impact on the representation of bones. The differences seen between bone representation and weathering may also be in part due to the bias mentioned earlier from the sample sizes of data used. Overall, the upper limb bones were represented similarly, and generally the bilateral bones of the upper limb exhibited similar weathering (e.g., right humeri and left humeri).

6.2.3 Representation and Weathering: Upper Limb v Lower Limb

The bones from each limb were represented similarly amongst each other (e.g., humeri, radii and ulnae); however, the humeri, radii and ulnae were significantly better represented than the femora, tibiae, and fibulae ($z=-4.668$). To clarify, this means each upper arm bone (left and right humeri, ulnae and radii) was better represented than each lower limb bone (left and right femora, tibiae and fibulae). The upper and lower limb bone representativeness was not the largest statistically significant comparison, but it is still important because it indicates that the limb bones were not similarly represented within the collection from the Battle of Stoney Creek.

Generally, each bilateral bone exhibited similar weathering. The weathering (as a frequency) and the representation results are provided by Table 14. The purpose of Table 14 is to provide a concise summary of the general weathering and representativeness patterns, and not to display the severity of the weathering scores. The most interesting pattern of the upper and lower limb bone data from Table 14 is that the upper limb bone fragments were slightly better represented, but generally more weathered in comparison to the lower limb (with the exception of the right and left fibulae). In conclusion, the weathering of the limbs seems to have had a minimal affect on their representation in the collection from the Battle of Stoney Creek.

6.2.4 Representation and Weathering: Small Bones (Metacarpals, Metatarsals, Tali, Calcanei)

All of the bilateral small bones were represented the similarly (Table 14), but not weathered the same. An issue with the left tali was encountered after the weathering scores were entered in the Minitab 16 software. The weathering scores were all the same (all fragments were given a score of 2), which violates a parameter of the Wilcoxon rank sum statistic. For this reason, the left tali were omitted from the weathering analysis.

The most interesting observation from the statistical analysis of the small bones presented by Table 14, is that the right metacarpals and right metatarsals were the least weathered out of the small bones. In general, the hand and foot bones (with the exception of the left tali) were often less weathered when compared to all other bone groups.

6.2.5 Representation and Weathering: Long Bones v Small Bones

The upper limb bones were slightly underrepresented and in some cases, more weathered in comparison to the small bones ($z=-3.268$). The lower limb bones were more underrepresented in comparison to the small bones ($z=-7.993$), which is an interesting pattern. Overall, the small bones were better represented and comparatively less weathered than the upper and lower limb bones. Assessing the weathering and representation data for the upper limb, lower limb, and small bones provided from Table

14, the right metacarpals and right metatarsals were the least weathered. Only three groups are listed in Table 14 because one of the objectives of this research was to compare the weathering and representation of the small bones to the large limb bones.

Table 14: Representation and Weathering Frequencies per Bone and Bone Group for the Lower Limb, Upper Limb, and Small Bones

Representation Group	**Bone**	**Significant Comparisons***	**More Weathered***	**Frequency***
Bone group 1	L Femora	14	5	35.7%
	R Femora	20	2	15%
	L Tibiae	13	4	30.7%
	R Tibiae	14	5	35.7%
	L Fibulae	29	29	100%
	R Fibulae	24	24	100%
Bone group 2	L Humeri	16	16	100%
	R Humeri	13	8	61.5%
	L Radii	20	20	100%
	R Radii	27	27	100%
	L Ulnae	15	14	93%
	R Ulnae	18	18	100%
Bone group 8	L Metacarpals	19	4	21.4%
	R Metacarpals	36	1	2.7%
	L Metatarsals	18	4	22.2%
	R Metatarsals	24	2	8.3%
	R Tali	19	15	78.9%
	L Calcanei	13	8	61.5%
	R Calcanei	12	9	75%

Bone groups under the representation heading indicate the bones represented similarly. Bolded cells outline the least weathered bones. 'Significant Comparisons' refers to the total statistically significant weathering comparisons where p=0.05*. 'More Weathered' lists the total number of times the bone being compared (on the same row) is more weathered where p=0.05*. 'Frequency' displays the frequency the bone is more weathered as a percentage out of 100 where p=0.05*. The larger the percentage, the more the bone is weathered. This table does not represent the severity of weathering scores.

6.2.6 Representation and Weathering: Vertebrae

The cervical and thoracic vertebrae were represented (z=-1.076) and weathered similarly (p=0.1271) (Table 13). The lumbar vertebrae were better represented in comparison to the cervical and thoracic vertebrae (z=-3.268), but were significantly more weathered (p=0.008 for the cervical vertebrae and p=0.000 for the thoracic vertebrae). The analysis of the inconsistent weathering and representation data suggests that weathering was likely not a primary factor influencing the representation of vertebrae. Most interestingly, the statistical representation data between the cervical and thoracic vertebrae and the small bones produced the largest z-statistic (z=-9.223). The analysis of these results suggests that the cervical and thoracic vertebrae were extremely underrepresented in comparison to the metacarpals, metatarsals, tali and calcanei.

Table 15: Vertebrae Representation and Weathering Frequencies

Representation Group	**Bone**	**Significant Comparisons***	**More Weathered***	**Frequency***
6	C Vertebrae	21	7	33.3%
	T Vertebrae	24	3	12.5%
7	Lu Vertebrae	18	10	55.5%

Bone groups under the representation heading indicate the bones represented similarly. C refers to cervical, T refers to thoracic, and Lu refers to lumbar vertebrae. ‘Significant Comparisons’ refers to the total statistically significant weathering comparisons where p=0.05*. ‘More Weathered’ lists the total number of times the bone being compared (on the same row) is more weathered where p=0.05*. ‘Frequency’ displays the frequency the bone is more weathered as a percentage out of 100 where p=0.05*. The larger the percentage, the more the bone is weathered. This table does not represent the severity of weathering scores.

6.2.7 Weathering: Carpals and Tarsals

The carpals and tarsals are compact, relatively round bones that comprise the wrist and ankle of the human body. The carpals and tarsals could not be assessed for representation because they were not scored for completeness using the zonation method, and an MNI estimate was only calculated for some of them. For this reason, it is not possible to determine how well they are represented in the collection as a verified frequency. However, the carpals and tarsals were consistently less weathered than the other bones they were statistically compared to (Table 16), including the left metacarpals and left metatarsals (Appendix D).

Table 16: Carpal and Tarsal Weathering Frequencies

Bone	**Significant Comparisons***	**More Weathered***	**Frequency***
L Carpal	35	0	0
R Carpal	33	0	0
L Tarsal	17	6	35.2%
R Tarsal	29	0	0

'Significant Comparisons' refers to the total statistically significant weathering comparisons where p=0.05*. L refers to left and R refers to right. 'More Weathered' lists the total number of times the bone being compared (on the same row) is more weathered where p=0.05*. 'Frequency' displays the frequency the bone is more weathered as a percentage out of 100 where p=0.05*. The larger the percentage, the more the bone is weathered. This table does not represent the severity of weathering scores.

6.3 Representation and Weathering: Cranial Bones

To determine if the cranial bones from the Battle of Stoney Creek were underrepresented relative to their expected value, MNI estimates were used. Each row from Table 17 compares the MNI from the cranial bone, to the highest MNI from the collection (24 from the right radius), which acts as an expected value for the binomial distribution statistic (Section 5.3.3). The binomial distribution determined that the cranial bones at the Battle of Stoney Creek were underrepresented in comparison to their expected value (p=0.1)

Table 17: Cranial Bone Representation from the Battle of Stoney Creek

Cranial Bone	**Cranial Bone MNI**	**Right Radius MNI**	**P-value (0.10)**	**Significance (Y/N)**
L Palatine	4	24	0.0000	N
L Parietal	6	24	0.0000	N
R Parietal	7	24	0.0000	N
R Temporal	7	24	0.0000	N
L Zygomatic	7	24	0.0000	N
R Zygomatic	9	24	0.0000	N
Occipital	11	24	0.0000	N

Cranial bones are significantly represented when the p-value approaches 0.1. L refers to left and R refers to right. The significance column indicates significantly represented cranial bones by Y for yes, and N for underrepresented cranial bones.

To determine the number of bones needed for the crania to be well represented, another binomial distribution was calculated with hypothetical MNIs at a 90% confidence level. The hypothetical MNIs, from zero to 24 were compared against the MNI of the right radius. Based on the hypothetical MNI values listed from Table 18, the MNI needed to be at least 19 for the crania from the Battle of Stoney Creek to be well represented. The MNI of 19 was chosen because it had the closest p-value to 0.10 without exceeding it.

Table 18: Hypothetical Cranial Bone Representation from the Battle of Stoney Creek

Hypothetical Cranial MNI	**Right Radius MNI**	**P-value (0.10)**	**Significance (Y/N)**
1	24	0.0000	N
…	24	0.0000	N
15	24	0.0003	N
16	24	0.0016	N
17	24	0.0074	N
18	24	0.0276	N
19	24	0.0850	Y
20	24	0.2142	Y
21	24	0.4357	Y
22	24	0.7075	Y
23	24	0.9202	Y
24	24	1.0	Y

Cranial bones are significantly represented when the p-value approaches 0.1, outlined by the bolded row. The significance column indicates significantly represented cranial bones by Y for yes, and N for no (underrepresented cranial bones). "…" refers to the sequential numbers between the top and bottom rows.

Table 19 provides a summary of the weathering data for the crania from the Battle of Stoney Creek. The crania were more weathered in 64.7% of the comparisons (e.g., against the cervical and thoracic vertebrae, and some of the small bones). In the greater context of this research, the crania from the Battle of Stoney Creek were weathered, but not as severely as some of the other bones. For example, the right and left fibulae had a greater number of significant weathering comparisons, and were always the worst weathered (Table 14).

Table 19: Cranial Weathering from the Battle of Stoney Creek

Bone	**Significant Comparisons***	**More Weathered***	**Frequency***
Crania	17	11	64.7%

'Significant Comparisons' refers to the total statistically significant weathering comparisons where p=0.05*. 'More Weathered' lists the total number of times the bone being compared (on the same row) is more weathered where p=0.05*. 'Frequency' displays the frequency the bone is more weathered as a percentage out of 100 where p=0.05*. The larger the percentage, the more the bone is weathered. This table does not represent the severity of weathering scores.

The West Tenter Street site also had an underrepresentation of cranial bones (Table 20). As with the collection from the Battle of Stoney Creek above, the binomial distribution was used to compare the cranial bone values to the expected MNI value of 88 for the sample (p=0.1). The totals per bone are listed in Table 20 and the hypothetical bone values to determine the minimum number of crania for optimum representation are presented by Table 21. Based on these results (Table 21), there needed to be at least 76 cranial bones to be sufficiently represented at a 90% confidence level.

Table 20: Cranial Bone Representation at West Tenter Street

Cranial Bone	**Cranial Bone Value**	**Total Adult Expected Value**	**P-value (0.10)**	**Significance (Y/N)**
L Frontal	36	88	0.0000	N
R Frontal	38	88	0.0000	N
L Parietal	29	88	0.0000	N
R Parietal	29	88	0.0000	N
L Occipital	35	88	0.0000	N
R Occipital	38	88	0.0000	N
L Occipital Condyle	41	88	0.0000	N
R Occipital Condyle	43	88	0.0000	N
L Petrous Portion	59	88	0.0000	N
R Petrous Portion	53	88	0.0000	N
L Mastoid	52	88	0.0000	N
R Mastoid	50	88	0.0000	N
L Zygomatic	42	88	0.0000	N
R Zygomatic	41	88	0.0000	N
L Maxilla	46	88	0.0000	N
R Maxilla	50	88	0.0000	N

Cranial bones are significantly represented when the p-value approaches 0.1. L refers to left and R refers to right. The significance column indicates significantly represented cranial bones by Y for yes, and N for no (underrepresented cranial bones).

Table 21: Hypothetical Cranial Bone Representation at West Tenter Street

Hypothetical Cranial Bone Value	**Total Adult Expected Value**	**P-value (0.10)**	**Significance (Y/N)**
1	88	0.0000	N
…	88	0.0000	N
70	88	0.0025	N
71	88	0.0059	N
72	88	0.0133	N
73	88	0.0278	N
74	88	0.0542	N
75	88	0.0986	N
76	88	0.1670	Y
77	88	0.2629	Y
78	88	0.3847	Y
79	88	0.5234	Y
80	88	0.6638	Y
81	88	0.7886	Y
82	88	0.8845	Y
83	88	0.9469	Y
84	88	0.9803	Y
85	88	0.9945	Y
86	88	0.9989	Y
87	88	0.9999	Y
88	88	1.0000	Y

Cranial bones are significantly represented when the p-value approaches 0.1, outlined by the bolded row. The significance column indicates significantly represented cranial bones by Y for yes, and N for no (underrepresented cranial bones). "…" refers to the sequential numbers between the top and bottom rows.

Unlike the Battle of Stoney Creek and West Tenter Street samples, the results for the representation of crania from the Cross Bones burial ground collection were different. As indicated by Table 22, six of the cranial bones types were significantly represented using the binomial distribution statistic (p=0.1) when compared to the expected MNI value of 44 total individuals. As was done for the Battle of Stoney Creek and the West Tenter Street sites, the minimum number of crania required for significant representation was calculated using hypothetical values, and are listed in Table 23. Based on Table 23, there would need to be at least 36 cranial bones to be significantly represented at a 90% confidence level. Interestingly, the only bones that had values above 36 were the frontal, left and right parietal, left and right temporal and occipital bones. Notably, the left temporal bone was the best represented out of the cranial bones at the Cross Bones burial ground site, with 41 bones present out of a total of 44.

Table 22: Cranial Bone Representation at the Cross Bones Burial Ground

Cranial Bone	**Cranial Bone Value**	**Total Adult Expected Value**	**P-value (0.10)**	**Significance (Y/N)**
Frontal	40	44	0.65345	Y
L Parietal	40	44	0.65345	Y
R Parietal	40	44	0.65345	Y
L Temporal	41	44	0.82963	Y
R Temporal	40	44	0.65345	Y
L Zygomatic	35	44	0.02800	N
R Zygomatic	33	44	0.00335	N
L Maxilla	33	44	0.00335	N
R Maxilla	34	44	0.01026	N
Occipital	40	44	0.65345	Y

Cranial bones are significantly represented when the p-value approaches 0.1. L refers to left and R refers to right. The significance column indicates significantly represented cranial bones by Y for yes, and N for no (underrepresented cranial bones). Rows are also outlined and bolded when the MNI value is significant. "…" refers to the sequential numbers between the top and bottom rows.

Table 23: Hypothetical Cranial Bone Representation at the Cross Bones Burial Ground

Hypothetical Cranial Bone Value	**Total Adult Expected Value**	**P-value (0.10)**	**Significance (Y/N)**
1	44	0.00000	N
…	44	0.00000	N
29	44	0.00001	N
30	44	0.00006	N
31	44	0.00026	N
32	44	0.00098	N
33	44	0.00335	N
34	44	0.01026	N
35	44	0.02800	N
36	44	0.06793	Y
37	44	0.14563	Y
38	44	0.27444	Y
39	44	0.45280	Y
40	44	0.65345	Y
41	44	0.82963	Y
42	44	0.94289	Y
43	44	0.99030	Y
44	44	1.00000	Y

Cranial bones are significantly represented when the p-value approaches 0.1, outlined by the bolded row. The significance column indicates significantly represented cranial bones by Y for yes, and N for no (underrepresented cranial bones).

Table 24 was generated to display the best preserved cranial bones and a representation frequency from each skeletal sample. Using Table 24, it was evident that the Cross Bones burial ground crania were best represented, while the crania from the Battle of Stoney Creek were the least represented. The features and types of cranial bones recorded across sites were not standardized, but the data were still comparable statistically. The temporal bones at both the West Tenter Street and the Cross Bones burial ground sites were both the best represented, lending credibility to the survivability and density of the bone as previously discussed in the literature (e.g., White and Folkens 2005:95).

Table 24: Site Comparisons of Cranial Representation

Site	**Cranial Bone**	**Cranial Bone Value**	**Adult Expected Value**	**Total of Expected (%)**
Battle of Stoney Creek	Occipital	11	24	45.8
West Tenter Street	L Petrous Port	59	88	67.0
Cross Bones burial ground	L Temporal	41	44	93.2

Cranial bone value was the highest value per site. Total of expected was generated by dividing and multiplying the cranial bone value and adult expected value by 100.

Chapter 7: Discussion

Disarticulated, fragmented, and commingled collections in both individual and mass graves occur over a range of geographic and temporal contexts. Although these collections occur in forensic and archaeological settings, they are often overlooked possibly because there is a limit to the type of information that can be learned about each individual in the assemblage. The bones from the site of Smith's Knoll were disarticulated, fragmented, and commingled due to the formation processes and subsequent taphonomic activity that occurred at the site. The analysis of the collection from the Battle of Stoney Creek demonstrates that a wide range of useful information can be learned from such sites.

Previous research on other archaeological assemblages suggested that the large bones such as the femora were better represented (e.g., Adams and Konisberg 2008). However, this research suggests that the small bones (metacarpals, metatarsals, tali and calcanei) were better represented and less weathered than the long bones of the limbs (Table 13, and Section 6.2.3). These results are important because they suggest that small bones may not be as underrepresented as they may be expected to be.

The reasons for the unique patterns of representation and weathering of the bones from the Battle of Stoney Creek may be due to a number of factors: (1) the interaction between bone density, size, and morphology, (2) the burial environment, (3) possible trauma (4) clothing and footwear, (5) possible animal activity. The representation and weathering of the crania are discussed separately in the context of the West Tenter Street site, and the Cross Bones burial ground site.

7.1 Bone Density, Size, Shape and Taphonomy

It is widely accepted in the taphonomic literature that the degree of taphonomic damage is directly influenced by the density, size, and shape of bone (Marean 1991). Marean's (1991) study of faunal carpal bones at two late Pleistocene sites in Kenya supported previous findings from faunal data (e.g., Klein 1989) indicating that the frequency of smaller, compact, dense bones was greater than the frequency of large, irregular, and less dense bones. However, a number of human osteological studies have suggested that the larger bones such as the femora, tend to be well represented due to their density, size, and strength (Adams and Konisberg 2008; Willey et al. 1997; White et al. 2011:241).

Three characteristics: bone density, size, and shape, translate to particularly dense cortical bone, which degrades slowly (Madgwic and Mulville 2011). Reference standards state that bone density may be affected by age, ancestry, genetic predisposition, body mass of the individual, and the bones being used for analysis (Cohn et al. 1977; Nelson et al. 1991). The age of British and American soldiers was suggested to have been between 16-54 (Smith 2012:80; Turner 2000:12, 26), yet it is unlikely that most soldiers were older than 54 (based on the age determinations that could be made from the skeleton,

Table 1 and the list of casualties, Elliott 2009:260-265). The lower limb bones have been found to have thicker cortical densities, and may have good survivability in archaeological collections because they are weight-bearing bones (Nelson et al. 1991; Willey et al. 1997). Theoretically then, the human lower limb bones should be better represented than the upper limb bones. However, in the collection from the Battle of Stoney Creek, the lower limb bones were significantly underrepresented in comparison to the upper limb bones at a 95% confidence level (Section 6.2.3). The fact that the lower limb bones are poorly represented when compared to the upper limb bones is contrary to previously published literature linking bone density and strength to their representation (e.g., Stodder 2008).

Furthermore, the size of long bones has also been attributed to their possible increased representation in collections (e.g., Adams and Konisberg 2008). The fact that small bones were better represented than long bones in this study is inconsistent with some of the previous literature. Taphonomic activity may affect all bones on a site; but it is possible that the density, size, and shape of small bones allow them to avoid damage from activities such as ploughing. For this reason, it is possible that long bones are better represented when archaeological sites are minimally disturbed, and underrepresented when sites have undergone extensive taphonomic activity such as farming. Smith's Knoll was affected by a number of taphonomic factors that likely contributed to the underrepresentation and increased weathering of long limb bones at the site.

Some of the range of taphonomic activity that occurred at the Smith's Knoll site is indicated from documentation. Historical data suggests that landowners Louisa and

Herim Smith farmed the area directly associated with the remains (McCulloch 1932). During interviews from the previous analysis of the Battle of Stoney Creek, the landowners stated that the Knoll was ploughed regularly, revealing human bone (Liston pers. comm. 2014). These statements provide evidence that ploughing was an activity that occurred on the site; although it is unclear what other farming activities took place. It has been established that farming activity fragments bone, and displaces it vertically and horizontally (Haglund et al. 2002). The degree of damage to human remains from farming depends on a range of factors including the type of plough used, the depth of the original burial, and if the bones continued to be ploughed after being exposed on the ground's surface (e.g., Roper 1976; Ammerman 1985; Haglund et al. 2002). The use of a plough on Smith's Knoll would have razed the soil, and any bones associated with the soil. The plough would have likely missed the compact small bones, because of their size. The ploughing activity likely damaged the long limb bones because they are longer and sometimes wider than the small bones. Therefore, it is possible that ploughing negatively affected the long bones because of their size, making them more susceptible to plough damage than small bones (Section 6.2.3).

It is possible that other archaeological sites that have undergone extensive taphonomic damage may also have a better representation of small bones in comparison to the long limb bones. To investigate this suggestion, the data from two sites were reviewed. Fillingham is the first site, a Late Anglo-Saxon cemetery in Lincolnshire, England (the Anglo-Saxon period lasted from 410 AD-1066 AD). Fillingham was excavated for the purpose of learning more about the cemetery (Buckberry and Hadley

2001). The second site consisted of commingled, disarticulated, and fragmented human remains from the Anasazi cannibalism site in Southwestern Colorado (dating prior to around 1000 AD) (White 1992:38). Both sites are reviewed in the paragraphs that follow.

The Fillingham cemetery consisted of mostly stone lined individual burials, although graves were noted to cut into each other (Buckberry 2000). The human remains from Fillingham were extremely fragmentary, because they were disturbed by past and present human activity such as a quarrying, and animal activity such as rabbit holes (Hadley n.d.). The collection from the Battle of Stoney Creek and the Fillingham site share the similarity that both were taphonomically disturbed. The MNI of the fifth right metatarsal at Fillingham was 7/13 (53%), where 13 was the highest MNI from the mandible (Hadley n.d.). The MNI from the fifth right metatarsal from the Battle of Stoney Creek was 15/24 (63%), where 24 was from the right radius. The MNI data for the fifth right metatarsal from Fillingham (7/13) and Smith's Knoll (15/24) were compared using the z-statistic. An analysis of the results determined that the metatarsals were represented similarly at both sites (z=0.512) at a 95% confidence level. This means that although the burial types from Fillingham and Smith's Knoll were different; both sites had similar representation patterns of the metatarsals. One possible reason for the similar representation patterns of the metatarsals may be the degree of taphonomic disturbance at both sites.

Another disarticulated, commingled, and fragmentary site that follows a different pattern of bone representation is the Anasazi cannibalism site (White 1992:38). Analysis of the data from the Anasazi site also known as Mancos (5MTUMR-2346) suggests that the small bones were not well represented (White 1992). The highest MNI of the small bones was 7, compared to the overall MNI of 29 for the site (24%) (White 1992). The MNI of 29 was calculated by using maxillodental and mandibulodental data by the researchers (White 1992:88-89). Selecting bones with more muscle mass and specific patterns of crushing, fracturing, and burning human bone for the purposes of butchery and consumption was among the evidence confirming cannibalistic activity at the Mancos site (White 1992). Processing and fragmenting the bones with more muscle (e.g., the long bones) for consumption is an activity that differentiates cannibalism and non-cannibalism sites. The purposeful fragmentation of long bones at Mancos suggests that representation is not reflective of the bone size, shape, or its density. This may be the reason why the representation of bones at the site of Mancos are not similar to those from the Battle of Stoney Creek (Table 25).

Table 25: Comparison of the MNI Frequencies at Fillingham, Mancos, and Smith's Knoll sites.

Site	**MNI of Small Bones**	**MNI from collection**	**Frequency (%)**
Fillingham	7	13	53%
Mancos*	7	29	24%
Smith's Knoll	15	24	63%

The MNI from the small bones at Fillingham and Smith's Knoll were from the fifth right metatarsal. The MNI from the collection refers to the largest MNI from the collection. The frequency was generated by dividing the MNI columns and multiplying by 100.
*Cannibalism has been noted at the Mancos site and likely influenced the MNI of the small bones.

The Fillingham and Mancos sites vary geographically and temporally from the Battle of Stoney Creek, so these comparisons must be interpreted with caution. The data from Fillingham also support the contention that the small bones may be well represented when there is extensive taphonomic activity at a site. The MNI data from Mancos suggests that the postmortem and taphonomic processes at cannibalistic sites are different. For this reason, extensive taphonomic activity at cannibalistic sites does not imply that the small bones will be well represented and it may be due to some of the reasons listed above.

The long limb bones were generally more weathered than the small bones from the Battle of Stoney Creek (p=0.05) (Section 6.2.5, Table 14), an established pattern in previous literature due to the larger surface area of long bones (e.g., Janjua and Rogers 2008). The differences in the size and shape of bones likely played an important role in their representation and weathering, in addition to the farming activity that was suggested to have taken place on Smith's Knoll. For example, the small carpals and tarsals were minimally weathered (p=0.05) (Section 6.2.7), and the calcaneus and fifth metatarsal were represented in the sample enough to estimate the MNI (Table 2, Section 3.3). Bones with larger surface areas have been found to exhibit a wider range of weathering changes (Gill-King 1997; Janjua and Rogers 2008). It is possible that weathering effects such as root etching and groundwater influenced the integrity of the larger bones from the Battle of Stoney Creek while they were in the soil. However, once the bones were razed from the plough, they may have been exposed to other weathering elements such as the sun, which would have dried out and warped the bones. Therefore, the ploughing activity at Smith's Knoll is likely responsible for the differential representation and weathering between long and small bones. In conclusion, the patterns of long limb bones and the degree of weathering are consistent with some previous literature, and support the possibility that the small bones may not have encountered the plough or the environmental elements influencing their representation and weathering to the same degree as the large long limb bones.

An especially interesting finding was the comparison of the vertebrae and small bones. The cervical and thoracic vertebrae were underrepresented in comparison to the small bones (metacarpals, metatarsals, tali and calcanei, $z=-9.223$) and lumbar vertebrae ($z=-3.268$) at a 95% confidence level (Section 6.2.6). Furthermore, the cervical and thoracic vertebrae were weathered similarly, while the lumbar vertebrae were the most weathered out of the vertebrae ($p=0.05$) (Section 6.2.6). The function, morphology, and muscular anatomy of the cervical, thoracic, and lumbar vertebrae may have influenced their representation and weathering in the collection from the Battle of Stoney Creek.

All three types of vertebrae have an irregular shape consisting of a spinous process, two transverse processes, pedicles, laminae, and a vertebral body (Figure 14 and 15). The cervical vertebrae are unique and have transverse foramina to accommodate the V2 nerve from the cranium. The primary function of the small cervical vertebrae (C1-7) is to support the cranium (Mayfield Clinic for Brain and Spine 2013). The thoracic vertebrae (T1-12) support the ribs and protect the major organs, such as the heart and lungs (Mayfield Clinic for Brain and Spine 2013). The lumbar vertebrae (L1-5) are markedly larger than the cervical and most of the thoracic vertebrae because they support the weight of the body, and absorb stress from lifting objects (White et al. 2005:159).

The lamina, spinous process, and transverse process are made up of thick cortical bone for all vertebrae. Their purpose is to posteriorly protect the spinal column and act as a site for muscle attachment (Mayfield Clinic for Brain and Spine 2013). The pedicle connects the processes and lamina to the vertebral body. The vertebral body is often oval in shape and is covered by a thin fragile layer of cortical bone with trabecular bone underneath, in order to absorb stress.

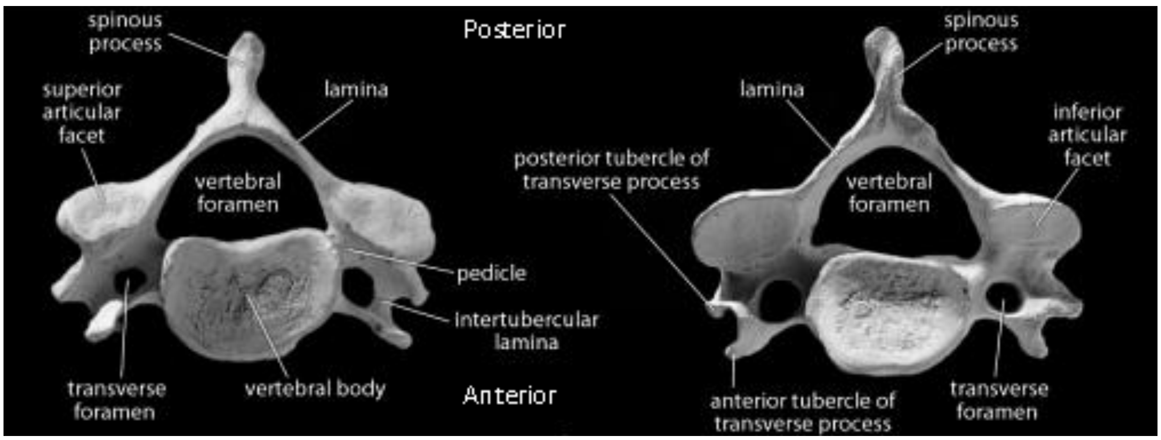

Figure 14: Features of the Cervical Vertebra (from White et al. 2011:132)

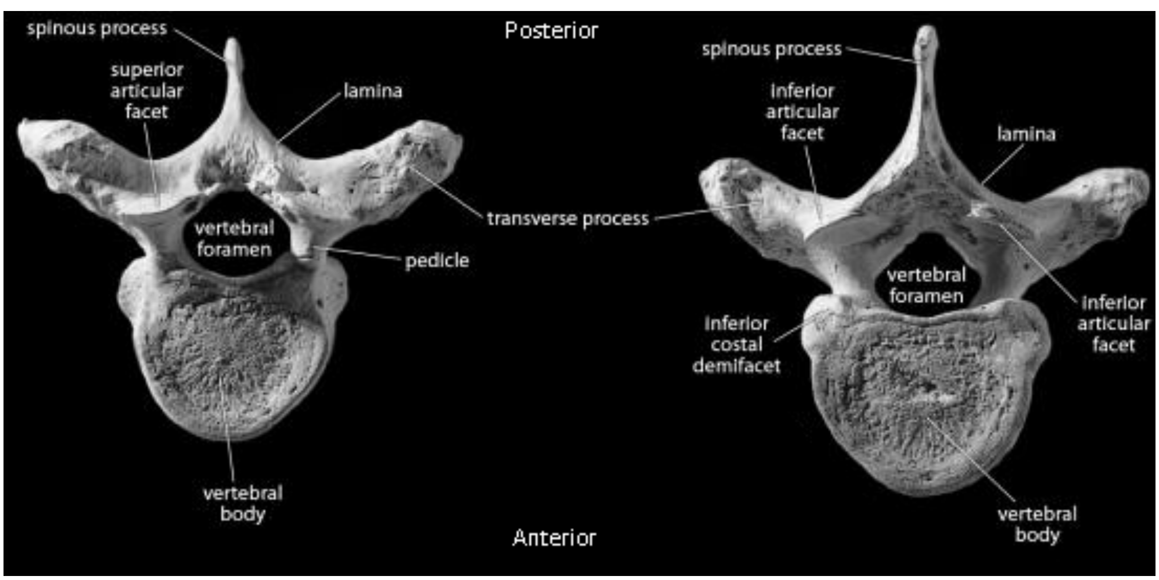

Figure 15: Features of the Thoracic and Lumbar Vertebrae (From White et al. 2011:133)

In anatomical position, the vertebrae are oriented so that the vertebral body is anterior, and the spinous process is posterior (Figures 14 and 15). Understanding the osteology of vertebrae is important because certain areas may be more prone to postmortem breakage than others (White et al. 2011:159). The zonation method is unique because it takes into account where bone is most likely to break postmortem (Knüsel and Outram 2004). Figure 16 from the zonation method illustrates that the zones for vertebrae are divided across the pedicle and spinous process, indicating they may be common sites of postmortem breakage in human cervical, thoracic, and lumbar vertebrae (Knüsel and Outram 2004).

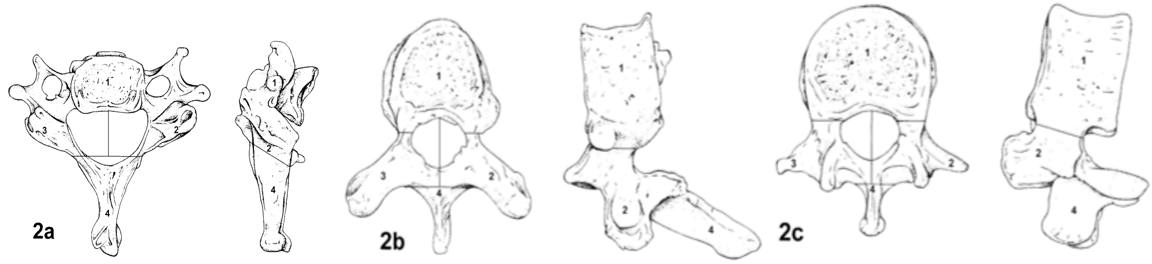

Figure 16: Zones of the Vertebrae: Cervical Vertebrae (2a), Thoracic Vertebrae (2b), and Lumbar Vertebrae (2c) (from Knüsel and Outram 2004:88).

The muscles of the spine may also contribute to the representation and weathering of cervical, thoracic, and lumbar vertebrae in this collection. In order for humans to stand erect bipedally, support, and move, the muscles of the spine need to be strong and dense. There are so many muscles securing the vertebrae together that during normal decomposition, the spine often decomposes and separates from the rest of the body as a single unit. Depending on the anatomy text, the muscles of the spine are divided by depth into two to four groups or layers (e.g., superficial, intermediate, and deep groups) that encompass a number of smaller muscles that are often paired (e.g., Grays 2003; Bowden and Bowden 2005; University of Arkansas for Medical Science 2009; Netter 2014; Spine Universe 2014). Muscles in each group may have their origin or insertion on various features of the vertebrae, often on the processes. The muscles of the spine allow for movement; however, there are also ligaments connecting the vertebrae to each other in order to stabilize the spine, and protect the intervertebral discs between vertebrae (Mayfield Clinic for Brain and Spine 2013).

Zones two or three (either the right or left transverse processes and lamina, Figure 16) were best represented for the cervical, thoracic, and lumbar vertebrae. One possible reason why these zones are the best represented may be due to the morphology of these zones and associated muscles. The transverse processes are composed of thick, dense bone and along with the lamina, are covered by many layers of thick muscles and ligaments (e.g. Figure 17 and 18). The anterior vertebral body is not covered with the same thickness of muscle. For this reason, it is possible that the muscles and ligaments better protected the transverse processes and lamina from the Battle of Stoney Creek. Thick muscles and ligaments also cover the spinous processes, but they were not as well represented as the transverse processes and lamina. The orientation of the transverse processes on either side of the vertebrae may have enabled them to be better represented than the spinous process that projects posteriorly. The vertebral bodies may have been more susceptible to taphonomic damage because of their structural fragility, and lack of protection from muscles and ligaments. Furthermore, the density relative to the width and height of the lumbar vertebrae (particularly the lower lumbar vertebrae) may have enabled them to better withstand taphonomic damage than the cervical and thoracic vertebrae.

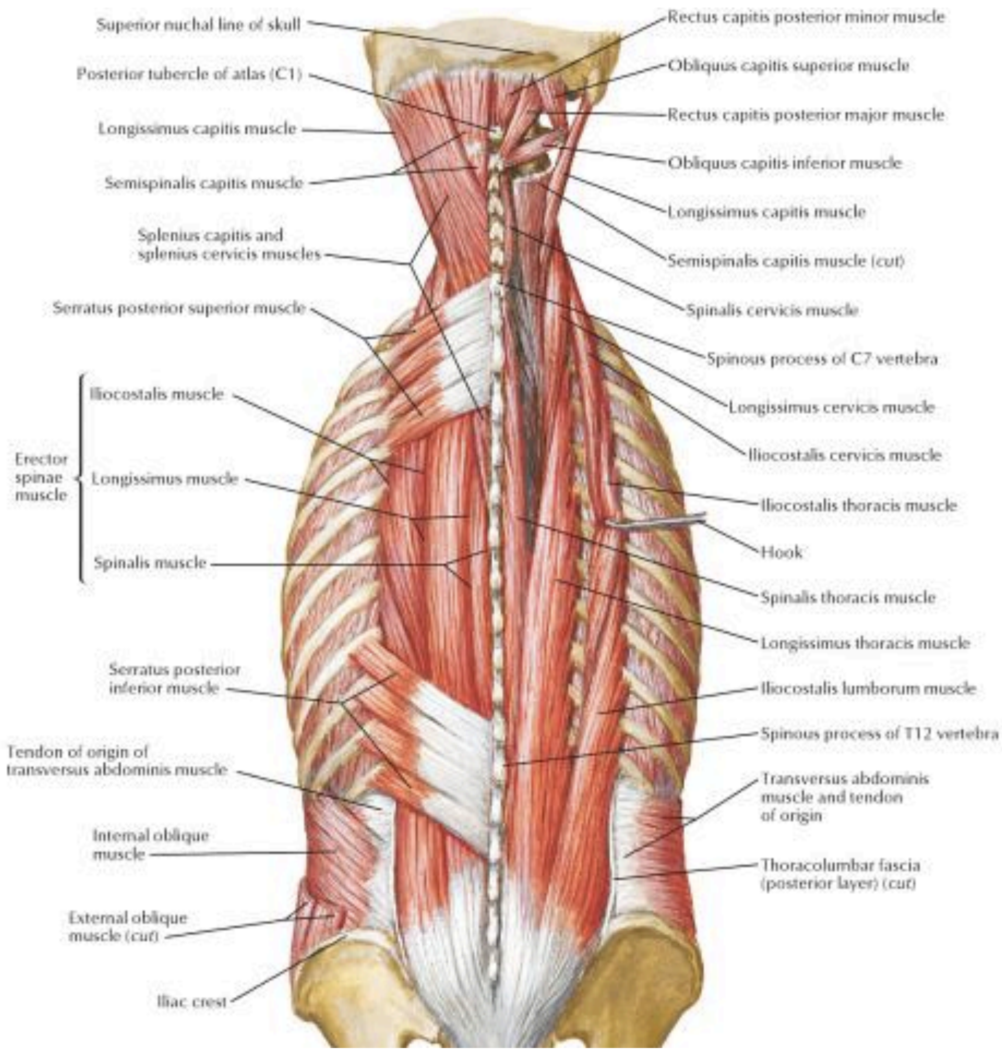

Figure 17: Overview of the Muscles in the Intermediate Layer of the Back (Netter 2014:Plate 172).

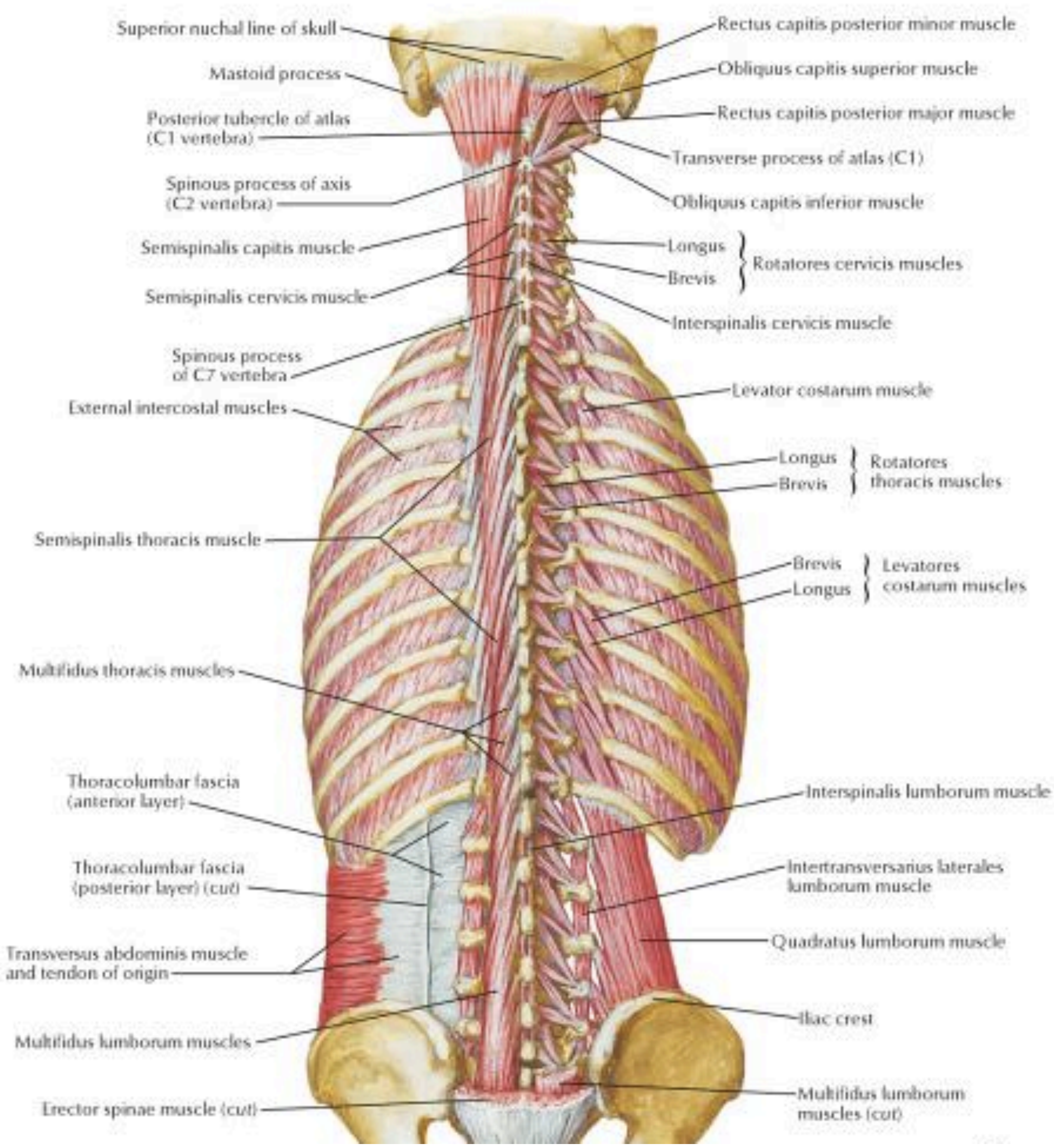

Figure 18: Overview of the Muscles in the Deep Layer of the Back (Netter 2014:Plate 173).

The irregular shape of the vertebrae and likely zones of fracture raised the possibility that not all vertebrae were categorized in the database as identifiable. Bone fragments that could not be identified were recorded in a separate unidentifiable database that was not used to collect the data for this research. The unidentifiable database organized the fragments into broad categories because they lacked osteological features to identify them further, or score them for completeness using the zonation method. Some of the broad categories include: large long bone, small long bone, vertebral column and sacrum, cranial or mandibular fragment, and flat bone (Lockau 2012:75-76). The proportion of unidentified vertebrae was calculated to determine if they were overrepresented in the unidentifiable, fragmented database. The unidentified vertebrae comprised only 5.905% (103 out of 1,744 bones) of the unidentified, fragmented database. The miniscule proportion of vertebrae in the unidentifiable, fragmented database, does not account for the underrepresentation of vertebrae as a whole. The representation of vertebrae at other archaeological sites is variable as they may be fragmented, damaged, and poorly represented (e.g., de Villiers 1974; Malville 1989), or fairly represented (Willey and Emerson 1993). The results of the current research suggest that the irregular morphology of the vertebrae influenced their representation at the Smith's Knoll site.

In sum, it is likely that the amount of taphonomic damage influences the types of bones represented. The degree of taphonomic damage experienced has been established in faunal literature to be related to the characteristics of a bone's density, size, and shape (Marean 1991). The small bones were better represented and less weathered than the long limb bones, and the vertebrae in the collection from the Battle of Stoney Creek. The likely reason for these findings are related to bone size, density, shape, and the amount of taphonomic activity at the Smith's Knoll site.

7.2 The Burial Environment: Soil and the Potential Mass Grave Orientation

The general changes of soil pH after deposition in burial environments are well known and influence the rate of decomposition. The initial burial of a body produces an alkaline environment (Carter 2005) proceeded by an acidic one (Gill-King 1997; Haslam and Tibbett 2009). Soil type and pH in the burial environment have been established as having significant impacts on cadaver decomposition (Haslam and Tibbett 2009); although, there are limited amounts of data for the specific effects soil pH has on the body, and vice versa (Carter and Tibbett 2008). There is a substantial amount of information on soil type, soil pH, soil moisture, and soil temperature, but it is unclear in the literature whether these characteristics differ in the same mass grave burial environment over time (e.g., at the center of the grave versus at the shallowest part of the grave). It is likely that the deceased soldiers were buried at the same time on the Knoll (The Spectator 1908; Elliott 2009). Burial at the same time, in the same mass grave environment suggests that all the bones were initially exposed to the same burial environment for the same length of time until disruption.

The human remains from the Battle of Stoney Creek were found in soil textures classified as mixed sandy loam and clay (Section 2.6) (Griffin-Short 2000, Figure 8). The combination of mixed sandy loam and clay soil may have slightly slowed the initial rate of decomposition at Smith's Knoll. Soil textures are grouped by the size of particles and have been established to directly influence the rate of decomposition (Tibbett and Carter 2009). Clay soil has the lowest rates of gas diffusion between the body and soil, slowing the rate of decomposition in comparison to other soil types (e.g., Carter et al. 2007; Tumer et al. 2013). See Section 4.3.2 for a larger discussion of how soil texture, soil pH, and diagenesis influences the rate of decomposition.

Another factor that may have also influenced the decomposition, representation, and weathering of bones is known as the "feather edge effect" within mass graves. First noted by Mant (1950), the feather edge effect occurs when bones in a mass graves are positioned in close proximity to each other, resulting in different rates of decomposition and different degrees of preservation depending on their location and orientation within the grave. Based on the feather edge effect, decomposition is slowed if individuals are located deeper and in the center of the mass grave (Mant 1950:33; Rodriguez and Bass 1985; Rodriguez 1997). Individuals buried closer to the surface of the soil, and near the outer rim of the mass grave will decompose more quickly, and may be more poorly preserved than those buried at the center (Mant 1950; Haglund 2002; Jessee and Skinner 2005). The reason for the varying degrees of preservation and different rates of decomposition of the bodies in the center of the mass versus those at the periphery is based on the environments. The first environment between the bodies and the soil matrix encourages decomposition, and is therefore different than the second 'synergistic' environment between bodies (Haglund 2002). The feather edge effect has been established in the literature (e.g., Mant 1950, FitzGibbon 1977; Haglund 2002; Jessee and Skinner 2005), although there is little known about its influence on bone weathering.

Recent experimental research aimed at learning more about different decomposition patterns recreated a circular mass grave by burying 21 wild rabbits at a surface depth of 30cm for approximately 60 days (Figure 19; Troutman et al. 2013). The experiment successfully proved that the feather edge effect does occur, with decomposition slowest at the center, and at the deepest portion of the mass grave (Troutman et al. 2013). Rabbit carcasses at the deepest portion in the grave had a slowest rate of decomposition, a lower internal temperature (in degrees), and showed the most amount of adipocere formation (Troutman et al. 2013). Adipocere is a white inodorous substance produced mainly from human and/or animal fat (Schoenen and Schoenen 2013). Adipocere may be due to: 1) the formation of hydroxy fatty acids, 2) a lack of oxygen, and/or 3) large amounts of water around the corpse during decomposition (Schoenen and Schoenen 2013). Although the preliminary experimental research did not involve assessing the condition or weathering of bone (Troutman et al. 2013), the results of the research provided indisputable evidence beyond the literature that the feather edge effect occurs in mass graves.

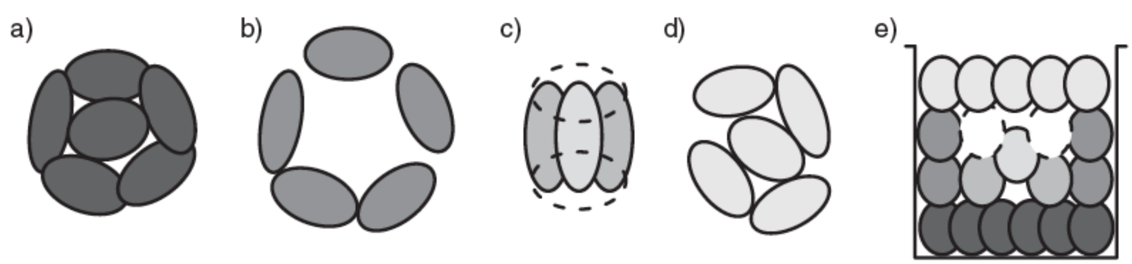

Figure 19: The Layers in the Experimental Mass Grave where a) is the Deepest Layer, b) is the Next Mid-outer Layer, c) is the Core, d) is the Shallowest Portion of the Grave, and e) is a Vertical Cross Section of the Grave (Troutman et al. 2013:3).

A mass grave contains at least six individuals buried in the same grave, making physical contact (Skinner 1987). Various sources suggested that following the battle, the deceased soldiers were buried together on the Knoll (The Spectator 1908, Griffin-Short 1998, Elliott 2009). An experimental reconstruction of the grave was undertaken and the analysis determined that there was not enough space to bury the 24 individuals separately. Furthermore, data from other battlefield sites suggest that it was not uncommon for soldiers to be buried in mass graves on the battlefields where they died (e.g., Primorac et al. 1996; Cunha and Silva 1997; Renshaw 2010). The multiple types of evidence suggest that at one point the soldiers from the Battle of Stoney Creek were buried together in a mass grave; although, it cannot be determined how long the grave persisted as mass before being disturbed.

The context of human remains from Smith's Knoll raises a complex issue that has not previously been addressed in the academic literature. In order to be considered a mass grave, how long do the human remains need to be interred, and what characteristics need to be met when human remains are re-deposited in a mass grave? There are many types of mass graves such as ossuaries or situations of genocide that have different formation processes and occur in a range of contexts (discussed at length in Section 3.1). For example, genocide is often related to the political climate of a geographic area, and will have different formation processes than First Nations ossuaries in Canada. Complicating matters further, a mass grave may be the interment of human remains from multiple contexts. For instance, First Nations ossuaries are a mass grave containing the disarticulated and commingled of human remains from primary, secondary, and tertiary burial sites (Section 3.2.1). The complex history of the disarticulated, commingled, and fragmented human remains from the Battle of Stoney Creek has highlighted that past definitions do not address how long human remains need to be interred in order to be considered a mass grave. Due to the gap in the literature, the human remains will be considered a mass grave because it is likely at one time they were as such (see Section 2.6).

It is possible that the feather edge effect influenced the preservation of bones from the Battle of Stoney Creek in the mass grave. Theoretically, the feather edge effect would have begun when the deceased soldiers were deposited in the mass grave. However, we do not know *how long* the bodies may have been impacted by the feather edge effect before being re-deposited.

Theoretically, parts of the bodies located at the periphery of the mass grave at Smith's Knoll may have been subjected to more damage (e.g., animal and insect activity, and the soil environment) and therefore may be underrepresented. The bones at the center and deepest part of the mass grave would hypothetically decompose the slowest, be better represented, and less weathered than the bones at the periphery (e.g., Mant 1950; FitzGibbon 1977; Rodriguez and Bass 1985; Rodriguez 1997; Haglund 2002; Jessee and Skinner 2005). The taphonomic disturbances have eliminated the possibility of definitively determining the original orientation of the burials; however, potential orientations may be suggested from other battlefield mass grave sites. Data regarding the orientation of bodies at three other mass grave sites are presented in (Table 26) and the following paragraphs describe the sites in further detail. These sites are the Battle of Towton in England (1461 AD), a World War I grave from Veneto in Italy (1914-1918 AD), and the mass grave from 120-122 London Road in England (2nd to 4th century AD).

The three archaeological sites are from different temporal and geographic periods, although they share similar grave outline shapes as square or rectangular, and body orientations within the mass grave according to cardinal directions (Table 26).

Table 26: Mass Grave Sites and Suggested Body Orientations

Site	**Battle of Towton**	**World War I, Veneto**	**120-122 London Road**
Location	England	Veneto, Italy	England
Year (AD)	1461	1914-1919	101-400
Shape of Grave	Rectangular	Rough square	Rough square
MNI	38	7	7
Suggested Orientation	West-East/East-West	West-East/East-West	North, South, East, West
References	Boylston et al. 2000; Burgess 2000; Sutherland 2000; Fiorato 2000; Sutherland 2014 pers. comm.	Gaudio et al. 2013.	Márquez-Grant and Loe 2008; Simmonds et al. 2008.

The information in this table was gathered from published documents and the analysis of tabular, and pictorial data. To save space in the table, full references are presented in the references cited section.

The first archaeological mass grave site is the Battle of Towton in Yorkshire, England. The mass grave from the battle was discovered during construction in 1996 and excavated later that year (Fiorato 2000). There were 38 individuals excavated from the mass grave that was rectangular in shape (Burgess 2000). The orientation of the bodies followed a West-East/East-West axis, and was later attributed to the way the bodies were placed in the grave, from West to East (Sutherland 2000). The excavation methodology and meticulous documentation of the bodies in the mass grave made these conclusions possible (Sutherland 2000). However, the loose soil fill of the grave meant that the hand and foot bones rarely stayed in-situ (Sutherland 2014 pers comm). These miscellaneous hand and foot bones that could not be attributed to an individual were recorded separately (Sutherland 2000). Investigating the representation of small bones was not among the numerous and complex research objectives from the Battle of Towton. For this reason, it is unclear from the analysis of published data whether the small bones were underrepresented at the Battle of Townton (Boylston et al. 2000).

The second mass grave is from World War I (1914-1919) from Veneto, Italy (Gaudio et al. 2013). The excavation was part of a three year project from 2006-2009 to improve the recovery and analysis of World War I soldiers (Gaudio et al. 2013). Seven individuals were exhumed from the grave in the Veneto mountains and based on the figures and textual data, the grave from Veneto was square in shape (Gaudio et al. 2013). The bodies were found in anatomical position, with six out of the seven bodies complete and “well preserved in every portion” (Gaudio et al. 2013:3). There was no discussion of postmortem cultural taphonomic disturbances affecting the bones possibly because they were nearly complete, and the location in the Veneto mountains is isolated. The data suggests that the bodies were placed in an East-West orientation until the bottom of the grave was covered, and then re-filled from West to East (Gaudio et al. 2013). The orientation of the individual bodies in regards to each other were variable, as some bodies were placed with the skull towards the North, while others were reversed (Gaudio et al. 2013). It is notable that the bodies from Veneto were oriented according to cardinal directions, and follow a similar pattern to the orientation of bodies from the Battle of Towton.

The last mass grave site is from the Roman cemetery at 120-122 London Road in Gloucester, England dating to the second to the fourth century AD (101-400 AD) (Márquez-Grant and Loe 2008). The cemetery was discovered during construction and excavated from 2004 until 2005 (Márquez-Grant and Loe 2008). The mass grave of 7 individuals was found within the greater cemetery, and exhibited a rough square shape (Márquez-Grant and Loe 2008). The orientation of the skeletons also suggested that bodies were generally oriented using cardinal directions (Simmonds et al. 2008). Data from this site support the earlier patterns for mass grave orientations according to cardinal directions. Furthermore, my review of the data from the mass grave suggest that the feather edge effect might have influenced the condition and completeness of the burials. Analysis of the data suggest that the three centermost burials were the best preserved (on a scale from destroyed to excellent), and the most complete (on a scale from 0-25%, 25-50%, 50-75%, and 75-100%) (Simmonds et al. 2008). An analysis of the data suggest that one reason for the poorer preservation and completeness of the four peripheral skeletons may also be due to intrusions, as certain graves cut into others. However, there was no evidence of additional taphonomic disturbances such as animal activity, sunlight bleaching, cannibalism, or purposeful disarticulation (Simmonds et al. 2008). From an analysis of the data, the long bones (femora, tibiae, fibulae, humeri, radii and ulnae) were the best represented, and the hands, feet, were the least represented (Simmonds et al. 2008). Other than intrusions, there were no additional taphonomic reasons suggested to account for the underrepresentation of certain bones. The high frequency of long limb bones supports previous literature that long bones are better represented at sites with a limited amount of taphonomic activity.

The shape of the original mass grave at Smith's Knoll is unknown; although the outline in Figure 3 from the archaeological excavation is an irregular rectangle with rounded edges (see Section 2.6). The possible shape of the grave outline is important because it restricts the area the deceased would have been buried, and the peripheral area influenced by the feather edge effect. For example, the measurement of the circumference of a small but deep circular burial will be less than the measurement of the perimeter of a long but shallow rectangular burial containing the same amount of people. The mass grave shapes from the Battle of Towton, Veneto, and 120-122 London Road are all similar, exhibiting a square or rough rectangular shape. The rough rectangular shape (Figure 8), and the similar shapes of mass graves from other sites reinforce the suggested rectangular grave outline from Smith's Knoll.

If the deceased soldiers from the Battle of Stoney Creek were placed systematically according to cardinal directions (similar to the mass grave from the Battle of Towton, 120-122 London Road, and Veneto), we would expect the representation of bones to be influenced. The original orientation of bodies from the Battle of Stoney Creek is not known, but it is possible that the soldiers were placed in the mass grave according to cardinal directions. Had there been a random orientation of bodies in the mass grave, the representation of bones, and weathering scores would likely have been more uniform across the skeleton. The range of the z-statistic data indicate the representation of bones was between -9.223 to 0.01 (Table 14). The range would be expected to be smaller if the orientation of bodies was random, that way the whole skeleton would have had an equal chance of being underrepresented, and more weathered.

The long upper limb bones were well represented in general (frequencies of 70-90%, from Figure 13) suggesting they may have been oriented towards the center of the mass grave (Figure 20). This would have slowed decomposition, and generally protected the long upper limb bones from weathering until other taphonomic activity took place. Taking this interpretation further, it is possible that the orientation of the carpals benefited from the orientation of the long upper limb bones. The carpals may have also been near the center and possibly at the deepest portion of the mass grave. The long lower limb bones were underrepresented in comparison to the long upper limb bones (z=-4.668), and were also slightly less weathered (Section 6.2.3). Based on the long lower limb bone data (Section 6.2.5), it would be expected that the tarsals would have expressed the same pattern and be underrepresented and weathered. Although representation based on the zonation method could not be assessed for neither the carpals nor the tarsals, their minimal weathering and high MNI of 17 for the left calcaneus (Table 2, Section 3.3) suggests that possibly other factors, such as the leather shoes, gaiters and boots worn by soldiers protected the tarsals (Section 7.1.3). Therefore, it is possible that the shoes protected the foot bones that would have otherwise been affected by the feather edge effect if the foot bones were oriented on the periphery of the grave.

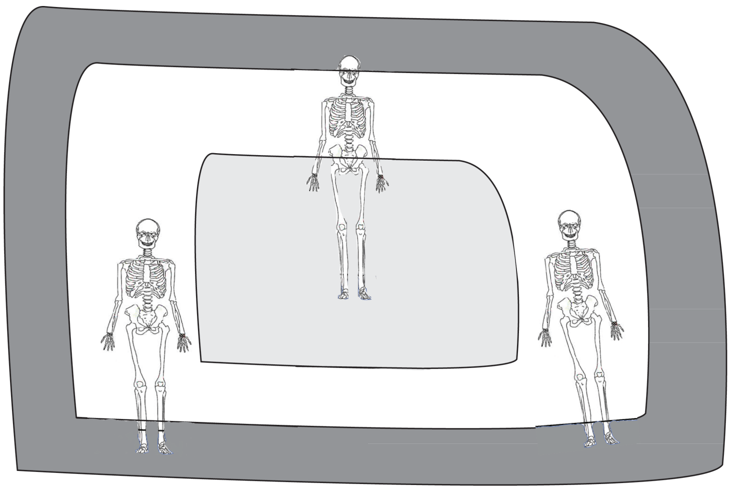

Figure 20: Possible Orientation in a Mass Grave. Dark grey fill indicates the periphery of the grave and light grey fill indicates the center of the grave, where bones would be better represented and less weathered.

One issue with this hypothesis is that the right radii were more weathered than the left, yet the right radii provided the MNI estimate for the collection because they were well represented. This inconsistency highlights the need for additional experimental research about the feather edge effect and its influence on the weathering of bone. Although the feather edge effect has been established in the literature (e.g., Rodriguez 1997; Haglund 2002; Jessee and Skinner 2005), and most recently with experimental research (Troutman et al. 2013), additional data would have proved useful in addressing the issue encountered with the radii.

The placement of bones in Figure 8 (Griffin-Short 2000) suggests that the bones were disturbed because the long bones were placed in clusters before the excavation began. The clustering and displacement of long bones would have been done when the soft tissues had decomposed, allowing complete access to the bones. It is possible that bones were clustered based on their shape, and their displacement likely had an impact on their representation and weathering. The clustering of bones from their original location implies the bones were disturbed. It is likely that tools were used to gain full access to the long bones, in order to rebury them in clusters. The tools used and the length of time taken to cluster the long bones may have damaged them further, negatively influencing their representation and weathering scores. The clusters of long bones from Figure 8 appear to generally be oriented parallel to each other. The parallel orientation of long bones would have supported each other's structure in a cluster, as opposed to being oriented perpendicularly. The perpendicular orientation of long bones would have resulted in the majority of long bones being broken due to taphonomic factors such as earlier disturbance and soil pressure from seasonal change. It is possible that the smaller bones were not included in the clusters and overlooked, a potential reason why the smaller bones were better represented and less weathered than the long limb bones.

In sum, the burial environment has a large influence on the representation and weathering of bones. The soil pH, soil moisture, soil temperature, and soil texture regulate the exchange of gases, water, and microbacteria, to facilitate the decomposition of a body (Haslam and Tibbett 2009). The type of burial (a mass grave or individual interments) would have also influenced the decomposition process, the representation, and weathering of bones. Primary resources for information on the burial type and shape are limited, whereas the resources were non-existent for the orientation of bodies at

Smith's Knoll. For this reason, suggestions regarding the orientation of bodies in the grave were made using information from other mass graves sites. It is important to recognize that individual burials at the Knoll were unlikely, although individual burials were theoretically possible. Based on the information available, the full extent of the feather edge effect on the preservation of each bone is impossible to know; therefore, general interpretations about the possible feather edge effect were made alongside the representation and weathering data from Smith's Knoll.

7.3 Trauma of the Upper and Lower Limbs from Weaponry Used in the Battle

The weapons used during the War of 1812 and the Battle of Stoney Creek are well-documented. The weapons such as muskets, rifles, bayonets, swords, and sabres (Section 2.2) caused projectile trauma, sharp force trauma, and blunt force trauma, all of which were recorded in the database. The specific role of weaponry and an investigation of perimortem trauma in the collection from the Battle of Stoney Creek were undertaken in previous analyses (Lockau 2012). A review of the data from Lockau (2012) in the context of this research suggests that the representation of limbs may be linked to perimortem trauma. The lower limbs are underrepresented in comparison to the upper limbs, possibly due to the weaponry used and the resulting potential trauma to the bones. The following paragraphs were written for the purpose of briefly summarizing the data from Lockau (2012) as relevant to this research to discuss how weaponry and trauma may have resulted in an underrepresentation of the lower limb.

While the human remains were curated at McMaster University, Lockau (2012) recorded the presence of lesions from possible trauma. There were three identified potential perimortem lesions on the lower limb (one on a right fibular fragment, category number SK0129; and two on femoral fragments SK0320 and SK0122). There was only one identified potential perimortem lesion on the upper limb, located on the diaphysis of a right ulna (category number SK0147). These data are important for two reasons.

Firstly, the identified frequencies of potential perimortem lesions indicate trauma to specific areas on the body. In the collection from the Battle of Stoney Creek there were more lesions identified in the lower limb than the upper limb (Lockau 2012) and the representation data indicated that the lower limb was underrepresented when compared to the upper limb. The fibulae and femora were among the bones with the highest prevalence of traumatic lesions in the collection (Lockau 2012:96). The lower limb is underrepresented, and this may, in part, be due to trauma from the battle concentrated towards the lower limb bones.

Secondly, the type of trauma (sharp force, blunt force, or projectile) will influence the rate of decomposition. The exposure of internal tissues (e.g., penetrating an internal organ) will quicken the autolysis and putrefaction stages of decomposition because of the release of bacteria (e.g, Stodder 2008) (Section 4.3.1). The majority of lesions in the collection including those on the long bones were attributed to sharp force trauma likely from swords or bayonets as opposed to tomahawks (Lockau 2012:134-140). Characteristics of the possible perimortem trauma from the long bones were attributed to slicing motions instead of stabbing motions (Lockau 2012:149). Theoretically, the sharp force trauma inflicted to bodies would increase their rate of decomposition, influence the completeness, and possibly the representation and weathering of bones.

The fragmentary, disarticulated, and commingled nature of the collection coupled with the extensive amount of taphonomic disturbance to the Smith's Knoll site likely hindered the identification of other perimortem lesions (Section 2.6). Therefore, it is possible that the quantity of identified possible perimortem lesions is an underestimate in the collection from the Battle of Stoney Creek (Lockau 2012).

7.4 Clothing and Footwear

Clothing may have played a role regarding the representation and weathering of small and large limb bones. It has been recognized that the type of material coverings (e.g., clothing) affects the rate of decomposition (e.g., Dautartas 2009). The soldiers from the War of 1812 wore uniforms made of wool, with different styles based on their rank, and whether they were British or American soldiers (Chartrand 2011a; 2011b). Wool is a resilient material and has been found to degrade slowly, even in experimental studies lasting 48 months (Janaway 2002). However, wool may still completely degrade over periods of time longer than two years due to bacterial attack, and in extremely acidic soils (Janaway 2002). It is possible that the wool uniforms for the British and American soldiers contributed to the initial protection of bones from the burial environment until the wool was completely degraded.

In addition to the wool uniforms for battle, there were also uniforms for fatigue dress for the British army (Chartrand 2011a), and specific 'undress' for the American army (Chartrand 2011b:31). The fatigue and undress uniforms were worn when the soldiers were not in battle. The Battle of Stoney Creek took place at night, possibly with an element of surprise (Section 2.4), so it is possible that some American soldiers were not in full dress. Not being in full dress, without pantaloons, breast plates, and coatees may have had an impact on the representation and weathering of bones. The potential lack of thick, layered clothing for the American soldiers means that there may not have been a barrier protecting the long limb bones from sharp force trauma during the battle, or the burial environment. A sample isotopic analysis from tooth enamel revealed that it is possible the soldiers buried at Smith's Knoll had a regional origin from North America and various places in Europe (Emery 2012:116). The soldiers that possibly originated from America and Britain may have worn different amounts of clothing, influencing the rate of decomposition and the preservation of bone albeit over a short-term period. It has been established in the literature that clothing will protect the body that is covered after burial; however, most experimental decomposition research is restricted to short periods of time lasting less than two years (e.g., Rodriguez and Bass 1985; Janaway et al. 2009). It is possible that the material and thickness of clothing during the Battle of Stoney Creek may have protected some of the larger bones over a short period of time from weathering (Section 6.2.5, Table 14). The limited data on the long-term effects of coverings such as clothing, and the uncertainty of how much clothing the soldiers were wearing hinders conclusions about the long-term effects of textile clothing at Smith's Knoll.

Another type of material that preserves well in the archaeological and forensic record is leather (Janaway 2002). In a notable forensic case in England, leather footwear preserved for almost 30 years, longer than some of the bones from the skeleton (Roberts 1996). Burials with shoes in archaeological and forensic sites have also been linked to improved preservation of the tarsals. Socks and shoes were found to preserve foot bones, which was noted during the identification of unknown war dead (Snow 1948). In addition to preserving bones, footwear is also beneficial during mass grave excavations because shoes and socks keep the foot bones together, improving their overall recovery at sites (Tuller and Đurić 2006). British soldiers of all ranks wore leather shoes in the War of 1812 while the American infantry wore shoes or tall boots (Chartrand 2011; 2011b:31). It is possible that the British soldiers also wore gaiters that extend from the base of the shoe to the middle of the shin, or below the knee (Chartrand 2011a:66-75). While the height of leather shoes and gaiters are unknown, it is possible that the shoes would have at least covered the dorsal portion of the foot and exposed the ankle. The strong, thick leather on the base and dorsal portion of the foot likely took a long time to decompose. The leather shoes, boots and/or gaiters may have contributed to the well-represented and minimally weathered calcanei, tali, and metatarsals.

An MNI estimate of 15 for the fifth right metatarsal was one of the largest MNI element counts for the collection (Brickley 2013), further suggesting the use of footwear improved the representation of foot bones, even if the feet were at the edge of the rectangular trench (Figure 20). The leather footwear would have likely protected the tarsals, metatarsals, tali and calcanei, enabling them to be well represented and minimally weathered (see 6.2.4 and 6.2.7). Acting as a barrier to the burial environment, the leather shoes, boots and/or gaiters would have also protected the foot bones from the other taphonomic activity such as animal scavenging and weathering. In conclusion, the use of leather shoes, boots, and/or gaiters likely influenced the representation and weathering of the calcanei, tali, and metatarsals.

The minimal weathering of the carpals; however, cannot be attributed to gloves because the spring, summer, and fall uniforms for both armies did not provide gloves (Chartrand 2011a, 2011b). The lack of glove wear suggests that the carpals were minimally weathered due to their small size, density and shape. These three characteristics also likely enabled them to avoid taphonomic disruption from ploughing. Furthermore, it is possible the orientation of the long upper limb bone and carpals in the center of the mass grave enabled them to be minimally weathered, even though there was no fabric to protect the carpals.

The interpretations of biological anthropologists are often challenged by the suggestions or lack of information recorded in the documentary data. It is likely that the material and thickness of clothing, and use of leather footwear enabled the small bones of the foot to be well represented and minimally weathered. The limited information about the original burial and orientation of bodies at Stoney Creek has impacted the conclusions and suggestions that can be definitively made in this thesis. Data regarding the shape of other archaeological mass graves sites from battle contexts were used to support the likelihood that the mass grave from the Battle of Stoney Creek was an irregular rectangular shape. Based on these data, it is possible that the orientation of bodies in the mass grave also influenced the representation and weathering of bones.

7.5 The Role of Animal Activity

Animals such as rodents and canids as well as insects, can modify human remains assemblages postmortem (e.g., Stodder 2008). Canids and rodents are known to leave characteristic marks on bone such as punctures, scoring, pits, furrows and gnawing (e.g., Binford 1981; Haynes 1980, 1982; Haglund 1997a; 1997b) (Section 4.3.3). Animal activity may also result in the damage and fragmentation of an assemblage, the removal of bones for consumption, and the scatter of the remains (Byers 2011:331). For example, canids may cause damage and fragmentation to an assemblage by gnawing and remove the proximal and distal portions of long bones to allow easier access to the bone marrow for consumption (Haglund 1997a).

The completeness and weathering of each bone fragment from the Battle of Stoney Creek are among the type of information recorded in the database under specific headings (Section 5.1). Unfortunately the database did not have a heading to consistently record the possible presence and type of animal activity. In the database, the same observer recorded animal activity on two bones out of 2,701 total bone fragments

(0.074%). The limited amount of recorded animal activity is atypical, and may be due to three possibilities.

The first possibility is that there was inconsistent recording of animal activity due to the lack of a defined animal activity heading in the database. The two cases of animal activity were recorded by the same observer in a 'general comments' heading. The recording of possible animal activity on bone fragments would likely have been more consistent had there been a heading in the database to prompt every observer to identify animal markings. A second possibility is that animals minimally modified the human remains from the Battle of Stoney Creek. Theoretically, canids have less time to access remains and produce maximum damage on a skeleton if they are interred immediately following death (Haglund et al. 1989). However, it is still possible for animals to disturb remains after their interment by digging up the remains or through burrows. The soldiers were suggested to be buried following the battle (e.g., Biggar 1873; Griffin-Short 2000), and were buried in a mass grave (e.g., The Spectator 1908; Elliott 2009). Burial in a mass grave may have restricted animal access to the bodies on the periphery and the most shallow parts of the grave. The last possibility for the limited amount of recorded animal activity may be the extreme fragmentation of the collection. It is possible that other postmortem processes (e.g., farming) may have hindered the identification of animal markings, and resulted in their possible underrepresentation.

Animals often have a large role in the modification of forensic and archaeological human remains assemblages. The minimal role of animal activity in the collection from the Battle of Stoney Creek is atypical, and may have been due to the three possibilities listed above.

7.6 Cranial Bone Representation and Weathering in relation to MNI

The bones that comprise the cranium are useful in archaeological and forensic contexts because of the amount of information that can be assessed from them. Various morphological features on the crania, such as mastoid robusticity (Buikstra and Ubelaker 1994), and metric features such as the mastoid and opisthion-bimastoid triangles may be used for sex determination (Deepali et al. 2013). General age assessment based on cranial suture closure is also possible through visual or radiographic analysis (Aggrawal et al. 2010). Ancestry may be assessed morphologically by traits such as cranial suture complexity, and orbit shape (Wood 2012). Important in forensic anthropology, antemortem and postmortem radiographs of the frontal sinuses may be compared to secure a positive identification of an individual from a missing persons database (Christensen 2005). Although crania may be fragmented, valuable information such as sex, age can still be assessed (e.g., de Villiers 1974; Willey and Emerson 1993). Furthermore, positive identification in the field of forensics is more likely to be determined if a cranium is present (Komar and Potter 2007). For these reasons, the recovery of the cranium is important in both archaeological and forensic contexts.

The crania from the Battle of Stoney Creek were fragmented, and statistically underrepresented in the sample at a 90% confidence level (Table 17, Section 6.3). To further investigate if the underrepresentation of crania is a common phenomenon at other archaeological sites, data from two other collections were gathered and compared to the remains from the Battle of Stoney Creek. The representation of crania (as a frequency) from the Battle of Stoney Creek was 45.8% (based on the number of occipital bone fragments present N=11, and the MNI of the sample N=24), compared to 67% from the West Tenter Street site (based on the left petrous portion N=59, and the expected value N=88), and 92.6% from the Cross Bones burial ground site (based on the left temporal bone N=41, and the expected value N=44) in England (Table 24, Section 6.3). The cranial bones normally expected to be well represented are the petrous portion of the temporal bone because of its density (e.g., McKinley 2000:408; Willey et al. 1997). The data from the West Tenter Street and Cross Bone burial ground sites are consistent with the pattern that the temporal bones are the best represented (Table 24, Section 6.3). The best represented cranial bone from Battle of Stoney Creek was the occipital, followed by the zygomatic bones (Table 7 and 24, Section 6.3). The right temporal bone MNI was 7 (29.2%), which is not as high as the occipital, nor is it the lowest MNI (Table 7, Section 5.2.3). The greater degree of underrepresentation of the crania from the Battle of Stoney Creek in comparison to West Tenter Street and the Cross Bones burial ground may be due to possible looting and exhumation, the soil texture, and a lack of coffins.

The representation of crania from the Battle of Stoney Creek was likely affected by looting damage from the supposed exhumations of the skeletons in the early 1900s on the Knoll (Griffin-Short 2000; Elliott 2009:217). Looting and grave robbing bones and/or memorabilia destroys the original context and provenience of an assemblage, and fragments bones (Gill and Chippindale 2002; Kelley et al. 2011). Looting may also result in the underrepresentation or damage of specific bones based on their significance to the looter (e.g., a skull being more noticeable and 'valuable' than a carpal), and orientation in the grave (e.g, shallow orientation versus deep). In 1889, Peter Van Wagner claimed to have exhumed 40 soldiers from the Knoll, and took 22 crania for his phrenology lectures (Mills 1899). It is possible that Van Wagner removed the most complete crania, because the crania exhumed from the archaeological excavation were extremely fragmented (Liston 2014 pers. comm.). If Van Wagner did remove 22 crania, this is further indirect evidence that there were more than 24 soldiers buried on the Knoll, an MNI estimate based on the right radius. The largest MNI for the crania was 11, based on the presence of the occipital bones (Table 17, Section 6.3). There is a possibility that at least 40 soldiers were buried on the Knoll, but this is a suggestion based on the cranial representation data, and an unverifiable claim in the historic record (Mills 1899). The MNI of the collection from the Battle of Stoney Creek remains at 24 because the claim that Peter Van Wagner exhumed a number of crania cannot be verified.

The unique anatomy of the cranium in conjunction with the soil texture may have also influenced the representation of crania in the collection from the Battle of Stoney Creek. The 22-23 cranial bones (excluding the six ear ossicles) fuse together during growth and development into adulthood. Therefore the cranium is not a single entity, but rather a combination of bones that are the most fragile at the sutures. The superior-inferior ground pressure from seasonal change, clay-like soils, and ground water may warp the diploe of the crania (Nawrocki 1995; Mays and Cox 2000:215) possibly accounting for some of the fragmentation of the cranial bones. The Smith's Knoll site did have a mix of sandy loam and clay soils (Figure 5, 6, and 7; Griffin-Short 2000), which may have put more pressure on the crania in their burial context, and made it difficult to remove complete crania during the excavation (Mays and Cox 2000:215). Lesions on the cranial fragments attributed to musket ball injuries during the battle may have also fractured the cranial bones before burial (Lockau 2012:122). The projectile trauma was identified by characteristics including circular lesions and beveling (Lockau 2012:122), fracturing the crania, and possibly enabling further postmortem breakage due to various taphonomic processes such as ground pressure. A combination of the unique characteristics of cranial bones, possible trauma, and the post-depositional environment at the site including the seasonal ground pressure may account for the fragmentation and underrepresentation of crania (p=0.1) (Table 17, Section 6.3).

The crania from the West Tenter Street in London were also underrepresented based on the data from published site reports (p=0.1), but not to the same degree as the crania from the Battle of Stoney Creek (Table 20, Section 6.3). The specific processes related to the loss of bone and cranial bone could not be pinpointed at West Tenter Street. General damage caused from the poor organization of the cemetery and intrusive graves is suggested to be the most likely reason for the loss of bone overall (Waldron 1987). Intrusions and poor organization of graves is a common reason attributed to cranial fragmentation and representation (Mays and Cox 2000:215). The poor organization of the cemetery and intrusive graves suggests that it was not uncommon for burials to cut into others and damage bones (Waldron 1987). There was no mention of looting, or decapitation burials in the West Tenter Street cemetery (Waldron 1987; Whytehead 1986). The lack of evidence for looting and decapitation burials reduces the possibility that these were reasons why the crania would be differentially represented than the rest of the body.

In addition, there was mention of coffin use at West Tenter Street based on the presence of nails and wood stains (Whytehead 1986). It is possible that coffins protected the crania from the burial environment and seasonal pressure at West Tenter Street, until the coffin lid caved in on the body. It is accepted that bodies in coffins decompose differently than those buried directly in the soil (Mant 1987; Dent et al. 2004). Coffin warping is common and occurs shortly after deposition (Mant 1987), and the coffin lid caving in on the body may have fragmented the crania. The lack of evidence in the form of coffin hardware and coffin wood from the archaeological excavation suggested that coffins were not used at Smith’s Knoll (Griffin Short 2000). Coffins are rarely used at battle sites. For instance, it is unlikely coffins were used at the Battle of Towton and the mass grave from Veneto. In sum, the West Tenter Street site exhibited a statistical underrepresentation of crania ($p=0.1$), albeit still a better representation than the collection from the Battle of Stoney Creek. Some reasons for the improved representation at West Tenter Street may have been the lack of looting, use of coffins, and minimal taphonomic damage.

The crania from another site, the Cross Bones burial ground were significantly represented in comparison to the expected value of 44 (p=0.01) (Table 22, Section 6.3). The representation frequency of crania from the Cross Bones burial ground was very good, at 93.2% (Table 24, Section 6.3). The graves from the Cross Bones burial ground were disturbed in the mid 1800s on a regular basis, because there was little room on the burial ground (Brickley et al. 1999). The disruptions at Cross Bones burial ground may not have had as large of an impact as they did at West Tenter Street, because all of the adult and juvenile remains were generally well preserved and relatively complete (Brickley et al. 1999).

Most of the cranial vault bones from the Cross Bones burial ground were well-represented (frontal, left and right parietals, left and right temporals, and occipital bones), except for the left and right zygomatics, and left and right maxillae. As with the West Tenter Street Site, the Cross Bone burial ground also used coffins, so one would theoretically expect that the crania were relatively well protected until the coffin lid caved in on the deceased (Mant 1987; Dent et al. 2004). The caving of coffin lids may account for the damage to the maxillae and zygomatic bones from the Cross Bones burial ground, because these bones are found on the anterior-most portion of the cranium and would likely have received most of the initial impact from the collapsing coffin lid. The Battle of Stoney Creek was the only site where there was no evidence of coffin use (Griffin-Short 2000). For this reason, the deceased soldiers would have been more exposed to the burial environment during the decomposition process and the possible taphonomic activity of looting, farming, and exhumation. The taphonomic disturbances in conjunction with the lack of coffin use and soil texture are the most likely reasons for the underrepresentation of crania in the collection from the Battle of Stoney Creek.

7.7 Summary of Factors Influencing Representation and Weathering

A summary of the major factors suggested to have influenced the representation and weathering of bones from the Battle of Stoney Creek are presented by Table 27. Alternative suggestions are also summarized below.

Table 27: Taphonomic Factors Known to Impact Human Remains in Burial Contexts

General Factor	**Specific Factor at Smith's Knoll**	**Established Effects (from the literature)**	**Likely Impact on Smith's Knoll**	**Alternative Scenarios for Smith's Knoll**
Soil	pH- Unknown	Alkaline to acidic in burial environment	Unknown	Alkaline to Acidic
	Temperature- Cool at night and in the winter	Decomposition slowed in cold	June was likely not cold enough for decomposition to be slowed	Decomposition slightly slowed at night and in the winter months
	Type of soil- Sandy loam and clay	Early decomposition slowed, increased fracture (from seasonal pressure), crania difficult to remove	Early decomposition slowed and crania were more damaged from seasonal pressure	Clay soil had a minimal effect on decomposition or cranial damage
Grave Type	Mass grave- Feather edge	Decomposition slowed at	Feather edge effect allowed	Bodies may have been

	effect	center and deepest portion	small bones of the hand to be better represented and less weathered than long bones	buried as individual graves and were not commingled until later, therefore eliminating the feather edge effect
Climate	Climate- Four seasons	Decomposition slowed in winter and quicker in the summer	The onset of decomposition was quick and cold temperatures at night had a minimal effect on decomposition	The decomposition process was not continuous because of cooler temperatures at night and in the fall and winter
Natural Effects	Animal Activity- Canids and rodents	Causes scatter of bones and postmortem damage	Minimal effects because burial was suggested to have taken place a couple days after the battle	Canid scavenging influenced the representation and weathering of bone
	Insect Activity	Quickened decomposition if bodies were left on the ground surface	Early insect activity before bodies buried days after the battle	Insects quickened decomposition and were attracted by open wounds from the battle
Cultural Effects	Human Activity- Farming	Plowing displaced bone vertically and horizontally, caused fracture	Bone fractured, displaced vertically and horizontally	Displacement and/or fracture of bone was limited
	Archaeology Assessment and Excavation Methodology	Method will influence completeness of bone	Limited damage, although excavation method unknown	Method caused more damage to bone
	Excavation	Staff may	Limited damage	Staff caused

	Staff	cause more damage to bone		more damage to bone
Covering	Clothing- Shoes, boots, gaiters, fabrics	Shoes and some fabrics protect foot bones	Shoes protected feet and (limiting the feather edge effect). Minimal clothing hindered preservation	Shoes and clothing did not impact representation and weathering
	Coffins- No evidence of coffin use	Coffins offer initial protection from the burial environment, but warp shortly after burial	Bones fully interacted with burial environment	Coffins may have been used, offering limited protection from the burial environment

A summary of the factors that were most likely to have influenced the representation of the crania from the Battle of Stoney Creek are provided by Table 28 along with alternative suggestions. This list was generated after additional comparisons were made to the cranial representation at the West Tenter Street and Cross Bones burial ground sites.

Table 28: Taphonomic Factors Known to Impact Crania in Burial Contexts

General Factor	**Specific Factor at Smith's Knoll**	**Established Effects (from the literature)**	**Likely Impact on Smith's Knoll**	**Alternative Scenarios for Smith's Knoll**
Soil	Type- Sandy loam and clay	Early decomposition slowed,	Early decomposition not slowed until	Clay soil had a minimal effect on

		increased fracture (from seasonal pressure), crania difficult to remove	season change from summer to fall	decomposition or cranial damage
Grave Type	Mass grave-Feather edge effect	Decomposition slowed at center and deepest portion	Crania oriented towards the center of the rough rectangular mass grave, enabling the feather edge effect to protect them until other taphonomic factors took place	Crania oriented near the border of the rough rectangular shaped mass grave, resulting in them being weathered and underrepresente-d
Cultural Effects	Human Activity-Looting	Causes damage to bones, explains missing bones/artifacts	Unverified accounts that Van Wagner exhumed 22 crania account for their underrepresenta-tion	Crania were not exhumed, instead extensively fragmented
	Human Activity-Farming	Plowing displaced bone vertically and horizontally, caused fracture	Bone fractured, displaced vertically and horizontally	Displacement and/or fracture of bone was limited
	Archaeology Assessment and Excavation Methodology	Method will influence completeness of bone	Compounded with clay soil, damage to crania was likely although excavation method unknown	Method caused more damage to bone

Covering	Coffins- No evidence for coffin use	Coffins offer initial protection from the burial environment, but warp shortly after burial	Bones fully interacted with burial environment	Coffins may have been used, offering limited protection from the burial environment until coffin lids would have fallen and damaged the cranial bones

Chapter 8: Conclusion

The preservation of human remains encompasses information regarding the completeness as well as the condition of bone (Stodder 2008). The size, shape, and density of bone have been linked to its representation in archaeological collections (e.g., Marean 1991). However, it was unclear whether the compact small bones, or the large dense long bones would be better represented in disarticulated, commingled, and fragmented collections that had undergone extensive taphonomic disturbances. The purpose of this research was to address this issue by using the collection from the Battle of Stoney Creek to examine the representation and weathering of human bone. Analysis of the data suggested that the metacarpals, metatarsals, tali, and calcanei were better represented and less weathered than the long lower limb bones (femora, tibiae, fibulae, $z=-7.933$) and the long upper limb bones (humeri, radii and ulnae, $z=-3.268$) at a 95% confidence level. Furthermore, the cranial bones from the Battle of Stoney Creek were underrepresented in comparison to the MNI of the collection, 24 based on the right radius ($p=0.1$). These results suggest that larger bones may be underrepresented in archaeological collections with extensive taphonomic disturbances such as ploughing, looting or the possible exhumation of specific skeletal elements. An analysis of the results also suggests that the smaller bones were relatively protected from these cultural activities due to their small size.

Ploughing has been established to fragment and displace bone vertically and horizontally (e.g., Haglund et al. 2002). Looting can also fragment bone while also destroying the provenience and context of the assemblage (e.g., Gill and Chippindale

2002). The ploughing, and looting seem to have negatively influenced the representation of long upper and lower limb bones due to their size, shape, and density. The small size, general round shape, and compact density of the hand and foot bones likely allowed them to avoid the taphonomic disturbances such as those created by ploughing. This resulted in the small bones being well represented and minimally weathered.

The soil pH, soil texture, soil moisture, and soil temperature are known to influence the representation and weathering of bone (e.g., Stodder 2008). The clothing and footwear worn might have also influenced the preservation of the bones along the edge of the mass grave. Influences of soil and the type of material used to clothe the bodies of soldiers, such as wool, have been both documented and established in the literature. The natural decomposition process of the body, and the climate of the geographical area where bodies were interred will influence the completeness and the condition of bone. The amount and material of possible coverings such as clothing and footwear might have also influenced the preservation of bone. The uniform for British and American soldiers involved wearing wool coatees, and dark leather shoes, or boots, and some ranks wearing gaiters (Chartrand 2011a; 2011b:31). Wool degrades from bacteria, and in acidic soil, but the wool might have initially protected the long upper and lower limb bones from the burial environment (Janaway 2002). Footwear has been proven to protect the soft tissues surrounding the tarsals, resulting in improved preservation (e.g., Snow 1948; Tuller and Đurić 2006). The leather footwear may have offered protection from the burial environment, allowing the foot bones to be represented and minimally weathered, even if they were located along the edge of the mass grave.

By systematically reviewing the available evidence (e.g., The Spectator 1908; Elliott 2009), a mass grave was determined to be the most likely form of burial at Smith's Knoll. Mass graves undergo different decomposition processes than individual interments that may influence the representation of bone. Furthermore, trauma caused by projectile, blunt force, and sharp force may have both damaged and quickened the rate of decomposition for some bones, specifically those of the lower limb. Although the original orientation of bodies in the mass grave was unclear, the representation and weathering data were interpreted to suggest that some bones were buried on the edge of the grave. Data from other mass grave sites including the Battle of Towton in England, Veneto in Italy, and from 120-122 London Road in England were used to suggest the possible orientation of bodies from Smith's Knoll. Data from these mass graves indicate that bodies were oriented according to cardinal directions, and this may have also been the case for the soldiers from the Battle of Stoney Creek. Based on the representation and weathering data, the long lower limb bones may have been oriented near the outer rim of the grave and the long upper limb bones at the center and deepest part of the mass grave. The tarsals and metatarsals may have been oriented largely towards the periphery of the grave, but may have been unaffected by the feather edge effect because of the leather footwear protecting the foot bones from the burial environment. The minimal weathering of the carpals may also be attributed to their orientation in the mass grave, in the center and deepest portion of the mass grave, close to the long upper limb bones. The validity of this scenario is based upon the suggestion that the soldiers from the Battle of Stoney

Creek were buried in a mass grave, and that the feather edge effect differentially influenced the remains based on their suggested orientation.

The crania from the Battle of Stoney Creek were also underrepresented at a 90% confidence level. When the largest MNI of the crania were compared to the collection as a frequency, the crania from the Battle of Stoney Creek were underrepresented at 45.8% (versus 67% at West Tenter Street, and 93.2% from the Cross Bones burial ground). The Cross Bones burial ground was the only site where the cranial bones were significantly represented (p=0.1). In comparison to the West Tenter Street and Cross Bones burial ground sites, the underrepresentation of cranial bone from the Battle of Stoney Creek may be a result of the multiple disturbances at the site such as farming practices and looting. It is also possible that a number of crania were exhumed; however, there is no direct evidence to prove this suggestion. Lastly, the underrepresentation of crania may also be due to the soil texture and burial environment, the lack of coffin use, and a possibly minor influence from the feather edge effect.

Fragmented and missing bones and/or artifacts may be a result of looting (e.g., Green and Doershuk 1998; Gill and Chippindale 2002; Kelley et al. 2011). It has been suggested that Smith's Knoll was looted for military memorabilia, and it has been suggested that crania were exhumed in the 1900s (Mills 1899; Griffin-Short 1998; Griffin-Short 2000). The soil texture, soil moisture, and seasonal (superior-inferior) ground pressure may have fragmented the crania because the crania are a combination of separate bones fused together. The West Tenter Street site and Cross Bones burial ground used coffins, which would have initially protected the bodies from the burial environment. The lack of coffin use (Griffin-Short 2000), and combination of taphonomic disruptions (e.g., looting and farming) also likely influenced the representation of crania in the collection from the Battle of Stoney Creek. The underrepresentation of crania and other bones at West Tenter Street was attributed to the cultural damage caused from the poor organization of the cemetery and grave intrusions (Waldron 1987). Intrusions and poor cemetery organization has been noted to cause fragmentation of the crania and influence their representation (Mays and Cox 2000:215). The Cross Bones burial ground was also disturbed, but likely to a lesser degree than the other two sites because the condition and completeness of bones was better than West Tenter Street, and the collection from the Battle of Stoney Creek.

In the context of the broader bioarchaeological literature, the results from these data, and interpretations are useful for other archaeological sites, especially those that have commingled, disarticulated, and fragmented human remains. Using the collection from the Battle of Stoney Creek, it was determined that the amount of taphonomic activity at an archaeological site may be positively correlated to the representation of small compact bones of the hands and feet, and negatively correlated to the representation of large long bones. Analysis of the weathering data in addition to the representation data also suggests that the underrepresented bones are not always more weathered. These results and interpretations significantly contribute to the bioarchaeological literature on the preservation, representation, and weathering of human bone especially in commingled, disarticulated, and fragmented contexts. Future research focusing on the feather edge effect would be beneficial for researchers who are analyzing mass grave archaeological or forensic sites. Future analyses regarding the completeness, representation, and weathering of bones from other collections should be undertaken, to add to the already existing patterns found from the remains recovered from the Battle of Stoney Creek.

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Appendix A: Zonation Method (from Knüsel and Outram 2004)

The images below are from a published paper by Knüsel and Outram (2004:88-96). The images are important, as they serve as a guide for those who are unfamiliar with the zonation method, which records the number, and location of each zone per bone.

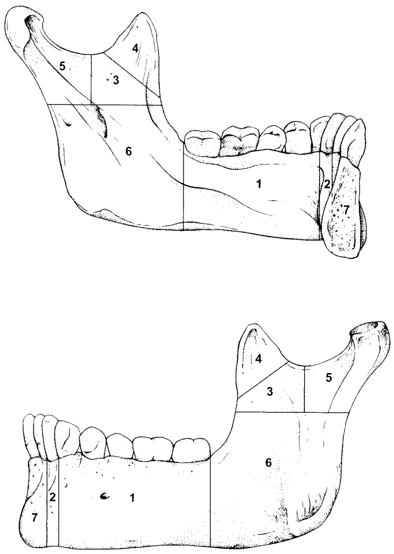
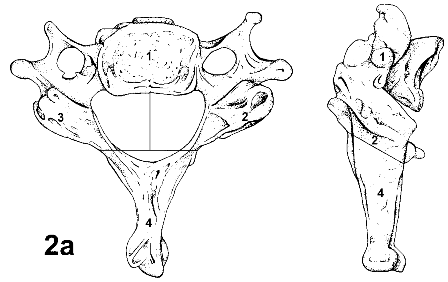
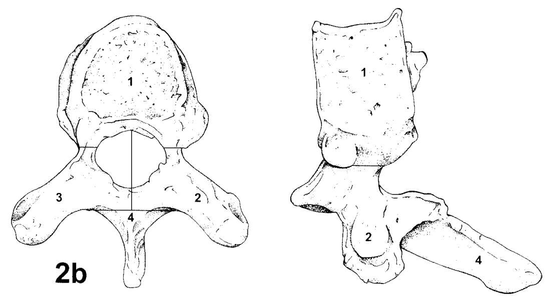


Figure 1. Mandible, medial (internal) and lateral (external) views: 1– the portion of the corpus, including the alveoli for the premolars and molars as well as the premolars and molars themselves; 2– the portion of the corpus, including the alveolus for the canine and the canine itself; 3– the area of the ascending ramus inferior to the coronoid process; 4– the coronoid process; 5– the posterior portion of the ascending ramus and the mandibular condyle; 6– the gonial angle, including the mandibular foramen and mylohyoid groove (internally) and the attachment of M. masseter (externally); 7– the anterior portion of the corpus, including the alveoli of the incisors and the incisors themselves.



2a



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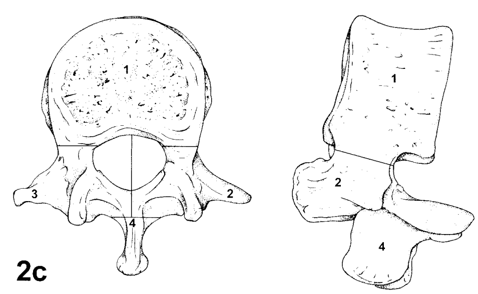

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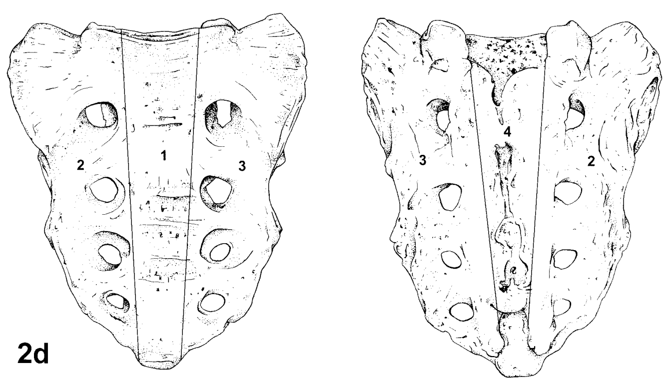

2d

Figure 2. Vertebrae: (a) Cervical vertebrae, superior and right lateral views; (b) Thoracic vertebrae, superior and right lateral views; (c) Lumbar vertebrae, superior and right lateral views; (d) Sacral vertebrae, ventral and dorsal views. 1– the body; 2– the right transverse process, including the pedicle, pars interarticularis, and articular facets; 3– the left transverse process, including the pedicle, pars interarticularis, and articular facets; 4– the spinous process.

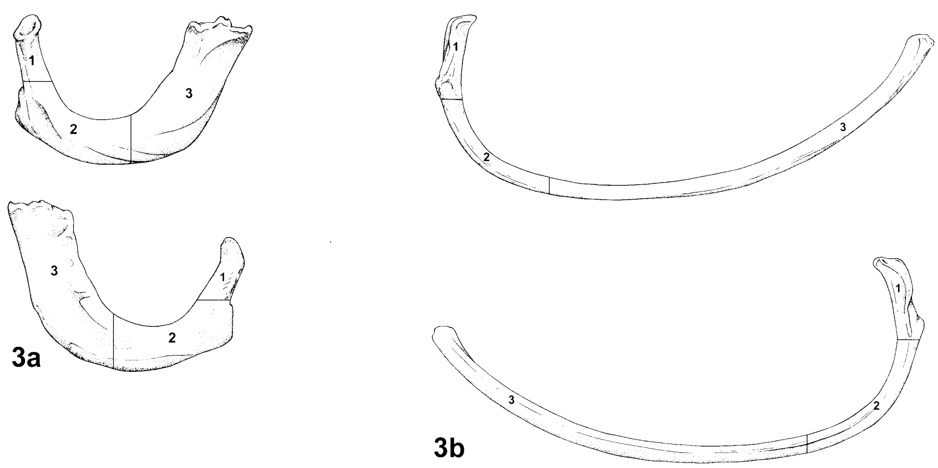

Figure 3. Ribs, inferior and superior views: (a) Rib 1; (b) Rib 7. 1– the head; 2– the area of the angle of the rib, including the articular and non-articular costal facets in ribs 1 through 10; 3– the remaining corpus and sternal end.

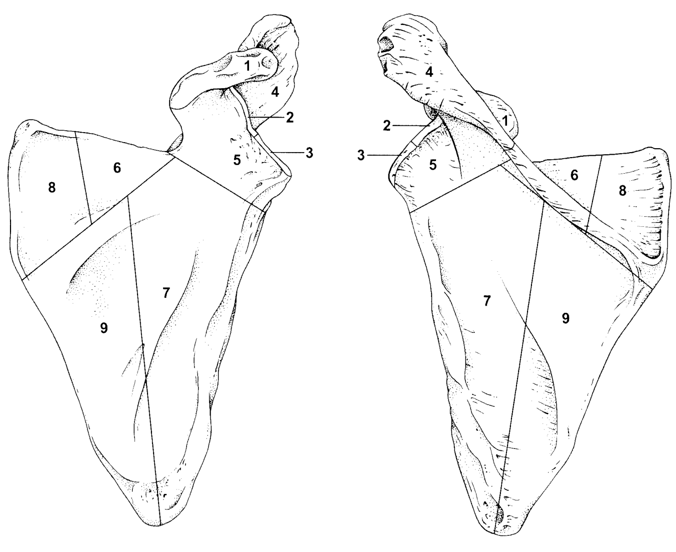

Figure 4. Scapula, ventral and dorsal views: 1– the coracoid process; 2– the superior half of the glenoid cavity; 3– inferior half of the glenoid cavity; 4– the acromial end and the axillary third of the spine; 5– the axillary third of the squamous portion and spine, including the neck and the area inferior to the coracoid process; 6– the middle third of the squamous portion superior to the spine and the middle portion of the spine, as well as the adjoining portion of the supraspinous fossa; 7– the axillary half of the squamous portion inferior to the spine, including the infraspinous fossa; 8– the vertebral third of the squamous portion and spine, including the attachment for M. rhomboideus major and supraspinous fossa; 9– the vertebral half of the squamous portion inferior to the spine, including the infraspinous fossa.

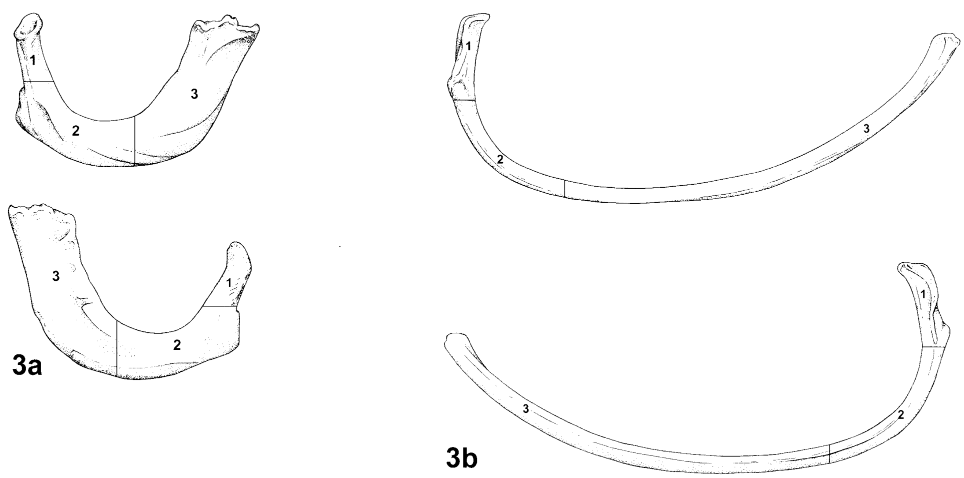

Figure 3. Ribs, inferior and superior views: (a) Rib 1; (b) Rib 7. 1– the head; 2– the area of the angle of the rib, including the articular and non-articular costal facets in ribs 1 through 10; 3– the remaining corpus and sternal end.

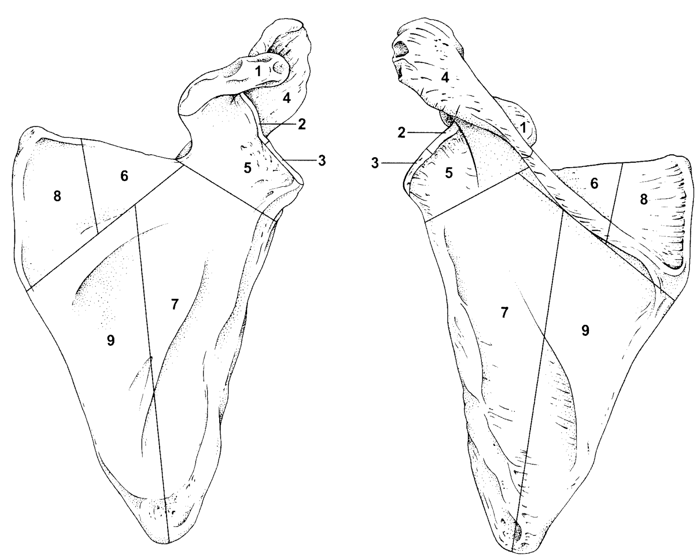

Figure 4. Scapula, ventral and dorsal views: 1– the coracoid process; 2– the superior half of the glenoid cavity; 3– inferior half of the glenoid cavity; 4– the acromial end and the axillary third of the spine; 5– the axillary third of the squamous portion and spine, including the neck and the area inferior to the coracoid process; 6– the middle third of the squamous portion superior to the spine and the middle portion of the spine, as well as the adjoining portion of the supraspinous fossa; 7– the axillary half of the squamous portion inferior to the spine, including the infraspinous fossa; 8– the vertebral third of the squamous portion and spine, including the attachment for M. rhomboideus major and supraspinous fossa; 9– the vertebral half of the squamous portion inferior to the spine, including the infraspinous fossa.

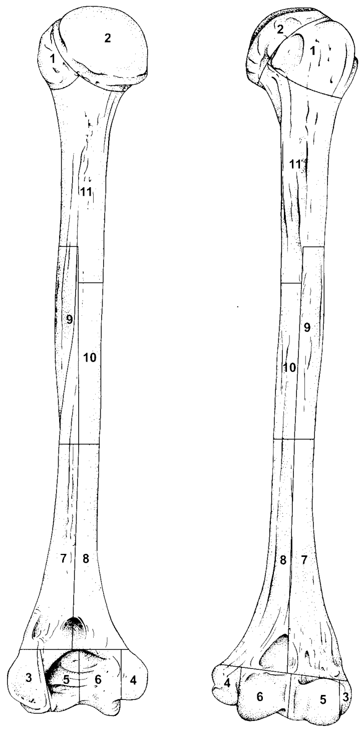

Figure 5 (left): Humerus, posterior and anterior views: 1– the greater and lesser tubercles; 2– the caput; 3– the lateral epicondyle; 4– the medial epicondyle; 5– the lateral articular process (capitulum) of the condyle; 6– the medial articular process (trochlea) of the condyle; 7– the distal lateral half of the diaphysis, including one-half of the olecranon fossa and the radial fossa; 8– the distal medial half of the diaphysis, including one-half of the olecranon fossa and the coronoid fossa, including the nutrient foramen; 9– the area surrounding the deltoid tuberosity; 10– the area opposite 9 making up one-half of the diaphysis longitudinally in the sagittal plane and cutting the bone transversely from medial to lateral; 11– the proximal portion of the diaphysis, including the surgical neck.

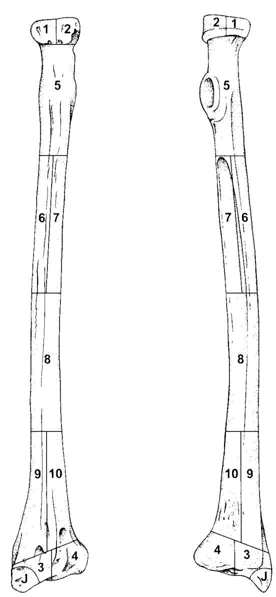

Figure 6 (left). Radius, posterior and anterior views: 1– the lateral half of the radial head; 2– the medial half of the radial head; 3–the lateral portion of the distal articulation; 4– the medial portion of the distal articulation; 5– the proximal portion of the diaphysis, including the radial tuberosity; 6– the lateral half of the diaphysis to the mid-point of the diaphysis, including the attachment for M. pronator teres; 7– the medial half of diaphysis to the mid-point of the diaphysis, opposite zone 6, including the nutrient foramen, which is located antero-medially; 8– the superior half the distal third of the radius; 9– the lateral distal third of the diaphysis; 10– the medial distal third of the diaphysis; J– the styloid process of the distal end.

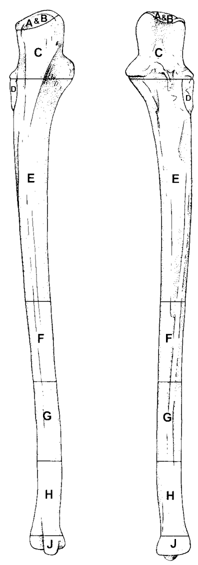

Figure 7 (left). Ulna, posterior and anterior views: A and B– the olecranon process; C– the area of the trochlear or semi-lunar notch, including the coronoid process; D– the radial notch; E– the proximal half of the diaphysis distal to area C, including the nutrient foramen, which is located antero-medially; F– the middle portion of the shaft; G– the superior one-half of the distal third of the diaphysis; H– the distal half of the distal third of the shaft, including the attachment of M. pronator quadratus; J– the styloid process and head, including the posterior groove for M. extensor carpi ulnaris.

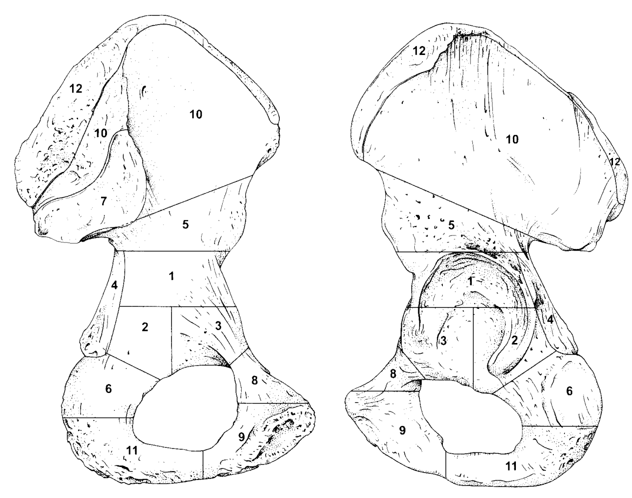

Figure 8 (left). Os coxae, medial (internal) and lateral (external) views: 1– the superior portion of the acetabulum and adjoining areas anteriorly and posteriorly; 2– the posterior half of the inferior portion of the acetabulum and adjoining areas; 3– the anterior half of the inferior portion of the acetabulum and adjoining areas; 4– the superior portion of the ischium, including the ischial spine; 5– the inferior portion of the ilium, including the greater sciatic notch; 6– superior portion of the ischial tuberosity; 7– the auricular surface of the ilium; 8– the superior portion of the pubis possessing the pectineal line and pubic tubercle; 9– the inferior portion of the pubis, including the pubic symphysis; 10– the greater part of the ilium, marked in an antero-posterior direction by a line running from just inferior to the anterior superior iliac spine to the posterior inferior iliac spine, but not including the iliac crest (superiorly); 11– the inferior portion of the ischium, including the majority of the ischial tuberosity; 12– the iliac crest.

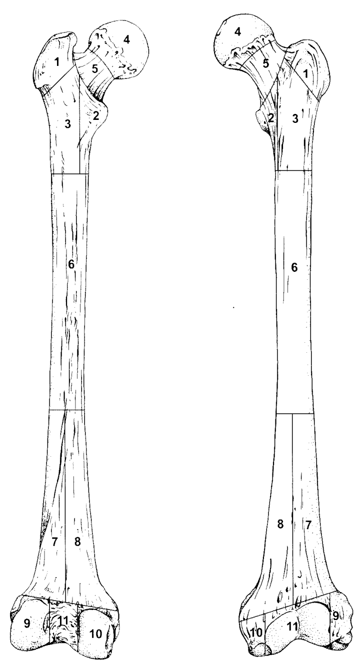

Figure 9 (left). Femur, posterior and anterior views: 1– the greater trochanter; 2– the area around the lesser trochanter and the lesser trochanter; 3– the area of the cranial attachment of M. gluteus maximus; 4– the caput; 5– the neck of the element and area along the inter-trochanteric line (anteriorly) and intertrochanteric crest (posteriorly); 6– the middle portion of the diaphysis to the point where the linea aspera bifurcates into the supra-condylar lines, including the nutrient foramen, which is located posteriorly; 7– the lateral half of the distal third of the diaphysis split longitudinally in the sagittal plane, including one-half of the popliteal space (posteriorly); 8– the medial half of the distal third of the diaphysis split longitudinally in the sagittal plane, including one-half of the popliteal space (posteriorly); 9– the lateral condyle and epicondyle; 10– the medial condyle and epicondyle; 11– the intercondylar space and distal articulation anteriorly.

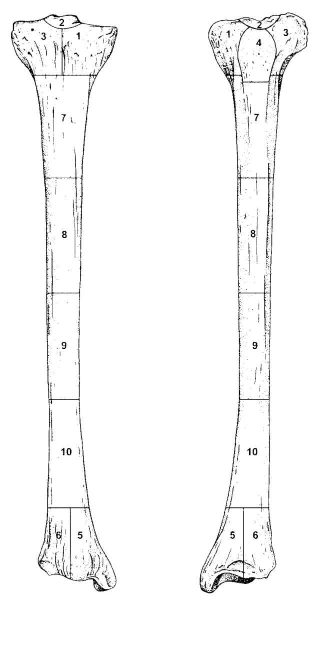

Figure 10 (left). Tibia, posterior and anterior views: 1– the medial proximal condyle; 2– the intercondylar fossa between the tibial spines, including the area of attachment of the posterior cruciate ligament; 3– the lateral proximal condyle; 4– the area of the tibial tuberosity; 5– the area of the medial malleolus; 6– the area of the lateral malleolus; 7– the proximal quarter of the diaphysis, including the nutrient foramen, posteriorly; 8– the second quarter of the diaphysis; 9– the third quarter of the diaphysis; 10– the distal quarter of the diaphysis.

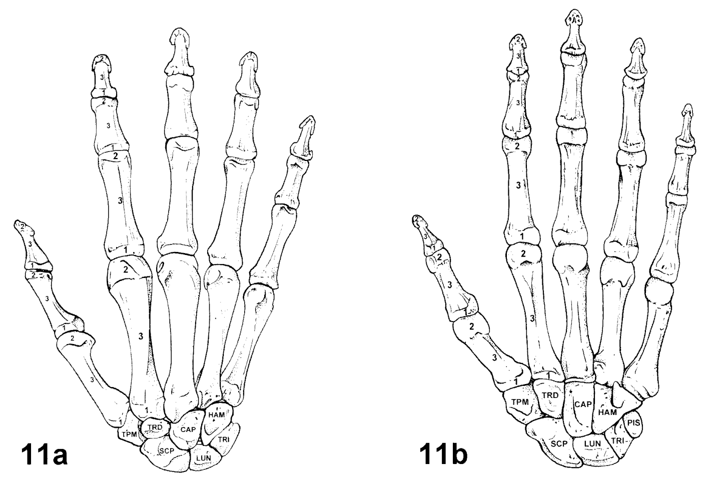

Figure 11. The hand and wrist: (a) dorsal view; (b) palmar view. Metapodials and phalanges: 1– the proximal articulation; 2– the distal articular condyle; 3– the diaphysis. Carpals: TPM– trapezium; TRD– trapezoid; CAP– capitate; HAM– hamate; SCP– scaphoid; LUN– lunate; TRI– triquetral.

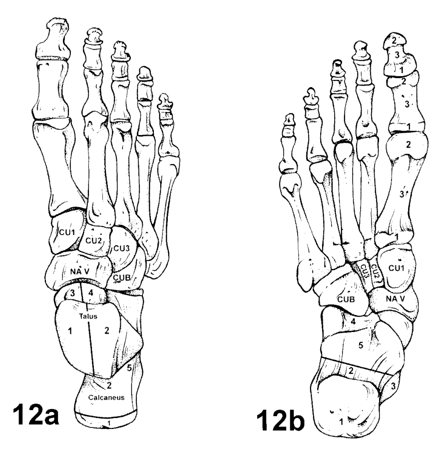

Figure 12. The foot and ankle: (a) dorsal view; (b) plantar view. Calcaneus: 1– the tuber calcis; 2–the distal portion of the body; 3– the sustentaculum tali; 4– the proximal articulation; 5– the proximal portion of the body inferior to the articulations. Talus: 1– medial half of the trochlea; 2– lateral half of the trochlea; 3– medial half of the proximal portion, splitting the head sagittally; 4– lateral half of the proximal portion, splitting the head sagittally. Metapodials and phalanges: 1– the proximal articulation; 2– the distal articular condyle; 3– the diaphysis. Tarsals: CU1– medial cuneiform; CU2– intermediate cuneiform; CU3– lateral cuneiform; NAV– navicular; CUB – cuboid.

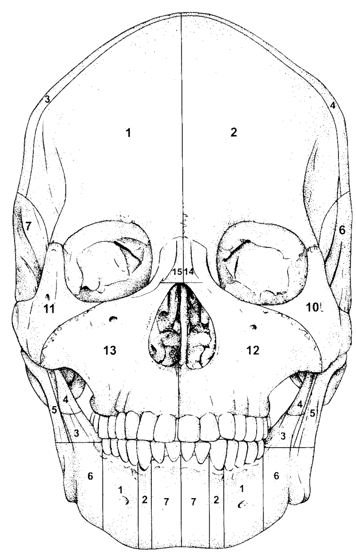

Figure 13: Cranium, Norma facialis: 1– the right frontal, split sagittally through the metopic suture; 2– the left frontal, split sagittally through the juvenile metopic suture; 3– the right parietal; 4– the left parietal; 6– the left temporal, including the root of the zygomatic process from the left side; 7–the right temporal, including the root of the zygomatic process from the right side; 10– the left zygoma; 11– the right zygoma; 12– the left maxilla; 13– the right maxilla; 14– the left nasal bone; 15– the right nasal bone.

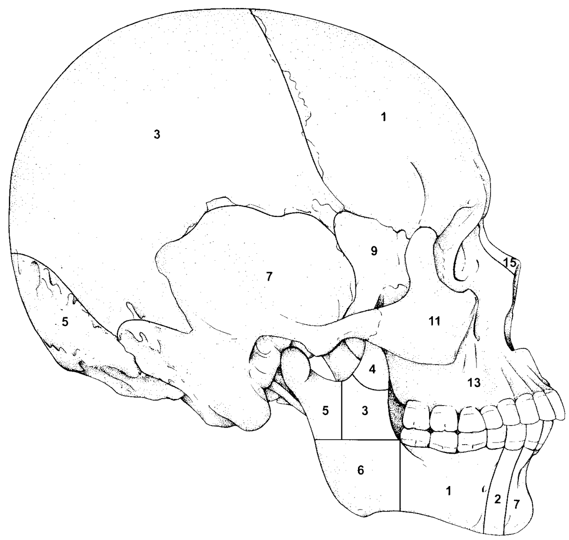

Figure 14. Cranium, Norma lateralis dextra: 1– the right frontal, split sagittally through the metopic suture; 3– the right parietal; 5– the occipital; 7– the right temporal, including the root of the zygomatic process from the right side; 9– the right sphenoid; 11– the right zygoma; 13– the right maxilla; 15– the right nasal bone.

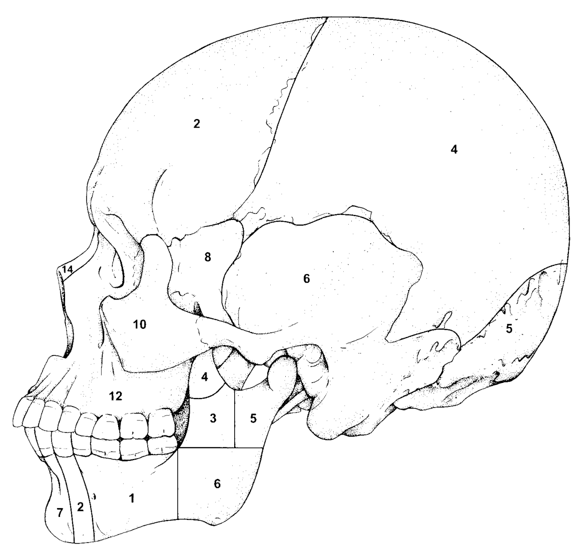

Figure 15. Cranium, Norma lateralis sinistra: 2– the left frontal, split sagittally through the metopic suture; 4– the left parietal; 5– the occipital; 6– the left temporal, including the root of the zygomatic process from the left side; 8– the left sphenoid; 10– the left zygoma; 12– the left maxilla; 14– the left nasal bone.

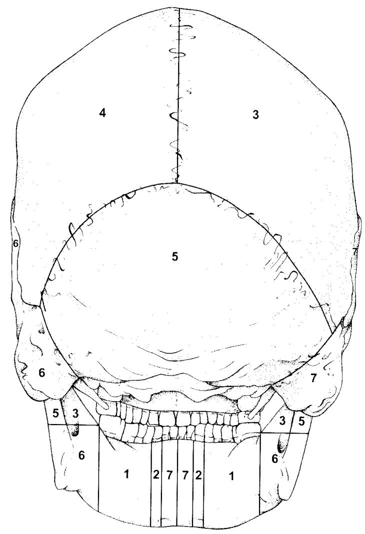

Figure 16. Cranium, Norma occipitalis: 3– the right parietal; 4– the left parietal; 5– the occipital; 6– the left temporal, including the root of the zygomatic process from the left side; 7– the right temporal, including the roo

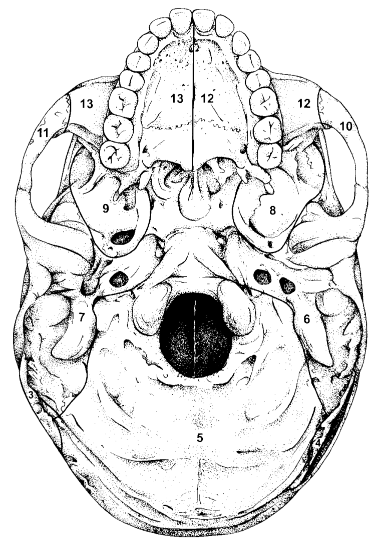

Figure 18. Cranium, Norma basalis: 3– the right parietal; 4– the left parietal; 5– the occipital; 6– the left temporal, including the root of the zygomatic process from the left side; 7– the right temporal, including the root of the zygomatic process from the right side; 8– the left sphenoid; 9– the right sphenoid; 10– the left zygoma; 11– the right zygoma; 12– the palatal process of the left maxilla; 13– the palatal process of the right maxilla.

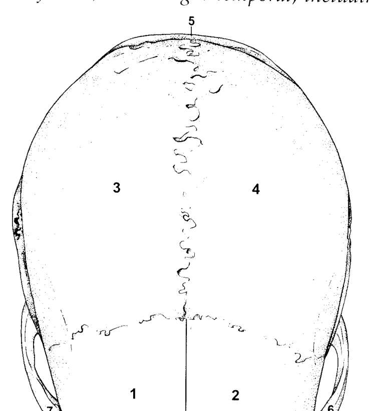

Figure 17. Cranium, Norma verticalis: 1– the right frontal, split sagittally through the metopic suture; 2– the left frontal, split sagittally through the metopic suture; 3– the right parietal; 4– the left parietal; 5– the occipital; 6– the left temporal, including the root of the zygomatic process from the left side; 7– the right temporal, including the root of the zygomatic process from the right side; 14– the left nasal bone; 15– the right nasal bone.

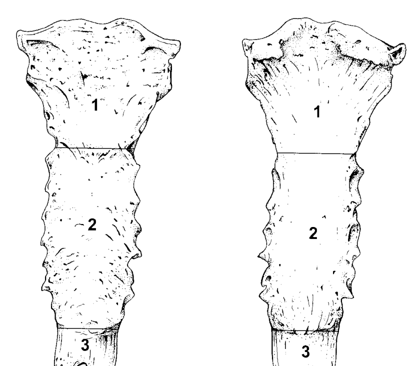

Figure 19. Sternum, anterior and posterior views: 1– the manubrium; 2– the corpus sterni; 3– the xiphoid process.

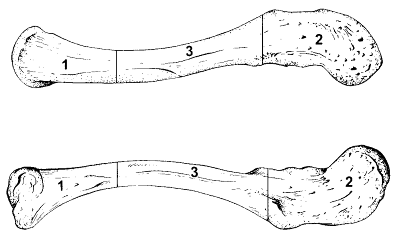

Figure 20. Clavicle, superior and inferior views: 1– the sternal end, including the area of the attachment for the costo-clavicular ligament; 2– the acromial end, including the conoid tubercle and trapezoid line, the attachments for the two components of the coraco-clavicular ligament; 3– the diaphysis, including the groove which marks the attachment for M. subclavius.

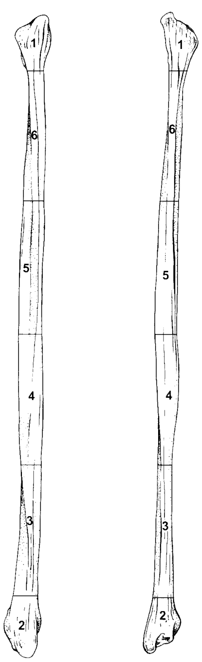

Figure 21. Fibula, anterior and posterior views: 1– the proximal end, essentially the juvenile epiphysis, including the styloid process; 2– the distal end, essentially the juvenile epiphysis; 3– the most distal quarter of the diaphysis, including the attachment for the inferior portion of the interosseous ligament (a triangular rugose region with its apex directed anteriorly); 4– the middle quarter of the diaphysis, including the nutrient foramen, which is located posteriorly; 5– the second quarter of the diaphysis; 6– the most proximal quarter of the diaphysis, distal to the juvenile epiphysis.

Conclusion

We anticipate that this recording system, or modified versions of it, will lead to more robustly defensible inferences drawn from assemblages of human remains and, specifically, to address questions exploring the similarity of human and non-human treatment from the past in the present.

Acknowledgements

The authors thank the Velim Skalka, Czech Republic, research team for their contributions to the project from whence this contribution sprang: Prof. Anthony F. Harding (Durham), Dr. Stephanie Knight (Wessex Archaeology), Rebecca Craig (Bradford), and Dr. Carol Palmer (Sheffield). We thank the Archaeological Institute of the Czech Academy of Sciences and, specifically, Radka Sumberová for providing space and logistical support for the work. Anthony Harding directed the excavation of the English Expedition's portion of the Velim Skalka site, and the team completed the analysis of human and animal bones from this excavation under the auspices of Leverhulme Trust Grant F/00 235/B. Caroline D. Needham, of the Unit of Medical Art in Medicine, University of Manchester, drew the figures of the zones, and her time and expertise was made available through British Academy Grant SG-36744.

Notes

1 Louise Loe from Bournemouth University, who has employed the human zonation system recently, has further divided the cranial zones by adding separate zones for the basilar process of the occipital and one each for the two petrous temporal bones. She has also combined zones 4 and 5 of the fibula due to the inherent difficulties in distinguishing diaphyseal fragments in this element.

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Appendix B: Summary of the Database

The database is summarized in this Appendix according to each bone. A key was created to allow more information to be displayed in each table. Definitions of the abbreviated headings are listed in the key. The bolded table headings at the top of each section (SK, SL, SR, S?, WG, and Z*x*) summarize the information for each respective column below. The bolded area at the bottom of each section (TP, TP?, and Total) are read horizontally, and summarize the total frequencies of the data. The column with a thicker border indicates the zone with the highest frequency.

Key

Abbreviation	**Meaning**
SK	Smith's Knoll category number
SR=*x*	Right side, *x* =the total number of bones fragments
SL=*x*	Left side, *x*=total number of bone fragments
S?=*x*	Unsideable, *x*=total number of bone fragments
WG	Weathering grade
Z*x*	Zone, *x* =the zone number
L	Left Side
R	Right Side
?	Unsideable
P	Frequency of 'P' or present
P?	Frequency of 'P?' or present?
TP	Sum of 'P' or present
TP?	Sum of 'P?' or present?
Total	Total sum of 'P' and 'P?'

Femora

SK	SL= 42	W G	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z 10	Z 11
SK0001	L	1	A	P	P	P	P	P	P	P	A	A	A
SK0002	L	1	P	P	P	P	P	P	P	P	A	A	A
SK0012	L?	1	A	A	A	P	A	A	A	A	A	A	A
SK0017	L?	1	A	A	A	A	A	A	A	A	P	A	P
SK0023	L	2	A	P	P	A	P	A	A	A	A	A	A
SK0025	L	1	A	P	A	A	P	A	A	A	A	A	A
SK0028	L	1	A	P	P	A	A	A	A	A	A	A	A
SK0034	L	2	A	P	P	P	P	P	P	P	P	P	P
SK0040	L	2	P	P	P	P	P	P	P	P	A	A	A
SK0042	L	3	A	P	P	P	P	P	P	P	P	P	P
SK0044	L	1	A	A	A	A	A	A	A	A	P	P	P
SK0045	L	2	P	P	P	A	P	P	P	P	A	A	A
SK0054	L	2	A	P	P	P	P	P	P	P	P	P	P
SK0088	L	2	P	P	P	A	A	P	P	P	P	P	P
SK0089	L	3	A	P	P	A	A	P	P	P	A	A	A
SK0096	L	1	A	A	A	A	A	A	P	P	P	P	P
SK0098	L	3	P	P	P	A	A	P	P	P	A	A	A
SK0099	L	1	P	P	P	P	P	P	P	P	A	A	A
SK0101	L	3	P	P	P	P	P	P	P	P	A	A	A
SK0103	L	2	P	P	P	A	A	P	P	P	A	A	A
SK0104	L	1	P	P	P	A	P	P	P	P	P	P	P
SK0105	L	1	P	P	P	P	P	P	P	P	P	P	P
SK0106	L	3	A	A	A	A	A	P	P	P	A	A	A
SK0107	L	2	A	P	P	A	P	P	P	P	A	A	A
SK0111	L	2	A	P	P	A	A	P	P	P	A	A	A
SK0116	L	3	A	P	P	A	A	P	P	P	A	A	A
SK0119	L	3	A	P	P	A	A	P	A	P	A	A	A
SK0127	L?	2	A	A	A	A	A	A	P?	P	A	A	A
SK0205	L?	1	A	A	A	A	A	A	A	A	P?	P?	P
SK0206	L?	1	A	A	A	P	P	A	A	A	A	A	A
SK0207	L	1	A	A	P	P	P	A	A	A	A	A	A
SK0213	L?	1	A	A	A	A	A	A	A	A	A	A	P
SK0214	L?	2	P?	A	A	A	A	A	A	A	A	A	A
SK0311	L	1	A	A	A	A	A	A	A	A	P	P	P
SK0312	L	2	A	A	A	A	A	A	A	A	P	P	P
SK0313	L	1	A	A	A	A	A	A	A	A	P	P	P

SK0314	L?	1	A	A	A	A	A	A	A	A	P	P	P
SK0317	L?	2	A	A	A	A	A	A	A	A	P	P	P
SK0318	L	1	A	A	A	A	A	A	A	A	P	P	P
SK0320	L	1	A	A	A	A	A	A	P	P	P	P	P
SK0037	L	3	A	P	P	A	A	P	P	P	A	A	A
SK0122	L	3	A	P	A	A	A	P	P	P	A	A	A
TP	**-**	**-**	**10**	**24**	**23**	**12**	**16**	**22**	**23**	**25**	**16**	**15**	**18**
TP?	**-**	**-**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**
Total	**-**	**-**	**11**	**24**	**23**	**12**	**14**	**22**	**24**	**25**	**17**	**16**	**18**

SK	**SR=40**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**	**Z 11**
SK0003	R	3	A	P	P	A	P	P	P	P	A	A	A
SK0004	R	1	A	P	P	A	A	P	P	P	A	A	A
SK0005	R	2	A	P	P	A	A	P	P	P	A	A	A
SK0008	R?	1	A	A	A	P	P	A	A	A	A	A	A
SK0010	R?	1	A	A	A	A	A	A	A	A	A	P	A
SK0015	R?	0	A	A	A	A	A	A	A	A	P	A	P
SK0016	R	2	A	A	A	A	A	A	A	A	P	A	A
SK0019	R?	1	P	A	A	A	P	A	A	A	A	A	A
SK0021	R	1	P	P	P	P	P	A	A	A	A	A	A
SK0030	R	1	A	P	P	A	A	A	A	A	A	A	A
SK0031	R?	1	A	A	P	A	A	A	A	A	A	A	A
SK0032	R?	2	A	A	A	A	A	A	P	P	A	A	A
SK0035	R	2	A	P	P	P	P?	P	P	P	A	A	A
SK0036	R	2	A	P	P	P	P	P	P	P	P	P	P
SK0038	R	1	A	P	P	A	P	P	P	P	P	P	P
SK0039	R	1	A	P	P	A	A	P	P	P	A	A	A
SK0041	R	1	P	P?	P	P	P	A	A	A	A	A	A
SK0043	R	1	P	P	P	P	P	P	P	P	P	P	P
SK0046	R	3	A	P	P	P	P	P	P	P	A	A	A
SK0047	R	2	A	P	P	A	A	P	P	P	A	A	A
SK0048	R	2	A	P	P	A	A	P	P	P	P	P	P
SK0050	R	2	A	A	A	A	A	A	A	A	P	P	P
SK0051	R	1	P	P	P	P	P	P	P	P	P	A	P
SK0052	R	3	P	P	P	P	P	P	P	P	A	A	A
SK0053	R	2	A	P	P	A	P	P	P	P	A	A	A
SK0055	R	2	P	P	P	P	P	P	P	P	P	P	P
SK0056	R	1	A	P	P	P	P	P	P	P	A	A	A
SK0102	R	3	A	P	P	A	P	P	P	P	A	A	A
SK0126	R	2	A	P	P	A	A	P	P	P	A	A	A

SK0201	R	1	A	A	A	A	A	A	A	A	P	P	P
SK0202	R	2	A	A	A	A	A	A	P	P	P	P	P
SK0203	R	1	A	A	A	A	A	A	A	A	P	P	P
SK0204	R	2	A	A	A	A	A	A	P	P	P	P	P
SK0208	R	2	A	A	A	A	A	A	A	A	P	P	P
SK0209	R?	1	A	A	A	P	P	A	A	A	A	A	A
SK0210	R	1	A	A	P	A	A	A	A	A	A	A	A
SK0211	R?	1	A	P?	A	A	P	A	A	A	A	A	A
SK0212	R?	1	A	A	A	A	A	A	P?	P?	A	A	A
SK0315	R	1	A	A	A	A	A	A	A	A	P	P	P
SK0319	R?	2	A	A	A	A	A	A	A	A	P	P	P
TP	**-**	**-**	**7**	**20**	**23**	**12**	**17**	**18**	**21**	**21**	**16**	**14**	**15**
TP?	**-**	**-**	**0**	**2**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**0**
Total	**-**	**-**	**7**	**22**	**23**	**12**	**18**	**18**	**22**	**22**	**16**	**14**	**15**

SK	**S?= 17**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**	**Z 11**
SK0007	?	1	A	A	A	P	A	A	A	A	A	A	A
SK0009	?	1	A	A	A	P	A	A	A	A	A	A	A
SK0011	?	1	A	A	A	P	A	A	A	A	A	A	A
SK0013	?	1	A	A	A	P	A	A	A	A	A	A	A
SK0014	?	1	A	A	A	P	P	A	A	A	A	A	A
SK0018	?	1	A	A	A	A	A	A	A	A	P?	P?	A
SK0022	?	1	A	A	A	A	A	A	A	A	P?	P?	P?
SK0024	?	0	A	A	A	P	A	A	A	A	A	A	A
SK0026	?	2	A	A	A	P	A	A	A	A	A	A	A
SK0027	?	1	A	A	A	P	A	A	A	A	A	A	A
SK0029	?	1	A	A	A	P	P?	A	A	A	A	A	A
SK0260	?	2	A	A	A	A	A	A	A	A	P?	P?	A
SK0261	?	1	A	A	A	A	A	A	A	A	P?	P?	A
SK0262	?	2	A	A	A	A	A	A	A	A	P?	A	P?
SK1863	?	1	A	A	A	A	A	A	A	A	P?	P?	A
SK2653	?	1	A	A	A	P	A	A	A	A	A	A	A
SK0049	?	1	A	A	A	A	A	A	A	A	P?	P?	A
TP	**-**	**-**	**0**	**0**	**0**	**10**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**7**	**6**	**2**
Total	**-**	**-**	**0**	**0**	**0**	**10**	**2**	**0**	**0**	**1**	**7**	**6**	**2**

Tibiae

SK	**SL=35**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**
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SK0058	L	1	P	A	P	A	P	P	P	P	P	P
SK0059	L?	4	A	A	A	A	A	A	P	P	P	A
SK0060	L	2	A	A	A	A	P	P	P	P	P	P
SK0061	L	2	P	A	A	A	A	A	P	P	P	P
SK0062	L	1	A	A	A	A	A	A	P	P	P	A
SK0072	L	4	A	A	A	A	A	A	P	P	P	P
SK0073	L	1	A	A	A	A	P	P	P	P	P	P
SK0074	L	3	A	A	A	P	A	A	P	P	P	P
SK0075	L	2	P	A	A	A	P	P	P	P	P	P
SK0077	L	2	A	A	A	A	P	P	P	P	P	P
SK0080	L?	2	A	A	A	A	P	P	A	P	P	P
SK0090	L	2	P	A	P	A	P	P	P	P	P	P
SK0091	L	1	P	A	P	P	P	P	P	P	P	P
SK0092	L	1	P	A	A	A	P	P	P	P	P	P
SK0093	L	4	P	A	P	P	P	P	P	P	P	P
SK0094	L	1	P	P	P	P	P	P	P	P	P	P
SK0095	L	1	P	A	P	A	P	P	P	P	P	P
SK0808	L	1	A	A	A	A	P	P	A	A	A	A
SK0810	L	3	A	A	A	A	P	P	A	A	A	P
SK0811	L	1	A	A	A	A	P	P	A	A	A	A
SK0812	L?	1	A	A	P	A	A	A	P	A	A	A
SK0813	L	2	P	P	P	A	A	A	A	A	A	A
SK0814	L	2	P	P	A	A	A	A	A	A	A	A
SK0818	L	2	P	P?	A	A	A	A	A	A	A	A
SK0819	L	2	P	P	A	A	A	A	A	A	A	A
SK0821	L	1	P	P	P	A	A	A	A	A	A	A
SK0823	L	1	P	A	A	A	A	A	A	A	A	A
SK0832	L?	2	A	A	P	A	A	A	A	A	A	A
SK0833	L	1	A	A	A	A	P	P	A	A	A	A
SK0835	L	2	A	A	A	A	A	A	P	A	A	A
SK0838	L?	2	P	P?	A	A	A	A	A	A	A	A
SK0841	L	1	A	A	A	A	P	P	A	A	A	A
SK0844	L	2	A	A	A	A	P	P	A	A	A	A
SK2626	L	1	A	A	A	A	P	A	A	A	A	A
TP	**-**	**-**	**16**	**5**	**11**	**5**	**19**	**18**	**19**	**18**	**18**	**17**

TP?	**-**	**-**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**-**	**16**	**7**	**11**	**5**	**19**	**18**	**19**	**18**	**18**	**17**
SK	**SR= 36**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**
SK0006	R	1	P	P	P	A	P	P	P	P	P	P
SK0063	R	2	A	A	A	P	A	A	P	P	P	P
SK0064	R	1	P	P	P	P	P	P	P	P	P	P
SK0065	R	3	A	A	A	P	P	A	P	P	P	P
SK0066	R	2	P	P	P	P	A	A	P	P	P	P
SK0067	R	2	A	A	A	P	A	A	P	P	P	P
SK0068	R	1	P	A	A	P	A	A	P	P	P	P
SK0069	R	1	A	A	P	P	P	P	P	P	P	P
SK0070	R	2	P	P	P	P	P	P	P	P	P	P
SK0071	R	1	P	P	P	A	P	P	P	P	P	P
SK0076	R	1	P	A	A	P	A	A	P	P	P	P
SK0078	R?	1	A	A	A	A	P	P	A	A	A	A
SK0079	R?	3	A	A	A	A	A	A	P	P	P	P
SK0081	R	1	P	P	P	P	P	P	P	P	P	P
SK0082	R	3	P	A	P	P	A	A	P	P	P	P
SK0083	R	2	P	A	P	P	P	A	P	P	P	P
SK0084	R	1	P	A	P	P	P	P	P	P	P	P
SK0085	R	3	P	A	P	P	P	P	P	P	P	P
SK0086	R	2	P	A	P	P	P	P	P	P	P	P
SK0087	R	1	P	A	P	P	P	P	P	P	P	P
SK0097	R	2	P	A	P	P	P	P	P	P	P	P
SK0100	R	2	A	A	A	A	P	P	P	P	P	P
SK0815	R	2	A	A	P	P	A	A	P	A	A	A
SK0816	R	1	A	A	A	A	P	P	A	A	A	A
SK0820	R	2	A	A	A	A	P	P	A	A	A	A
SK0822	R	1	A	P	P	A	A	A	A	A	A	A
SK0825	R	1	A	A	A	A	P	A	A	A	A	A
SK0826	R?	2	P?	A	A	A	A	A	P?	A	A	A
SK0827	R	1	A	A	A	A	A	A	P	A	A	A
SK0829	R?	2	A	A	A	A	P	P	A	A	A	A
SK0831	R?	2	A	A	A	A	A	A	A	A	P	A
SK0836	R?	2	P	A	A	A	A	A	A	A	A	A
SK0843	R?	1	A	A	A	A	P	P	A	A	A	A
SK1695	R	3	A	A	A	A	P	P	A	A	A	A
SK2627	R	1	A	A	A	A	P	A	A	A	A	A
SK2649	R	2	A	A	P	A	A	A	A	A	A	A

TP	**-**	**-**	**16**	**7**	**17**	**18**	**22**	**18**	**23**	**21**	**22**	**21**
TP?	**-**	**-**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Total	**-**	**-**	**17**	**7**	**17**	**18**	**22**	**18**	**24**	**21**	**22**	**21**

SK	**S?= 18**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**
SK0817	?	1	P?	A	P?	A	P	P	A	A	A	A
SK0824	?	2	P?	A	P?	A	A	A	A	A	A	A
SK0809	?	2	A	A	A	A	P	P	A	A	A	A
SK0828	?	2	P?	P	P?	A	A	A	A	A	A	A
SK0830	?	1	A	A	A	P	A	A	A	A	A	A
SK0834	?	1	A	A	A	A	A	A	A	A	P	A
SK0837	?	1	P	P	A	A	A	A	A	A	A	A
SK0839	?	2	A	A	A	P	A	A	A	A	A	A
SK0840	?	1	P?	A	P?	A	A	A	A	A	A	A
SK0842	?	2	A	A	A	A	P	A	A	A	A	P
SK0845	?	2	P?	A	P?	A	A	A	A	A	A	A
SK1865	?	1	P	A	P	A	A	A	A	A	A	A
SK1874	?	2	A	A	A	A	P?	P	A	A	A	A
SK2622	?	2	P?	A	P?	A	A	A	A	A	A	A
SK2623	?	1	P?	A	P?	A	A	A	A	A	A	A
SK2624	?	1	P?	A	P?	A	A	A	A	A	A	A
SK2625	?	1	P	P	A	A	A	A	A	A	A	A
SK2648	?	1	P?	P	P?	A	A	A	A	A	A	A
TP	-	-	3	4	1	2	3	3	0	0	1	1
TP?	-	-	9	0	9	0	1	0	0	0	0	0
Total	-	-	12	4	10	2	4	3	0	0	1	1

Fibulae

SK	**SL= 29**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**
SK0128	L?	3	A	A	P	P	P	P
SK1288	L	2	A	P	A	A	A	A
SK1289	L	3	A	P	A	A	A	A
SK1290	L	2	A	P	A	A	A	A
SK1291	L	2	A	P	P?	A	A	A

SK1292	L	2	A	P	P	A	A	A
SK1293	L	2	A	P	P	A	A	A
SK1294	L?	3	P?	A	A	A	A	A
SK1295	L	3	A	P	P	P	P	P
SK1296	L	2	A	A	P	P	P	P
SK1297	L	3	A	A	P	P	P	P
SK1298	L	3	A	A	P	P	P	P
SK1299	L	3	A	A	P	P	P	P
SK1300	L	3	A	A	P	P	P?	A
SK1301	L	4	A	A	P	P	A	A
SK1302	L	4	A	A	P	P?	A	A
SK1303	L	2	A	A	P	A	A	A
SK1304	L?	1	A	A	P	A	A	A
SK1305	L	2	A	A	P	A	A	A
SK1310	L	2	A	A	P	P	P	A
SK1321	L?	4	A	A	P	P	P	P
SK1322	L?	2	A	A	P	A	A	A
SK1323	L?	4	A	A	A	P	P	P?
SK1324	L?	3	A	A	P	P	A	A
SK1341	L?	1	A	A	A	P	P	A
SK1348	L	3	A	A	P	P?	A	A
SK1352	L?	2	A	A	A	A	P	P
SK1355	L?	2	A	P	P	A	A	A
SK2643	L	1	P	A	A	A	A	A
TP	**-**	**-**	**1**	**8**	**20**	**13**	**11**	**8**
TP?	**-**	**-**	**1**	**0**	**1**	**2**	**1**	**1**
Total	**-**	**-**	**2**	**8**	**21**	**15**	**12**	**9**
SK	**SR= 32**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**
SK0129	R	2	A	P	P	P?	A	A
SK0130	R?	2	A	A	A	A	P	P
SK0131	R	2	P?	A	P	P	P	P
SK0146	R	3	A	A	P	P	A	A
SK1306	R	3	A	P	A	A	A	A
SK1307	R	3	A	P	A	A	A	A
SK1308	R	2	A	P	A	A	A	A
SK1309	R	2	A	P	P?	A	A	A
SK1311	R	2	A	A	P	P?	A	A
SK1312	R	2	A	A	P	A	A	A
SK1313	R	3	A	A	P	P?	A	A

SK1314	R?	3	A	A	P	P?	A	A
SK1315	R	3	A	A	P	P	P	P?
SK1316	R	3	A	A	P	P	P	P
SK1317	R	1	A	A	P	P	P	P
SK1318	R?	4	A	A	P	P	P	P
SK1319	R?	2	A	A	A	A	P	P
SK1320	R?	2	A	A	A	A	P	P
SK1325	R?	3	A	A	P	P	A	A
SK1328	R?	4	A	P	P	A	A	A
SK1331	R?	1	A	A	A	P	P	A
SK1334	R?	2	A	A	P	P?	A	A
SK1336	R?	2	A	A	P	P	P?	A
SK1338	R?	3	A	A	A	A	P?	P
SK1342	R?	3	A	A	A	P	P	A
SK1344	R?	2	A	A	P?	P	P?	A
SK1356	R?	3	A	A	P	A	A	A
SK1357	R?	2	P	A	A	A	A	A
SK1360	R?	4	A	A	A	P?	P	P
SK1697	R	1	A	P	A	A	A	A
SK1857	R	1	A	P	A	A	A	A
SK2642	R	1	A	P	A	A	A	A
TP	**-**	**-**	**1**	**9**	**16**	**11**	**11**	**9**
TP?	**-**	**-**	**1**	**0**	**2**	**6**	**3**	**1**
Total	**-**	**-**	**2**	**9**	**18**	**17**	**14**	**10**

SK	**S?= 21**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**
SK1326	?	2	A	A	P	P	A	A
SK1327	?	3	A	A	A	A	P?	P?
SK1329	?	4	A	A	P	P?	A	A
SK1330	?	4	A	A	A	P	P	A
SK1332	?	2	A	A	A	P?	P?	P?
SK1333	?	3	A	A	A	P?	P?	P?
SK1335	?	2	A	A	P?	P?	P?	P?
SK1337	?	2	A	A	P?	P?	P?	A
SK1339	?	4	A	A	A	P?	P?	P?
SK1340	?	4	A	A	A	P?	P?	P?
SK1343	?	3	A	A	A	P	P	A
SK1345	?	2	A	A	P?	P?	A	A
SK1346	?	2	A	A	A	A	P?	P?
SK1347	?	2	A	A	A	A	P?	P?

SK1349	?	2	A	A	A	P?	P?	P?
SK1350	?	2	A	A	A	P?	P?	P?
SK1353	?	3	A	A	A	P?	P?	A
SK1354	?	3	A	A	A	P?	P?	A
SK1358	?	2	A	A	P?	A	A	A
SK1359	?	4	A	A	P?	P?	P?	A
SK2651	?	2	A	A	A	P	A	A
TP	**-**	**-**	**0**	**0**	**2**	**4**	**2**	**0**
TP?	**-**	**-**	**0**	**0**	**5**	**13**	**14**	**10**
Total	**-**	**-**	**0**	**0**	**7**	**17**	**16**	**10**

Humeri

SK	**SL=28**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**Z11**
SK0143	L	1	A	A	P	P	P	P	P	P	A	A	A
SK0144	L	1	A	A	A	A	A	A	P	P	P	P	P
SK0171	L?	2	P	P	A	A	A	A	A	A	A	A	A
SK0173	L?	1	P	P	A	A	A	A	A	A	A	A	A
SK0175	L	2	A	A	P	P	P	P	P	P	P	P	P
SK0177	L	2	P	A	P	P	P	P	P	P	P	P	P
SK0178	L	2	P	A	P	P	P	P	P	P	P	P	P
SK0179	L	2	A	A	P	P	P	P	P	P	P	P	P
SK0180	L	3	A	A	P	P	P	P	P	P	P	P	P
SK0181	L	3	A	A	P	P	P	P	P	P	P	P	P
SK0185	L	2	A	A	P	P	P	P	P	P	P	P	P
SK0188	L	3	A	A	P	P	P	P	P	P	P	P	P
SK0189	L	2	A	A	A	A	A	A	A	A	P	P	P
SK0190	L	2	A	A	A	A	P	P	P	P	P	P	A
SK0192	L	5	A	A	A	P	P	P	P	P	P	P	P
SK0193	L	3	A	A	A	P	A	A	P	P	P	P	P
SK0215	L	3	A	A	A	A	A	A	P	P	P	P	P
SK0219	L	3	A	A	A	P	A	A	P	P	P	P	P
SK0220	L	1	P	P	A	P	P	P	P	P	P	P	P
SK0221	L	1	A	A	P	P	P	P	P	P	P	P	P
SK0222	L	2	A	P	P	P	P	P	P	P	P	P	P

SK0223	L	3	A	A	A	P	P	P	P	P	P	P	P
SK0224	L	3	A	A	A	A	A	A	P	P	P	P	P
SK0228	L	1	A	A	A	A	A	A	P	P	P	P	P
SK0230	L	4	A	A	A	A	A	A	P	P	P	P	P
SK0249	L	1	P	P	A	A	A	A	A	A	A	A	A
SK0251	L	1	A	A	A	A	P	P	P	A	A	A	A
SK1860	L	1	A	A	P	A	P	A	A	A	A	A	A
TP	**-**	**-**	**6**	**5**	**12**	**16**	**17**	**16**	**23**	**22**	**22**	**22**	**21**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**-**	**6**	**5**	**12**	**16**	**17**	**16**	**23**	**22**	**22**	**22**	**21**

SK	**SR= 31**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**	**Z 11**
SK0168	R	3	A	A	A	P	P	P	P	P	P	P	P
SK0169	R	2	P	P	A	A	A	A	A	A	A	A	P
SK0170	R	2	A	A	A	P	P	P	A	A	A	A	A
SK0172	R	2	A	A	P	A	P	P	A	A	A	A	A
SK0174	R	1	P	A	A	P	P	P	P	P	P	P	P
SK0176	R	3	A	A	A	A	A	A	P	P	P	P	P
SK0182	R	3	A	A	A	A	A	A	P	P	P	P	P
SK0183	R	1	A	A	P	A	P	P	P	P	P	P	P
SK0184	R	2	A	A	A	P	P	P	P	P	P	P	A
SK0186	R	3	A	A	A	A	A	A	P	P	P	P	P
SK0187	R?	4	A	A	A	A	A	A	A	A	P	P	P
SK0191	R	3	A	A	A	A	A	A	P	P	P	P	P
SK0216	R	2	A	A	P	P	P	P	P	P	P	P	P
SK0217	R	1	P	P	P	P	P	P	P	P	P	P	P
SK0218	R	1	A	A	P	P	P	P	P	P	P	P	P
SK0225	R	3	A	A	A	A	A	A	A	A	A	A	P
SK0226	R	1	A	A	A	A	A	A	P	P	P	P	P
SK0227	R	1	A	A	A	A	P	P	P	P	P	P	P
SK0229	R	3	A	A	P	P	P	P	P	P	P	P	P
SK0231	R	1	A	A	P	P	P	P	P	P	P	P	P
SK0232	R	1	A	A	P	P	P	P	P	P	P	P	P
SK0233	R	2	P	A	P	P	P	P	P	P	P	P	P
SK0234	R	1	P	A	A	P	A	A	P	P	P	P	P
SK0235	R	3	A	A	A	P	P	P	P	P	P	P	P
SK0236	R	2	A	A	A	P	A	A	P	P	P	P	P
SK0237	R	0	P	P	A	A	A	A	A	A	A	A	P
SK0238	R?	1	A	P	A	A	A	A	A	A	A	A	A
SK0241	R	2	A	A	A	A	A	A	A	A	A	A	P

SK0253	R	1	A	A	A	A	P	P	A	A	A	A	A
SK0256	R?	2	A	A	A	A	A	P	A	A	A	A	A
SK0257	R?	1	A	A	A	P	A	P	A	A	A	A	A
TP	**-**	**-**	**6**	**4**	**9**	**15**	**16**	**18**	**20**	**20**	**21**	**21**	**24**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**-**	**6**	**4**	**9**	**15**	**16**	**18**	**20**	**20**	**21**	**21**	**24**

SK	**SL= 15**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**	**Z 11**
SK0239	?	1	A	P	A	A	A	A	A	A	A	A	P
SK0240	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0242	?	1	A	P	A	A	A	A	A	A	A	A	P
SK0243	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0244	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0245	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0246	?	2	A	P	A	A	A	A	A	A	A	A	A
SK0247	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0248	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0250	?	1	A	P	A	A	A	A	A	A	A	A	A
SK0252	?	2	A	P	A	A	A	A	A	A	A	A	A
SK0254	?	1	A	A	A	A	A	P	A	A	A	A	A
SK0255	?	1	A	A	A	P	A	P	A	A	A	A	A
SK0258	?	1	A	A	A	P	A	P	A	A	A	A	A
SK0259	?	1	A	A	A	A	A	P	A	A	A	A	A
TP	**-**	**-**	**0**	**11**	**0**	**2**	**0**	**4**	**0**	**0**	**0**	**0**	**2**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**-**	**0**	**11**	**0**	**2**	**0**	**4**	**0**	**0**	**0**	**0**	**2**

Ulnae

SK	**SL= 27**	**W G**	**ZA _B**	**ZC**	**ZD**	**ZE**	**ZF**	**ZG**	**ZH**	**ZJ**
SK0858	L	3	A	A	A	P	P	P	P	A
SK0869	L	2	P	P	P	P	P	P	P	A
SK0873	L	3	P	P	P	P	P	P	P	A
SK0874	L	1	P	P	A	A	A	A	A	A
SK0876	L	3	P	P	P	P	P	P	P	A

SK0878	L?	2	P	P	A	A	A	A	A	A
SK0881	L	2	P	P	P	P	A	A	A	A
SK0883	L	2	P	P	A	A	A	A	A	A
SK0884	L	2	P	P	P	P	P	P	P	A
SK0885	L	2	P	P	P	P	P	P	A	A
SK0886	L	1	P	P	P	P	P	P	P	P
SK0887	L	1	P	P	P	P	P	P	A	A
SK0888	L	3	A	P	P	P	P	A	A	A
SK0889	L	1	P	P	P	P	P	A	A	A
SK0890	L	1	P	P	P	P	P	P	P	P
SK0891	L	1	A	P	P	P	P	P	P	P
SK0892	L	3	A	P	P	P	A	A	A	A
SK0893	L	3	A	P	P	P	P	P	A	A
SK0894	L	3	P	P	P	P	P	P	P	P
SK0895	L	2	A	P	P	P	P	P	P	A
SK0896	L	2	A	P	P	P	P	P	P	A
SK0898	L?	3	A	A	A	P	A	A	A	A
SK0899	L	4	A	A	A	P	P	A	A	A
SK0900	L	2	A	A	A	P	P	A	A	A
SK0902	L	1	A	A	A	A	P	P	P	P
SK0903	L?	2	A	A	A	P	P	P	A	A
SK2652	L	1	A	A	A	P	A	A	A	A
TP	**-**	**-**	**14**	**20**	**17**	**23**	**20**	**16**	**12**	**5**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**-**	**14**	**20**	**17**	**23**	**20**	**16**	**12**	**5**

SK	**SR=31**	**WG**	**ZA_B**	**ZC**	**ZD**	**ZE**	**ZF**	**ZG**	**ZH**	**ZJ**
SK0145	R	3	P	P	P	P	P	P	P	A
SK0147	R	3	A	P	P	P	P	P	P	P
SK0194	R	2	P	P	P	P	P	P	P	A
SK0199	R	3	A	A	A	P	P	A	A	A
SK0846	R	3	A	P	P	P	P	P	P	A
SK0851	R	2	P	P	P	P	P	P	A	A
SK0852	R	3	A	A	A	P	P	P	P	A
SK0853	R	1	P	P	P	P	P	P	P	A
SK0854	R	2	P	P	P	P	P	P	P	A
SK0855	R	3	A	P	P	P	P	P	P	A
SK0856	R	3	A	P	A	P	P	P	P	A
SK0857	R	3	A	P	A	P	P	P	P	A
SK0859	R	1	A	P	A	P	P	P	P	A

SK0860	R	1	P	P	P	P	P	P	A	A
SK0861	R	1	A	P	P	P	P	P	P	A
SK0862	R	3	A	P	P	P	P	P	P?	A
SK0863	R	0	P	P	P	P	P	P	P	A
SK0864	R	2	A	A	A	P	P	P	A	A
SK0865	R	3	A	A	A	P	P	P	P	A
SK0866	R	1	A	A	A	A	A	A	P	P
SK0867	R	3	A	A	A	P	P	P	P?	A
SK0868	R	2	A	P	P	P	P	P	A	A
SK0870	R	1	A	P	P	A	A	A	A	A
SK0871	R	1	P	P	A	A	A	A	A	A
SK0872	R	2	P	P	A	A	A	A	A	A
SK0875	R?	2	A	A	A	P	P?	A	A	A
SK0879	R?	3	A	A	A	P	A	A	A	A
SK0880	R?	2	A	A	A	A	P	P	A	A
SK0882	R	2	P	P	A	A	A	A	A	A
SK0897	R?	2	A	P	A	A	A	A	A	A
SK1069	R	3	P	P	P	P	P	P	p	A
TP	**-**	**-**	**11**	**22**	**15**	**24**	**23**	**22**	**16**	**2**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**0**
Total	**-**	**-**	**11**	**22**	**15**	**24**	**24**	**22**	**18**	**2**

SK	**SL=3**	**WG**	**ZA_B**	**ZC**	**ZD**	**ZE**	**ZF**	**ZG**	**ZH**	**ZJ**
SK0877	?	1	A	A	A	A	A	A	P	A
SK0901	?	2	A	P	A	A	A	A	A	A
SK0904	?	-	A	A	A	P	P	P?	A	A
TP	**-**	**-**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
Total	**-**	**-**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**

Radii

SK	**SL=24**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**ZJ**
SK0987	L	3	A	A	A	A	P	P	P	P	P	P	A
SK0990	L	2	A	A	A	A	P	P	P	P	P	P	A

SK0991	L	4	A	A	A	A	P	P	P	P	P	P	A
SK0992	L	2	A	A	A	A	P	P	P	P	P	P	A
SK0993	L	1	A	A	A	A	P	P	P	P	P	P	A
SK0995	L	2	P	P	A	A	P	P	P	P	P	P	A
SK0996	L	3	A	A	A	A	P	P	P	P	P	P	A
SK0997	L	2	A	A	A	A	P	P	P	P	P	P	A
SK0998	L	1	A	A	A	A	P	P	P	P	P	P	A
SK0999	L	3	A	A	A	A	P	P	P	P	P	P	A
SK1000	L?	4	A	A	A	A	P	P	P	P	A	A	A
SK1001	L	1	A	A	P	P	P	P	P	P	P	P	A
SK1002	L	3	A	A	A	A	P	P	P	P	A	A	A
SK1003	L	2	P	P	A	A	P	P	P	P	P	P	A
SK1004	L	2	A	A	P	P	A	A	A	A	P	P	P
SK1005	L	4	P	P	A	A	P	P	P	P	P	P	A
SK1007	L	1	A	A	P	P	A	A	A	A	A	A	P
SK1008	L	1	P	P	A	A	P	P	P	P	P	P	A
SK1009	L	2	A	A	P	P	A	A	A	A	P?	P?	P
SK1011	L	2	A	A	A	A	P	P	P	P	P	P	A
SK1012	L	2	A	A	A	A	P	P	P	P	P	P	A
SK1013	L	2	A	A	P	P	P	P	P	P	P?	P?	A
SK1014	L	2	P	P	P	P	P	P	P	P	P	P	P?
SK1015	L	3	A	A	A	A	P	P	P	P	P	P	A
TP	**-**	**-**	**5**	**5**	**6**	**6**	**21**	**21**	**21**	**21**	**19**	**19**	**3**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**1**
Total	**-**	**-**	**5**	**5**	**6**	**6**	**21**	**21**	**21**	**21**	**21**	**21**	**4**

SK	**SR=31**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**ZJ**
SK0986	R?	3	A	A	A	A	A	P	P	P	A	A	A
SK0988	R	3	A	A	A	A	P	P	P	P	P	P	A
SK0989	R	3	A	A	A	A	P	P	P	P	P	P	A
SK0994	R?	4	A	A	A	A	P	P	P	P	A	A	A
SK1006	R	2	A	A	P	P	A	A	A	A	P?	P?	P
SK1010	R?	2	A	A	A	A	P	A	A	A	A	A	A
SK1016	R	2	P	P	P	P	P	P	P	P	P	P	A
SK1017	R	1	A	A	A	A	P	P	P	P	P	P	A
SK1018	R	3	A	A	A	A	A	A	A	P?	P	P	A
SK1019	R	3	P	P	A	A	P	P	P	P	P	P	A
SK1024	R	2	A	A	A	A	P	P	P	P?	A	A	A
SK1025	R	1	A	A	A	A	P	P	P	P	P	P	A
SK1026	R	2	A	A	A	A	P	P	P	P	P	P	A

SK1027	R	2	P	P	A	A	P	P	P	P	P	P	A
SK1028	R	3	A	A	A	A	P	P	P	P	P	P	A
SK1029	R	1	A	A	A	A	P	P	P	P	P	P	A
SK1030	R	2	A	A	A	A	A	P	P	P	P	P	A
SK1031	R	2	A	A	A	A	P	P	P	P	P	P	A
SK1032	R	3	A	A	A	A	P	P	P	P	P	P	A
SK1033	R	3	A	A	A	A	P	P	P	P	P	P	A
SK1034	R	3	A	A	A	A	P	P	P	A	A	A	A
SK1035	R	4	A	A	A	A	P	P	P	P	P?	P?	A
SK1036	R?	1	A	A	A	A	A	P	P	P	P?	P?	A
SK1037	R	3	A	A	A	A	P	P	P	P	P	P	A
SK1038	R	2	A	A	A	A	P	P	P	A	A	A	A
SK1039	R	3	A	A	A	A	P	P	P	P	A	A	A
SK1040	R?	3	A	A	A	A	P	P	P	P	A	A	A
SK1041	R?	3	A	A	A	A	P?	P	P	P?	A	A	A
SK1043	R?	3	A	A	A	A	P	P?	P?	A	A	A	A
SK1044	R?	4	A	A	A	A	P?	P	P	P	A	A	A
SK2641	R	1	A	A	A	P	A	A	A	A	A	A	A
TP	**-**	**-**	**3**	**3**	**2**	**3**	**23**	**26**	**26**	**22**	**16**	**16**	**1**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**2**	**1**	**1**	**3**	**3**	**3**	**0**
Total	**-**	**-**	**3**	**3**	**2**	**3**	**25**	**27**	**27**	**25**	**19**	**19**	**1**

SK	**S?= 6**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z 10**	**ZJ**
SK1020	?	1	P	P	A	A	A	A	A	A	A	A	A
SK1021	?	1	P	P	A	A	A	A	A	A	A	A	A
SK1022	?	1	P	P	A	A	A	A	A	A	A	A	A
SK1023	?	1	P	P	A	A	A	A	A	A	A	A	A
SK1042	?	4	A	A	A	A	A	P	P	P?	A	A	A
SK2640	?	1	P	P	A	A	A	A	A	A	A	A	A
TP	**-**	**-**	**5**	**5**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Total	**-**	**-**	**5**	**5**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**

Scapulae

SK	SL= 36	W G	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9
SK1921	L	3	A	A	A	A	A	P	A	P	A
SK1922	L	1	A	A	A	A	A	A	P	A	A
SK1924	L	2	A	P	P	P	P	P	P	A	A
SK1925	L	2	P	P	P	P	P	A	P	A	A
SK1926	L	3	P	P	P	P	P	P	P	A	A
SK1927	L	2	A	P	P	P	P	A	P	A	A
SK1928	L	2	A	P	P	P	P	P	A	A	A
SK1929	L	2	P	P	P	P	A	P	A	A	A
SK1930	L	3	P	P	P	P	A	A	A	A	A
SK1931	L	1	A	P	P	P	P	A	P	A	A
SK1932	L	3	A	P	P	P	P	A	A	A	A
SK1933	L	1	A	A	A	P	P	P	A	A	A
SK1934	L	2	A	P	A	P	P	A	A	A	A
SK1936	L	2	A	A	A	A	A	A	P	A	A
SK1940	L	2	A	A	A	A	A	A	P	A	A
SK1942	L	1	A	A	A	P	P	P	P	A	A
SK1945	L	1	P	A	A	A	A	A	A	A	A
SK1947	L?	1	A	A	A	A	A	A	P	A	A
SK1950	L	2	A	A	A	P	P	P	P	A	A
SK1951	L	1	A	A	A	P	P	P	A	A	A
SK1952	L	4	A	A	A	P	P	P	A	A	A
SK1953	L	1	A	A	A	A	A	P	A	P	A
SK1955	L	1	A	A	A	A	A	P	A	P	A
SK1956	L	3	A	A	A	A	A	A	P	A	A
SK1957	L	2	A	A	A	P	P	A	A	A	A
SK1958	L?	3	A	A	A	P	A	A	A	A	A
SK1959	L?	4	A	A	A	A	A	A	P	A	A
SK1961	L?	3	A	A	A	A	A	A	P	A	A
SK1977	L	2	A	A	A	A	A	A	P	A	A
SK1978	L	2	A	A	A	A	A	A	P	A	A
SK1981	L?	2	A	A	A	P	A	A	A	A	A
SK1983	L?	2	A	A	A	A	A	A	P	A	A
SK1984	L?	2	A	A	P	A	P	A	A	A	A
SK1990 A	L	2	A	P	P	A	P	P	P	P	P
SK1990	L	2	A	A	A	A	A	A	A	P	A

B											
SK2650	L	2	A	P	A	P	A	A	A	A	A
TP	**-**	**-**	**5**	**12**	**11**	**19**	**16**	**13**	**18**	**5**	**1**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**-**	**5**	**12**	**11**	**19**	**16**	**13**	**18**	**5**	**1**
SK	**SL= 29**	**W G**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**
SK1907	R	1	P	P	P	P	P	P	P	A	A
SK1908	R	2	P	P	P	P	P	P	A	A	A
SK1909	R	2	A	P	P	P	P	A	P	A	A
SK1910	R	1	A	P	P	P	P	P	P	A	A
SK1911	R	3	P	P	A	P	P	P	A	P	A
SK1912	R	2	A	P	P	P	P	A	A	A	A
SK1913	R	3	A	P	P	P	P	P	P	P	A
SK1914	R	2	A	A	P	P	P	P	A	A	A
SK1915	R	2	A	A	P	P	P	A	A	A	A
SK1916	R	2	P	P	A	A	P	A	A	A	A
SK1917	R	1	P	P	P	P	P	A	A	A	A
SK1918	R	1	A	A	A	P	P	A	A	A	A
SK1919	R	2	A	A	A	A	P	A	A	A	A
SK1920	R	2	A	A	A	A	P	A	A	A	A
SK1923	R	5	A	A	A	P	A	A	A	A	A
SK1935	R	1	A	A	A	A	A	P	A	P	A
SK1937	R	2	A	A	A	P	P	A	A	A	A
SK1938	R	3	A	A	A	P	P	A	P	A	A
SK1939	R?	1	A	A	A	P	P	A	A	A	A
SK1941	R	2	A	A	A	A	A	A	P	A	A
SK1943	R?	2	A	A	A	A	A	A	P	A	A
SK1944	R	1	A	A	A	A	A	A	P	A	A
SK1946	R	2	A	A	A	A	A	A	P	A	A
SK1948	R?	1	A	A	A	P	A	A	A	A	A
SK1954	R?	2	A	A	A	P	A	A	A	A	A
SK1960	R?	1	A	A	A	A	A	P	A	P	A
SK1963	R?	3	A	A	A	A	A	A	P	A	A
SK1985	R?	2	A	A	A	A	A	P	P	A	P?
SK2629	R?	1	A	A	A	A	A	A	A	P	A
TP	**-**	**-**	**5**	**9**	**9**	**17**	**17**	**9**	**11**	**5**	**0**
TP?	**-**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Total	**-**	**-**	**5**	**9**	**9**	**17**	**17**	**9**	**11**	**5**	**1**

SK	SL= 20	WG	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9
SK1949	?	1	A	P?	P?	A	A	A	A	A	A
SK1962	?	2	A	A	A	A	A	A	P	A	A
SK1964	?	1	A	A	P	A	P	A	A	A	A
SK1965	?	1	A	A	A	A	A	A	P	A	P
SK1973	?	1	A	A	A	A	A	A	P	A	P
SK1974	?	1	A	A	A	A	A	A	P	A	P
SK1975	?	1	A	A	A	A	A	A	P?	A	P?
SK1976	?	1	A	A	A	A	A	A	P?	A	P?
SK1979	?	1	A	A	A	A	A	A	P?	A	P?
SK1980	?	2	A	A	A	A	A	A	P	A	A
SK1982	?	4	A	A	A	A	A	A	P	A	A
SK1986	?	1	A	A	A	A	A	A	P	A	A
SK1987	?	1	A	A	A	A	A	P	P	A	A
SK1988	?	1	A	A	A	A	A	P	P	A	A
SK1989	?	1	A	A	A	A	A	A	P?	A	P?
SK1991	?	2	A	A	A	A	A	P	P	A	A
SK2527	?	2	A	A	A	A	A	A	A	A	P
SK2628	?	1	A	A	A	A	A	P?	P?	P?	P?
SK2630	?	2	A	A	A	A	A	P?	A	P?	A
TP	**-**	**-**	**0**	**0**	**1**	**0**	**1**	**3**	**10**	**0**	**4**
TP?	**-**	**-**	**0**	**1**	**1**	**0**	**0**	**2**	**5**	**2**	**5**
Total	**-**	**-**	**0**	**1**	**2**	**0**	**1**	**5**	**15**	**2**	**9**

Ribs

SK	SL= 110	WG	Z1	Z2	Z3
SK0321	L?	2	A	P	P
SK0322	L	1	A	P	P
SK0324	L	2	P	P	P
SK0328	L	1	P	P	A
SK0330	L	1	P	P	A
SK0333	L	2	A	P	P
SK0334	L	1	A	A	P

SK0335	L	1	P	P	A
SK0336	L	2	P	P	A
SK0338	L	2	P	P	A
SK0345	L	1	P	P	A
SK0349	L	1	P	P	P
SK0351	L	2	A	P	P
SK0352	L	1	P	P	P
SK0353	L	1	P	P	P
SK0354	L	1	P	P	P
SK0357	L	2	A	P	A
SK0360	L	1	P	P	P
SK0361	L	2	A	P	P
SK0363	L	2	A	P	A
SK0364	L	2	A	P	P
SK0366	L	3	A	P	A
SK0367	L	1	P	P	A
SK0369	L	1	P	P	A
SK0370	L	1	P	P	A
SK0371	L	2	A	P	P
SK0373	L	1	P	P	A
SK0374	L	2	A	P	A
SK0376	L	2	A	P	A
SK0379	L?	2	A	P	A
SK0382	L	1	P	A	A
SK0383	L?	1	P	P	A
SK0384	L	1	A	P?	P?
SK0386	L	1	A	P	P
SK0387	L	2	P	P	P?
SK0390	L	2	P	P	P
SK0394	L?	2	P	A	A
SK0395	L?	1	A	P	A
SK0406	L	2	P	P	A
SK0407	L?	2	P	P	A
SK0409	L?	4	P?	P	A
SK0410	L	2	P	P	P
SK0411	L?	4	A	P?	P
SK0413	L	2	P	A	A
SK0417	L	2	A	P	P
Sk0418	L	1	P	P	P
SK0422	L	1	A	P	P
SK0423	L	1	A	P	P
SK0427	L?	2	A	P?	P?

SK0442	L?	2	A	A	P
SK0450	L	2	A	P	P
SK0472	L?	2	P?	P?	A
SK0473	L?	1	A	P?	A
SK0478	L?	1	P	A	A
SK0491	L	2	A	P	P
SK0504	L?	2	A	A	P
SK0506	L?	1	A	A	P
SK0507	L	2	A	P	P
SK0510	L?	1	P?	P	A
SK0519	L	3	A	P	P
SK0549	L?	2	P?	P?	A
SK0553	L	1	P	P	A
SK0554	L	1	P	P	A
SK0555	L?	1	A	A	P
SK0558	L?	1	P	P	A
SK0562	L	2	A	P	A
SK0563	L	2	P	P	A
SK0574	L?	1	A	P?	A
SK0575	L	2	P	P	P
SK0598	L	1	A	P	A
SK0627	L?	2	A	P	A
SK0649	L?	1	P	P	A
SK0671	L?	2	P?	P?	A
SK0705	L	2	A	A	P
SK0707	L?	1	A	A	P
SK0708	L?	1	A	A	P
SK0709	L	2	A	A	P
SK0710	L	1	A	P	A
SK0711	L	1	A	P	A
SK0712	L	1	A	P?	P
SK0713	L	1	A	P	A
SK0716	L?	2	A	A	P
SK0721	L?	3	A	P?	P?
SK0729	L	1	A	A	P
SK0731	L?	2	A	P	A
SK0733	L	2	A	P?	P
SK0735	L?	1	A	P	A
SK0737	L	1	A	P	A
SK0739	L	2	A	P	P?
SK0743	L	1	A	P	P
SK0744	L	1	A	P	P

SK0745	L?	1	A	A	P
SK0749	L	1	A	A	P
SK0751	L	2	A	A	P
SK0752	L	1	A	A	P
SK0753	L?	2	A	P?	A
SK0756	L?	1	A	P?	A
SK0759	L?	1	A	P	P
SK0764	L	3	A	P	P
SK0766	L	2	P	P	P
SK0768	L	1	P	P	P
SK0769	L	1	P	P	A
SK0770	L	1	P	P	A
SK0777	L	1	A	P	A
SK0786	L	1	P	P	P
SK0793	L?	2	P?	P	A
SK0804	L?	1	P?	A	A
SK0807	L	2	A	P	A
SK2634	L?	1	A	P?	P
SK2654	L	2	A	P	A
TP	**-**	**-**	**38**	**76**	**51**
TP?	**-**	**-**	**7**	**14**	**5**
Total	**-**	**-**	**45**	**90**	**56**
SK	**SR= 103**	**WG**	**Z1**	**Z2**	**Z3**
SK0316	R	2	P	P	A
SK0323	R	2	A	P	P
SK0325	R	1	P	P	P
SK0326	R	1	P	P	P
SK0327	R	2	A	P	P
SK0329	R	1	P	P	P
SK0331	R	1	P	P	P
SK0332	R	1	P	P	P
SK0337	R	1	A	A	P
SK0339	R	2	A	P	P
SK0341	R	1	A	A	P
SK0343	R	1	P	P	A
SK0347	R?	1	A	A	P
SK0350	R	1	P	P	P
SK0356	R	1	A	P	P
SK0359	R	2	P	P	A

SK0365	R	1	A	P	P
SK0372	R	2	P	A	A
SK0375	R	1	P	P	P
SK0380	R?	1	A	A	P
SK0388	R?	2	A	A	P
SK0392	R	1	P	P	A
SK0393	R?	2	A	P	A
SK0396	R?	2	P	A	A
SK0397	R	1	P	P	P
SK0398	R?	1	A	P	A
SK0400	R?	2	P	A	A
SK0402	R	1	P	P	A
SK0403	R?	2	A	P	A
SK0405	R?	1	A	P	A
SK0408	R?	3	A	P?	P
SK0415	R	2	P	P	P
SK0416	R	3	A	P	P
SK0419	R?	1	A	A	P
SK0420	R	1	P	P	A
SK0421	R?	2	A	A	P
SK0425	R?	1	A	P?	P
SK0429	R?	1	A	P?	P
SK0438	R?	1	A	A	P
SK0439	R	1	A	P?	P
SK0440	R	1	A	p	p
SK0444	R?	1	A	P	A
SK0447	R?	2	A	P	A
SK0451	R?	2	A	A	P
SK0494	R?	2	A	P	A
SK0499	R	2	A	P	P
SK0501	R?	1	A	P?	P?
SK0523	R?	1	A	P	A
SK0526	R	1	P	P	A
SK0564	R	1	A	P	A
SK0565	R	3	A	P	A
SK0585	R?	2	P	P	A
SK0586	R?	2	P	P	A
SK0617	R?	1	A	P	A
SK0630	R?	1	A	P?	P
SK0641	R	2	A	P	A
SK0648	R?	1	A	P	A
SK0669	R?	2	P?	P	A

SK0700	R?	1	P?	P?	A
SK0706	R	2	A	P	P
SK0717	R?	3	A	P	P
SK0722	R?	1	A	A	P
SK0727	R?	2	A	P?	P
SK0728	R?	1	A	A	P
SK0732	R	1	A	P?	P
SK0734	R	1	A	P?	P
SK0736	R?	1	A	A	P
SK0746	R	1	P	P	A
SK0747	R	1	P?	P	A
SK0748	R?	2	A	P?	P?
SK0750	R?	1	A	A	P
SK0758	R?	2	P	P	A
SK0760	R?	1	P?	P	A
SK0762	R	2	P?	P	P
SK0763	R	1	A	P	P
SK0765	R	2	P	P	P
SK0767	R	1	P	P	P
SK0771	R	2	A	P	P
SK0772	R	1	P	P	A
SK0773	R	1	P	P	A
SK0774	R?	1	A	P	P
SK0775	R	2	P	P	P
SK0776	R	2	P	P	A
SK0779	R	1	A	P	A
SK0780	R	2	A	P	P
SK0781	R	1	P	P	A
SK0782	R	1	P	P	A
SK0783	R	1	A	P	P
SK0784	R	3	A	P	P
SK0785	R	1	A	P	P
SK0787	R	1	P	P	A
SK0788	R	1	P	P	A
SK0789	R	2	A	P	P
SK0790	R	2	A	P	P
SK0792	R?	2	A	P	P?
SK0794	R?	2	A	P?	P
SK0795	R	2	A	P	A
SK0796	R	2	P	P	A
SK0799	R	1	P	P	A
SK0801	R	1	A	P	A

SK0805	R	1	P	P	A
SK1711	R	1	A	P?	P?
SK1722	R?	1	P	P?	A
TP	**-**	**-**	**37**	**73**	**54**
TP?	**-**	**-**	**5**	**14**	**4**
Total	**-**	**-**	**42**	**87**	**58**

SK	**S?= 203**	**W G**	**Z1**	**Z2**	**Z3**
SK0340	?	2	A	P	A
SK0342	?	1	A	A	P
SK0344	?	1	A	A	P
SK0346	?	2	A	A	P
SK0348	?	2	A	A	P
SK0355	?	1	A	P	A
SK0358	?	1	A	A	P
SK0362	?	2	A	A	P
SK0368	?	2	A	A	P
SK0377	?	2	A	A	P
SK0378	?	1	A	A	P
SK0381	?	1	A	A	P
SK0385	?	2	A	A	P
SK0389	?	2	A	P	A
SK0391	?	1	A	A	P
SK0399	?	2	A	A	P
SK0401	?	1	A	A	P
SK0404	?	2	A	A	P
SK0414	?	1	P?	A	A
SK0424	?	1	A	P	A
SK0426	?	2	A	A	P
SK0428	?	1	A	A	P
SK0430	?	3	A	A	P
SK0431	?	2	A	A	P
SK0432	?	2	A	A	P
SK0433	?	1	A	A	P
SK0434	?	1	A	P?	P?
SK0435	?	2	A	P	P
SK0436	?	2	A	P?	P?
SK0437	?	2	A	P?	P?
SK0441	?	1	A	P?	P
SK0443	?	2	A	A	P

SK0445	?	1	A	P	A
SK0446	?	1	A	A	P
SK0448	?	1	A	A	P
SK0449	?	1	A	A	P
SK0452	?	1	A	A	P
SK0453	?	2	A	A	P
SK0454	?	2	A	A	P
SK0455	?	2	A	A	P
SK0456	?	2	A	A	P
SK0457	?	1	A	A	P
SK0458	?	2	A	A	P
SK0459	?	1	A	A	P
SK0460	?	3	A	A	P
SK0461	?	3	A	A	P
SK0462	?	1	A	A	P
SK0463	?	2	A	A	P
SK0464	?	2	A	A	P
SK0465	?	2	A	A	P
SK0466	?	1	A	A	P
SK0467	?	2	A	A	P
SK0468	?	3	A	A	P?
SK0469	?	2	A	A	P
SK0470	?	1	A	A	P?
SK0471	?	1	P?	A	A
SK0474	?	2	A	P	A
SK0475	?	2	A	A	P
SK0476	?	2	A	P	A
SK0477	?	3	P	A	A
SK0479	?	1	A	A	P
SK0480	?	2	A	A	P
SK0481	?	2	A	A	P
SK0482	?	2	A	A	P?
SK0483	?	2	A	A	P
SK0484	?	1	A	P?	P?
SK0485	?	1	A	A	P
SK0486	?	1	A	P?	P
SK0487	?	1	A	A	P
SK0488	?	1	A	A	P
SK0489	?	1	A	A	P
SK0490	?	1	A	A	P
SK0492	?	1	A	P?	P?
SK0493	?	1	A	P?	P

SK0495	?	1	A	A	P
SK0496	?	1	A	A	P
SK0497	?	1	A	A	P
SK0498	?	1	A	P?	P?
SK0500	?	1	A	P?	P?
SK0502	?	2	A	A	P
SK0503	?	1	A	A	P
SK0505	?	1	A	A	P
SK0508	?	1	A	A	P
SK0509	?	2	A	A	P
SK0511	?	1	A	A	P
SK0512	?	1	A	A	P
SK0513	?	2	A	A	P
SK0514	?	2	A	A	P
SK0515	?	2	A	A	P
SK0516	?	2	A	A	P
SK0517	?	1	A	A	P
SK0518	?	2	A	A	P
SK0520	?	2	A	A	P
SK0521	?	2	A	A	P
SK0522	?	1	A	A	P
SK0524	?	1	A	P?	P?
SK0525	?	1	A	A	P
SK0527	?	1	A	A	P
SK0528	?	1	A	A	P?
SK0529	?	1	A	A	P
SK0530	?	1	A	A	P?
SK0531	?	1	A	A	P
SK0532	?	2	A	A	P
SK0533	?	2	A	A	P?
SK0534	?	1	A	A	P
SK0535	?	1	A	A	P
SK0536	?	1	A	A	P
SK0537	?	2	A	A	P
SK0538	?	2	A	A	P
SK0539	?	2	A	A	P
SK0540	?	2	A	A	P
SK0541	?	1	A	P	A
SK0542	?	1	A	A	P
SK0543	?	2	A	P?	P?
SK0544	?	1	A	P	A
SK0545	?	2	A	P	A

SK0546	?	2	A	P	A
SK0547	?	2	A	P	A
SK0548	?	1	A	P	A
SK0550	?	1	A	A	P
SK0551	?	2	A	P	A
SK0552	?	0	A	P?	P
SK0556	?	2	A	P?	P
SK0557	?	1	A	A	P
SK0559	?	1	A	A	P
SK0560	?	1	A	A	P
SK0561	?	1	A	P	A
SK0566	?	0	A	A	P
SK0567	?	2	A	P	P?
SK0568	?	1	A	A	P
SK0569	?	1	A	A	P
SK0570	?	1	A	A	P
SK0571	?	1	A	A	P
SK0572	?	1	A	A	P
SK0573	?	1	A	P	A
SK0576	?	1	A	A	P
SK0577	?	1	A	P?	P?
SK0578	?	1	A	A	P
SK0579	?	2	A	A	P
SK0580	?	1	A	A	P
SK0581	?	2	A	P?	P?
SK0582	?	1	A	P	A
SK0583	?	1	A	A	P
SK0584	?	1	A	P	A
SK0587	?	1	A	A	P
SK0588	?	2	A	A	P
SK0589	?	2	A	A	P
SK0590	?	3	A	A	P
SK0591	?	1	A	A	P
SK0592	?	1	A	A	P
SK0593	?	4	A	P	A
SK0594	?	3	A	P?	P?
SK0595	?	3	A	A	P
SK0596	?	1	A	A	P
SK0597	?	2	A	P	A
SK0599	?	1	A	A	P
SK0600	?	1	A	A	P
SK0601	?	2	A	A	P

SK0602	?	1	A	P?	P?
SK0603	?	2	A	A	P
SK0604	?	2	A	A	P
SK0605	?	1	A	P	A
SK0606	?	1	A	P?	P?
SK0607	?	1	A	A	P
SK0608	?	1	A	A	P
SK0609	?	0	A	A	P
SK0610	?	1	A	P	A
SK0611	?	1	A	A	P
SK0612	?	1	A	A	P
SK0613	?	1	A	A	P
SK0614	?	1	A	A	P
SK0615	?	3	A	P	A
SK0616	?	1	A	A	P
SK0618	?	2	A	P?	A
SK0619	?	2	A	A	P
SK0620	?	2	A	P?	A
SK0621	?	1	A	A	P
SK0622	?	4	A	A	P
SK0623	?	2	A	A	P
SK0624	?	1	A	A	P
SK0625	?	1	P?	P?	A
SK0626	?	4	P?	P?	A
SK0628	?	1	A	A	P
SK0629	?	1	A	P	P?
SK0631	?	3	A	P	A
SK0632	?	2	A	A	P
SK0633	?	2	A	P	A
SK0634	?	1	A	P	A
SK0635	?	2	A	A	P
SK0636	?	2	A	A	P
SK0637	?	1	A	A	P
SK0638	?	3	A	A	P
SK0639	?	1	A	A	P
SK0640	?	1	A	A	P
SK0642	?	1	A	A	P
SK0643	?	4	A	A	P
SK0644	?	1	A	P?	P?
SK0645	?	1	A	A	P
SK0646	?	2	A	P	A
SK0647	?	1	A	A	P

SK0650	?	1	A	A	P
SK0651	?	1	A	A	P
SK0652	?	2	A	A	P
SK0653	?	4	A	A	P
SK0654	?	1	A	A	P
SK0655	?	2	A	A	P
SK0656	?	1	A	P	A
SK0657	?	2	A	A	P
SK0658	?	1	A	A	P
SK0659	?	3	A	A	P
SK0660	?	1	A	A	P
SK0661	?	2	A	A	P
SK0662	?	1	A	A	P
SK0663	?	1	A	P	A
SK0664	?	2	A	A	P
SK0665	?	1	A	A	P
SK0666	?	1	A	A	P
SK0667	?	3	A	P?	P?
SK0668	?	1	A	A	P
SK0670	?	3	A	P	P
SK0672	?	1	A	A	P
SK0673	?	2	A	A	P
SK0674	?	2	A	A	P
SK0675	?	3	P?	P?	A
SK0676	?	1	A	A	P
SK0677	?	2	A	A	P
SK0678	?	1	A	A	P
SK0679	?	1	A	A	P
SK0680	?	1	A	A	P
SK0681	?	1	A	A	P
SK0682	?	2	A	A	P
SK0683	?	1	A	A	P
SK0684	?	1	A	A	P
SK0685	?	2	A	A	P
SK0686	?	1	A	A	P
SK0687	?	1	A	P?	P?
SK0688	?	1	A	A	P
SK0689	?	2	A	P?	A
SK0690	?	1	A	P?	P?
SK0691	?	2	A	A	P
SK0692	?	2	A	A	P
SK0693	?	1	A	A	P

SK0694	?	1	A	A	P
SK0695	?	1	A	A	P
SK0696	?	2	A	A	P
SK0697	?	1	A	A	P
SK0698	?	2	A	A	P
SK0699	?	1	P?	A	A
SK0701	?	1	A	A	P
SK0702	?	4	A	A	P
SK0703	?	2	A	A	P
SK0704	?	2	A	A	P
SK0714	?	2	A	A	P
SK0715	?	2	A	P	P
SK0718	?	1	A	A	P
SK0719	?	2	A	A	P
SK0720	?	2	A	A	P
SK0723	?	1	A	A	P
SK0724	?	1	A	P?	P
SK0725	?	1	A	P?	P?
SK0726	?	1	A	A	P
SK0730	?	1	A	A	P
SK0738	?	1	A	A	P
SK0740	?	1	A	A	P
SK0741	?	1	A	A	P
SK0742	?	1	A	A	P
SK0754	?	2	A	A	P
SK0755	?	1	A	A	P
SK0757	?	1	A	P?	A
SK0761	?	4	P?	P	A
SK0778	?	1	A	A	P
SK0791	?	2	A	A	P
SK0797	?	3	A	A	P
SK0798	?	1	A	P	A
SK0800	?	3	A	P?	A
SK0802	?	1	A	A	P
SK0803	?	1	P	P?	A
SK0806	?	1	A	A	P
SK1750	?	2	P	A	A
SK1754	?	1	A	P?	A
SK2526	?	1	A	A	P
SK2655	?	2	A	A	P
SK0412	?	3	A	A	P
TP	**-**	**-**	**3**	**36**	**210**

TP?	**-**	**-**	**7**	**35**	**27**
Total	**-**	**-**	**10**	**71**	**237**

Sterna

There were six sternal fragments identified in the database.

SK	WG	Z1	Z2	Z3
SK2520	2	A	P	A
SK2521	1	A	P	A
SK2522	3	A	P	A
SK2523	2	P	A	A
SK2524	3	A	P	A
SK2525	5	P	A	A
TP	**-**	**2**	**4**	**0**
TP?	**-**	**0**	**0**	**0**
Total	**-**	**2**	**4**	**0**

Sacra

There were 17 sacral fragments identified in the database.

SK	WG	Z1	Z2	Z3	Z4
SK2585	1	P	P	P	A
SK2586	1	P	A	A	P
SK2587	2	P	A	A	P
SK2588	1	P	A	P	P
SK2589	2	A	P	A	P
SK2590	2	A	A	A	P
SK2591	2	A	A	A	P
SK2592	1	A	A	P	A
SK2593	2	A	A	A	P
SK2594	2	P	A	P	A

SK2595	1	A	P?	P?	P
SK2596	3	P	A	A	A
SK2599	1	A	A	A	P
SK2600	2	A	P	P	P
SK2601	1	P	A	A	A
SK2602		A	P?	P?	A
SK2603		A	A	A	P
TP	**-**	**7**	**3**	**5**	**11**
TP?	**-**	**0**	**2**	**2**	**0**
Total	**-**	**7**	**5**	**7**	**11**

Coccyx

There was one coccyx fragment identified in the database.

SK	**WG**
SK2597	1
-	-

Patellae

SK	**SL=12**	**WG**
SK1992	L	1
SK1994	L	2
SK1998	L	2
SK2000	L	2
SK2002	L	2
SK2003	L	3
SK2007	L	2
SK2008	L	2
SK2012	L	2
SK2013	L	1

SK2014	L	2
SK2015	L?	2
-	-	-
SK	**SR= 13**	**WG**
SK1361	R	2
SK1993	R	2
SK1995	R	3
SK1996	R	2
SK1997	R	2
SK1999	R	3
SK2001	R	3
SK2004	R	1
SK2005	R	2
SK2006	R	2
SK2009	R	2
SK2010	R	2
SK2011	R?	3
-	-	-
SK	**S?= 1**	**WG**
SK2667	?	1
-	-	-

Mandibles

There were 32 total mandibular fragments identified in the database. L indicates the left side, and R indicates the right.

SK	**WG**	**Z1**	**Z1**	**Z2**	**Z2**	**Z3L**	**Z3**	**Z4**	**Z4**	**Z5**	**Z5**	**Z6**	**Z6**	**Z7**	**Z7**

		L	**R**	**L**	**R**		**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**	**R**
SK0108	1	P	P	P	P	P	A	P	A	P	A	P	P	P	P
SK0109	1	P	P	P	P	P	A	P	A	P	A	P	P	P	P
SK0110	2	A	P	P	P	A	P	A	P	A	A	A	P	P	P
SK0112	1	P	P	P	P	A	A	A	A	A	A	P	P	P	P
SK0113	1	P	P	P	P	P	P	A	P	A	P	A	P	P	P
SK0114	1	P	P	P	P	P	A	P	A	P	A	P	A	P	P
SK0115	1	P	A	P	A	P	A	A	A	A	A	P	A	P	P
SK0117	1	P	A	A	A	A	A	A	A	A	A	P	A	A	A
SK0118	1	A	P	A	P	A	P	A	A	A	P	A	P	A	A
SK0120	1	P	A	P	A	A	A	A	A	A	A	P	A	P	A
SK0121	2	P	A	A	A	A	A	A	A	A	A	P	A	A	A
SK0123	1	P	A	P	P	A	A	A	A	A	A	A	A	P	P
SK0124	1	A	A	A	A	A	P	A	A	A	P	A	P	A	A
SK0125	1	A	A	A	A	P	A	P	A	P	A	P	A	A	A
SK0132	1	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK0133	1	A	A	A	A	P?	A	A	A	P	A	P	A	A	A
SK0134	2	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK0135	2	A	A	A	A	A	A	A	A	A	A	A	A	P	P
SK0136	1	A	A	A	A	P	A	P	A	P	A	P	A	A	A
SK0137	3	A	A	A	A	A	A	A	A	A	A	A	A	P	P
SK0138	2	A	A	A	A	A	A	A	A	P	A	P	A	A	A
SK0139	2	A	A	A	A	A	P	A	P	A	A	A	P	A	A
SK0140	2	A	A	A	A	A	A	A	A	A	A	A	A	P	P
SK0141	1	A	A	A	A	A	A	A	A	A	A	A	A	P	P
SK0142	1	A	A	A	A	A	A	A	A	A	P	A	P	A	A
SK2604	2	A	A	A	A	A	A	A	P	A	A	A	A	A	A
SK2605	2	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK2607	2	A	P	A	A	A	A	A	A	A	A	A	A	A	A
SK2584	2	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK2677	2	A	A	A	A	P	A	A	A	P	A	P	A	A	A
SK2678	2	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2679	2	A	A	A	A	A	A	A	A	A	A	A	P	A	A
TP	**-**	**10**	**8**	**9**	**8**	**8**	**5**	**5**	**4**	**10**	**7**	**13**	**10**	**13**	**12**
TP?	**-**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**-**	**10**	**8**	**9**	**8**	**9**	**5**	**5**	**4**	**10**	**7**	**13**	**10**	**13**	**12**

Maxillae

There were 25 total maxillae fragments identified in the database. Zone 12 is the left maxillae, and zone 13 is the right.

SK	**WG**	**Z 12**	**Z 13**
SK0148	1	P	A
SK0149	2	P	P
SK0150	1	P	A
SK0151	1	A	P
SK0152	1	P	A
SK0153	2	P	A
SK0154	2	A	P
SK0155	1	A	P
SK0156	1	A	P
SK0157	2	P	A
SK0158	2	A	P
SK0159	1	P	A
SK0160	1	P	A
SK0161	1	P	A
SK0162	1	P	A
SK0163	1	P	A
SK0164	1	A	P
SK0165	1	A	P
SK0166	1	P	A
SK0167	2	P	A
SK0195	2	P	A
SK0196	1	P	A
SK0197	1	A	P?
SK0198	1	P?	P?
SK2606	2	P	A
TP	**-**	**16**	**8**
TP?	**-**	**1**	**2**
Total	**-**	**17**	**10**

Crania

There were 163 cranial fragments identified in the database.

SK	WG	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z15
SK0847	1	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK0848	1	A	A	A	P	P	A	A	A	A	A	A	A	A	A	A
SK0849	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK0850	3	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2444	2	A	A	A	A	A	A	A	A	A	P	A	P	A	A	A
SK2445	2	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2446	2	A	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK2447	2	A	A	A	A	A	A	A	A	A	A	P	A	P	A	A
SK2448	2	A	A	A	A	A	A	A	A	A	P	A	P	A	A	A
SK2449	2	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2450	2	A	A	A	A	A	A	A	A	A	P	A	P	A	A	A
SK2451	1	A	P	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2452	2	A	P	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2453	3	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2454	1	A	A	A	A	A	A	A	A	A	A	P	A	P	A	A
SK2455	2	P	A	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2456	2	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2457	1	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2458	2	P	P	A	A	A	A	A	A	A	A	A	A	A	A	A
SK2459	1	A	A	A	A	A	A	A	A	A	A	P	A	P	A	A
SK2460	1	P	A	A	A	A	A	A	A	P	A	A	A	A	A	A
SK2461	3	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2462	1	P	P	A	A	A	A	A	A	A	A	A	A	P	P	P
SK2463	2	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2464	1	P	P	P	A	A	A	A	A	A	A	A	A	A	P	P
SK2465	1	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2466	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2467	3	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2468	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2469	2	A	A	A	P	P	A	A	A	A	A	A	A	A	A	A
SK2470	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A

SK2471	1	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2472	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2473	2	A	A	P	A	P	A	A	A	A	A	A	A	A	A	A
SK2474	2	A	A	P	P	P	A	A	A	A	A	A	A	A	A	A
SK2475	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2476	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2477	1	A	A	A	A	P	P	A	A	A	A	A	A	A	A	A
SK2478	2	A	A	A	A	A	P	A	P	A	A	A	A	A	A	A
SK2479	1	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2480	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2481	1	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2482	2	A	A	A	A	A	P	A	P	A	A	A	A	A	A	A
SK2483	1	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2484	3	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2485	2	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2486	3	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2487	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2488	3	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2489	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2490	2	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2491	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2492	1	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2493	2	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2494	1	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2495	2	A	A	P	A	A	A	P	A	A	A	A	A	A	A	A
SK2496	3	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2497	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2498	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2499	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2500	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2501	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2502	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2503	4	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2504	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2505	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2506	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2507	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2508	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2509	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A

SK2510	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2511	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2512	3	A	A	A	P?	A	A	A	A	A	A	A	A	A	A	A
SK2513	3	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2514	1	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2515	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2516	2	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2517	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2518	1	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2519	2	A	A	A	A	A	A	A	A	P?	A	A	A	A	A	A
SK2528	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2529	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2530	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2531	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2532	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2533	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2534	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2535	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2536	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2537	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2538	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2539	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2540	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2541	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2542	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2543	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2544	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2545	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2546	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2547	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2548	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2549	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2550	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2551	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2552	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2553	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2554	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2555	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2556	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A

SK2557	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2558	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2559	2	A	A	A?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2560	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2561	3	A	A	P	P	A	A	A	A	A	A	A	A	A	A	A
SK2562	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2563	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2564	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2565	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2566	3	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2567	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2568	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2569	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2570	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2571	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2572	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2573	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2574	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2575	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2576	2	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2577	2	A	A	P?	A?	A	A	A	A	A	A	A	A	A	A	A
SK2578	4	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2579	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2580	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2581	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2582	3	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2583	2	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2608	3	A	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK2609	3	A	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK2610	3	A	A	A	A	A	A	A	A	A	A	P	A	A	A	A
SK2611	3	P	P	P	P	A	A	A	A	A	A	A	A	A	A	A
SK2612	2	P	P	P	P	P	A	P	A	A	A	A	A	A	A	A
SK2668	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2669	1	A	A	P?	P?	A	A	A	A	A	A	A	A	A	A	A
SK2670	1	A	A	A	A	A	A	A	A	A	A	A	P	A	A	A
SK2671	1	A	A	A	A	A	A	A	A	A	A	A	P?	A	A	A
SK2672	2	A	A	A	A	A	A	A	A	A	A	A	P?	P?	A	A

SK2673	1	A	A	A	A	A	A	A	P	A	A	A	A	A	A	A
SK2674	1	A	A	A	A	A	A	A	P?	P?	A	A	A	A	A	A
SK2675	2	A	A	A	A	A	A	A	A	P	A	A	A	A	A	A
SK2676	1	A	A	A	A	A	P?	P?	A	A	A	A	A	A	A	A
SK2646	1	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A
SK2647	1	A	A	A	A	A	P?	P?	A	A	A	A	A	A	A	A
SK2680	1	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2681	1	A	A	A	A	A	A	A	A	A	P	A	A	A	A	A
SK2682	1	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2683	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2684	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2685	2	A	A	A	A	A	P	A	A	A	A	A	A	A	A	A
SK2686	1	A	A	A	A	A	A	P	A	A	A	A	A	A	A	A
SK2687	2	A	A	A	A	A	P?	P?	A	A	A	A	A	A	A	A
SK2688	1	A	A	A	A	A	P?	P?	A	A	A	A	A	A	A	A
SK2689	3	A	A	A	A	A	P?	A ?	A	A	A	A	A	A	A	A
SK2690	1	A	A	A	A	A	P?	P?	A	A	A	A	A	A	A	A
TP	**-**	**10**	**10**	**7**	**6**	**24**	**15**	**15**	**3**	**2**	**9**	**7**	**4**	**4**	**2**	**2**
TP?	**-**	**0**	**0**	**68**	**69**	**0**	**6**	**5**	**1**	**2**	**0**	**0**	**2**	**1**	**0**	**0**
Total	**-**	**10**	**10**	**75**	**75**	**24**	**21**	**20**	**4**	**4**	**9**	**7**	**6**	**5**	**2**	**2**

Innominates

SK	**SL= 48**	**W G**	**Z 1**	**Z 2**	**Z 3**	**Z 4**	**Z 5**	**Z 6**	**Z 7**	**Z 8**	**Z 9**	**Z 10**	**Z 11**	**Z 12**
SK1129	L	2	A	P	A	A	A	P	A	A	A	A	A	A
SK1130	L	3	A	A	A	A	A	P	A	A	A	A	P?	A
SK1133	L	3	A	P?	A	P?	A	P	A	A	A	A	P?	A
SK1134	L	2	A	P	A	P	A	P	A	A	A	A	P?	A
SK1135	L	2	P	P	A	P	A	P	A	A	A	A	P	A
SK1136	L	2	P	P	P	P	P	P	P	A	A	P	P	P
SK1124	L	3	A	P?	A	P?	A	P	A	A	A	A	P	A
SK1125	L	2	A	P	A	A	A	P	A	A	A	A	P	A
SK1126	L	2	P?	P	A	P	A	P	A	A	A	A	P	A
SK1138	L	2	P	P	P	P	P	P	P	A	A	P	A	A

SK1139	L	1	P	P	P	P	P	P	P	A	A	P	P	P
SK1140	L	1	P	P	P	P	P	P	P	A	A	P	P	P
SK1143	L	2	P	P	P?	P	P	P	P	A	A	P	P	A
SK1144	L	2	P	P	P	P	P	P	P	A	A	P	P	P
SK1146	L	2	P	P	A	P	P	P	P	A	A	P	A	A
SK1154	L	2	P	A	A	P	P	A	P	A	A	P	A	P
SK1160	L	3	P	A	A	A	P	A	P	A	A	P	A	A
SK1161	L	1	P	A	P	P	P	A	P	A	A	P	A	P
SK1162	L	3	P	A	A	P	P	A	P	A	A	P	A	A
SK1163	L	1	P	A	A	P	P	A	P	A	A	P	A	A
SK1164	L	3	P	A	A	P	P	A	P	A	A	P	A	A
SK1165	L	4	P	A	A	P	P	A	P	A	A	P	A	A
SK1166	L	1	P	A	A	P	P	A	P	A	A	P	A	A
SK1167	L	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1168	L	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1169	L	1	P	A	A	P	P	A	P	A	A	P	A	A
SK1170	L	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1171	L	2	A	P	A	A	A	P?	A	A	A	A	A	A
SK1172	L	3	P	A	A	P	P	A	A	A	A	P	A	A
SK1173	L	1	A	A	A	A	P	A	P	A	A	P	A	A
SK1186	L	2	P	A	A	A	P	A	A	A	A	A	A	A
SK1187	L	2	A	A	A	A	A	A	A	P	P	A	A	A
SK1188	L	2	P	A	A	A	P	A	A	A	A	A	A	A
SK1189	L	2	A	P	A	A	A	P?	A	A	A	A	A	A
SK1191	L	2	A	P	A	A	A	A	A	A	A	A	A	A
SK1193	L	2	P	A	A	A	P	A	A	A	A	A	A	A
SK1198	L	3	A	P	A	A	A	A	A	A	A	A	A	A
SK1199	L	2	A	A	A	A	A	A	A	P	A	A	A	A
SK1200	L?	2	A	P?	P	A	A	A	A	A	A	A	A	A
SK1217	L?	1	P	A	P?	A	A	A	A	A	A	A	A	A
SK1227	L?	2	A	A	A	A	A	P	A	A	A	A	P?	A
SK1229	L	2	A	A	P	A	A	A	A	P	A	A	A	A
SK1230	L	4	A	A	A	A	A	A	A	P	A	A	A	A
SK1231	L	2	A	A	A	A	A	A	A	P	A	A	A	A
SK1232	L	3	A	A	A	A	A	A	A	P	A	A	A	A
SK1239	L?	2	A	A	A	A	A	A	A	A	A	A	P	A
SK1240	L	2	A	P?	A	P	A	P	A	A	A	A	P	A
SK1242	L?	4	A	A	A	A	A	A	A	A	A	P?	A	A
TP	**-**	**-**	**25**	**16**	**8**	**23**	**24**	**17**	**20**	**6**	**1**	**21**	**11**	**6**
TP?	**-**	**-**	**1**	**4**	**2**	**2**	**0**	**2**	**0**	**0**	**0**	**1**	**4**	**0**
Total	**-**	**-**	**26**	**20**	**10**	**25**	**24**	**19**	**20**	**6**	**1**	**22**	**15**	**6**

SK	**SR=44**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**Z11**	**Z12**
SK1127	R	2	A	A	A	P?	A	P	A	A	A	A	A	A
SK1128	R	3	A	P	A	P?	A	P	A	A	A	A	P	A
SK1131	R	3	A	P	A	P	A	P	A	A	A	A	P	A
SK1132	R	4	A	P	A	P?	A	P	A	A	A	A	P	A
SK1122	R	3	A	A	A	A	A	P	A	A	A	A	P?	A
SK1123	R	2	A	P	A	A	A	P	A	A	A	A	P?	A
SK1137	R	2	P	P	P?	P	P	P	P	A	A	P	A	A
SK1141	R	2	P	P	P	P	P	P	P	A	A	P	P	A
SK1142	R	2	P	P	P?	P	P	P	P	A	A	P	P?	A
SK1145	R	2	P	P	P?	P	P	P	P	A	A	P	A	A
SK1147	R	1	P	P	P	P	P	P	P	A	A	P	P	P
SK1148	R	3	P	P	P	P	P	P	P	A	A	P	A	A
SK1149	R	2	P	P	P	P	P	P	P	A	A	P	P	A
SK1150	R	4	P	P	P	P	P	P	P	A	A	P	P	A
SK1151	R	2	P	P	A	P	P	A	P?	A	A	P	A	P
SK1152	R	2	A	P	A	P	A	P	A	A	A	A	P?	A
SK1153	R	3	A	P	A	P?	A	P	A	A	A	A	A	A
SK1174	R	3	P	A	A	A	P	A	A	A	A	A	A	A
SK1175	R	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1176	R	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1177	R	3	P	A	P?	P	P	A	P	A	A	P	A	P
SK1178	R	3	P	A	A	P	P	A	P	A	A	P	A	P
SK1179	R	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1180	R	3	P	A	A	P	P	A	P	A	A	P	A	A
SK1181	R	4	P	A	A	P	P	A	P	A	A	P	A	A
SK1182	R	3	P?	A	A	P	P	A	P	A	A	P	A	A
SK1183	R	2	P	A	A	P	P	A	P	A	A	P	A	A
SK1184	R	2	P	A	A	P	P	A	P	A	A	P	A	P
SK1185	R	2	P	A	A	A	P	A	A	A	A	P	A	A
SK1190	R	2	P	A	A	A	A	A	A	A	A	A	A	A
SK1192	R	2	P	A	A	A	A	A	A	A	A	A	A	A
SK1195	R	2	A	P	A	A	A	A	A	A	A	A	A	A
SK1196	R	2	A	P	A	A	A	A	A	A	A	A	A	A
SK1201	R?	2	P	A	P?	A	A	A	A	A	A	A	A	A
SK1220	R?	2	P	A	P?	A	A	A	A	A	A	A	A	A
SK1226	R	2	P	A	A	A	P	A	A	A	A	A	A	A
SK1233	R	2	A	A	A	A	A	A	A	P	P	A	A	A
SK1234	R	2	A	A	P?	A	A	A	A	P	P?	A	A	A

SK1235	R	2	A	A	A	A	A	A	A	A	P	A	P	A
SK1236	R	2	A	A	A	A	A	A	A	A	P	A	A	A
SK1237	R	2	A	A	A	A	A	A	A	P?	P	A	A	A
SK1238	R?	2	A	A	A	A	A	A	A	A	P	A	A	A
SK1241	R?	4	A	P?	A	P	A	P	A	A	A	A	P	A
SK2661	R?	1	A	P	P	A	A	A	A	A	A	A	A	A
TP	**-**	**-**	**25**	**18**	**6**	**22**	**22**	**17**	**18**	**2**	**5**	**20**	**9**	**5**
TP?	**-**	**-**	**1**	**1**	**7**	**4**	**0**	**0**	**1**	**1**	**1**	**0**	**4**	**0**
Total	**-**	**-**	**26**	**19**	**13**	**26**	**22**	**17**	**19**	**3**	**6**	**20**	**13**	**5**
SK	**S?= 37**	**W G**	**Z 1**	**Z 2**	**Z 3**	**Z 4**	**Z 5**	**Z 6**	**Z 7**	**Z 8**	**Z 9**	**Z 10**	**Z 11**	**Z 12**
SK1155	?	2	A	A	A	A	A	A	A	A	A	P	A	A
SK1156	?	2	A	A	A	A	A	A	A	A	A	A	A	P
SK1157	?	2	A	A	A	A	A	A	A	A	A	A	A	P
SK1158	?	2	A	A	A	A	A	A	A	A	A	A	A	P
SK1159	?	3	A	A	A	A	A	A	A	A	A	P	A	P
SK1194	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1197	?	4	P	A	A	P	A	A	A	A	A	A	A	A
SK1202	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1203	?	4	A	A	A	A	A	A	A	A	A	P	A	P
SK1204	?	1	A	A	A	A	A	A	A	A	A	P	A	P
SK1205	?	3	A	A	A	A	A	A	A	A	A	P	A	P
SK1206	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1207	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1208	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1209	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1210	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1211	?	4	A	A	A	A	A	A	A	A	A	P	A	P
SK1212	?	1	A	A	A	A	A	A	A	A	A	P	A	P
SK1213	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1214	?	3	A	A	A	A	A	A	A	A	A	A	A	P
SK1215	?	1	A	A	A	A	A	A	A	A	A	A	A	P
SK1216	?	2	A	A	A	A	A	A	A	A	A	P	A	P
SK1218	?	2	P?	P?	A	A	A	A	A	A	A	A	A	A
SK1219	?	2	P?	P?	A	A	A	A	A	A	A	A	A	A
SK1221	?	3	A	A	A	A	A	A	A	A	A	P	A	A

SK1222	?	1	A	A	A	A	A	A	A	A	A	P	A	A
SK1223	?	2	A	A	A	A	A	A	A	A	A	P	A	A
SK1224	?	2	A	A	A	A	A	A	A	A	A	P	A	A
SK1225	?	1	A	A	A	A	A	A	A	A	A	P	A	A
SK1228	?	2	A	A	A	A	A	P?	A	A	A	P?	P?	A
SK2659	?	1	A	A	A	A	A	A	A	A	A	P	A	A
SK2660	?	1	A	P	P	A	A	A	A	A	A	A	A	A
SK2662	?	2	P	A	A	A	A	A	A	A	A	A	A	A
SK2663	?	3	P	A	A	A	A	A	A	A	A	A	A	A
SK2664	?	2	P	A	A	A	P	A	A	A	A	A	A	A
SK2665	?	2	A	A	P	A	A	A	A	A	A	A	A	A
SK2666	?	2	P	A	A	A	P	A	A	A	A	A	A	A
TP	**-**	**-**	**5**	**1**	**2**	**1**	**2**	**0**	**0**	**0**	**0**	**22**	**0**	**20**
TP?	**-**	**-**	**2**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**
Total	**-**	**-**	**7**	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**0**	**23**	**1**	**20**

Vertebrae

The vertebrae were identified as cervical (CL), thoracic (TH), lumbar (LB), or unidentifiable (?).

SK	**CL=87**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**
SK2016	Cervical	1	P	P	P	P
SK2017	Cervical	2	P	P	P	P
SK2018	Cervical	2	P	P	A	A
SK2019	Cervical	2	A	A	P	P
SK2020	Cervical	1	A	A	A	P
SK2021	Cervical	2	P	P	P	P
SK2022	Cervical	2	P	P	P	P
SK2023	Cervical	1	P	P	P	P
SK2024	Cervical	2	P	P	P	A
SK2025	Cervical	1	P	P	P	A
SK2026	Cervical	2	P	P	P	A
SK2027	Cervical	2	A	A	P	A

SK2028	Cervical	4	P	A	A	A
SK2029	Cervical	1	P	P	P	P
SK2030	Cervical	2	P	P	P	A
SK2031	Cervical	2	P	P	P	P
SK2032	Cervical	1	P	A	P	P
SK2033	Cervical	2	P	P	A	A
SK2034	Cervical	2	P	A	A	A
SK2035	Cervical	1	P	A	A	A
SK2036	Cervical	2	P	A	P	A
SK2037	Cervical	2	P	P	A	A
SK2038	Cervical	1	P	A	A	A
SK2039	Cervical	1	A	P	A	A
SK2040	Cervical	1	A	A	P	A
SK2041	Cervical	1	A	P	A	A
SK2160	Cervical	2	P	P	P	P
SK2162	Cervical	1	P	P	P	P
SK2165	Cervical	1	P	P	P	P
SK2168	Cervical	2	P	P	P	A
SK2169	Cervical	2	P	A	A	A
SK2171	Cervical	2	P	A	A	A
SK2173	Cervical	1	A	A	A	P
SK2174	Cervical	1	P	A	A	A
SK2176	Cervical	1	A	A	A	P
SK2177	Cervical	1	A	A	A	P
SK2178	Cervical	2	A	P	P	P
SK2179	Cervical	2	A	P	P	P
SK2180	Cervical	2	P	A	P	A
SK2181	Cervical	1	A	P	A	A
SK2182	Cervical	2	A	P	A	A
SK2183	Cervical	3	A	A	P	A
SK2184	Cervical	1	A	P?	P?	A
SK2185	Cervical	1	A	A	P	A
SK2186	Cervical	1	A	A	P	A
SK2187	Cervical	4	A	P?	P?	A
SK2188	Cervical	1	A	A	P	A
SK2282	Cervical	1	A	A	P	A
SK2283	Cervical	2	A	P	A	A
SK2284	Cervical	1	A	P	A	A
SK2285	Cervical	2	P	A	A	A
SK2286	Cervical	1	A	A	P	A
SK2287	Cervical	1	A	P	A	A
SK2288	Cervical	2	A	P	A	A

SK2289	Cervical	1	A	P	A	A
SK2290	Cervical	2	A	P	A	P
SK2291	Cervical	2	P	A	A	A
SK2301	Cervical	2	A	A	P	A
SK2311	Cervical	1	P	A	A	A
SK2313	Cervical	2	P	A	A	A
SK2316	Cervical	1	P	A	A	A
SK2324	Cervical	2	A	P	A	A
SK2331	Cervical	2	A	A	P	A
SK2332	Cervical	2	A	A	P	A
SK2334	Cervical	2	P	A	A	A
SK2360	Cervical	2	A	A	P	A
SK2363	Cervical	2	P	A	A	A
SK2365	Cervical	2	A	A	P	A
SK2366	Cervical	2	A	A	P	A
SK2367	Cervical	1	A	A	P	A
SK2368	Cervical	1	A	A	P	A
SK2369	Cervical	1	A	A	P	A
SK2387	Cervical	2	P	A	A	A
SK2388	Cervical	2	P	A	A	A
SK2395	Cervical	2	A	A	P	P
SK2400	Cervical	1	A	A	P	A
SK2401	Cervical	1	P	P	A	P
SK2411	Cervical	2	A	A	P	A
SK2415	Cervical	2	A	P	A	A
SK2416	Cervical	2	A	A	P	A
SK2417	Cervical	2	A	P	A	A
SK2429	Cervical	1	P	A	A	A
SK2437	Cervical?	1	A	P	A	A
SK2441	Cervical?	1	A	P	A	A
SK2620	Cervical	1	P	A	A	A
SK2621	Cervical	1	P	A	A	A
SK2658	Cervical	3	P	A	A	A
TP	**-**	**-**	**42**	**36**	**42**	**21**
TP?	**-**	**-**	**0**	**2**	**2**	**0**
Total	**-**	**-**	**42**	**38**	**44**	**21**
SK	**TH=186**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**
SK2042	Thoracic	1	P	P	P	P
SK2043	Thoracic	1	P	P	P	P
SK2044	Thoracic	2	P	P	P	P

SK2045	Thoracic	1	A	P	P	A
SK2046	Thoracic	1	A	P	P	P
SK2047	Thoracic	1	A	P	P	P
SK2048	Thoracic	1	A	P	P	P
SK2049	Thoracic	2	P	P	P	P
SK2050	Thoracic	1	A	A	P	P
SK2051	Thoracic	1	A	P	P	P
SK2052	Thoracic	1	A	P	A	P
SK2053	Thoracic	1	A	P	P	P
SK2054	Thoracic	1	A	P	P	P
SK2055	Thoracic	1	A	P	A	P
SK2056	Thoracic	2	A	P	P	P
SK2057	Thoracic	1	A	P	P	P
SK2058	Thoracic	1	A	P	P	P
SK2059	Thoracic	2	A	P	A	P
SK2060	Thoracic	1	A	P	P	P
SK2061	Thoracic	1	A	P	P	P
SK2062	Thoracic	2	P	P	P	P
SK2063	Thoracic	2	A	P	P	P
SK2064	Thoracic	2	P	P	P	P
SK2065	Thoracic	1	A	P	P	A
SK2066	Thoracic	2	A	P	P	P
SK2067	Thoracic	1	A	P	P	P
SK2068	Thoracic	1	A	P	P	A
SK2069	Thoracic	1	A	P	P	P
SK2070	Thoracic	3	A	P	P	P
SK2071	Thoracic	2	A	P	P	A
SK2072	Thoracic	1	A	A	A	P
SK2073	Thoracic	1	A	P	P	A
SK2074	Thoracic	2	A	P	P	A
SK2075	Thoracic	2	A	P	P	A
SK2076	Thoracic	1	A	A	P	P
SK2077	Thoracic	2	A	P	P	P
SK2078	Thoracic	2	P	P	P	A
SK2079	Thoracic	2	P	P	P	P
SK2080	Thoracic	1	A	P	A	P
SK2081	Thoracic	2	A	A	P	P
SK2082	Thoracic	1	A	P	P	A
SK2083	Thoracic	1	A	P	P	P
SK2084	Thoracic	1	A	P	P	A
SK2085	Thoracic	3	P	A	A	A
SK2086	Thoracic	1	A	P	A	P

SK2087	Thoracic	3	A	P	P	P
SK2088	Thoracic	3	P	A	A	A
SK2089	Thoracic	2	A	P	P	A
SK2090	Thoracic	2	A	P	A	P
SK2092	Thoracic	1	A	A	P	A
SK2093	Thoracic	1	A	A	P	A
SK2094	Thoracic	1	A	P	P	A
SK2095	Thoracic	1	A	P	A	A
SK2096	Thoracic	2	A	P	A	A
SK2097	Thoracic	2	A	A	P	A
SK2098	Thoracic	1	A	A	P	A
SK2099	Thoracic	1	A	A	P	A
SK2100	Thoracic	3	A	P	A	A
SK2101	Thoracic	1	A	A	P	A
SK2102	Thoracic	2	A	A	P	P
SK2103	Thoracic	1	A	P	P	A
SK2104	Thoracic	1	A	P	A	A
SK2105	Thoracic	1	A	P?	P?	A
SK2115	Thoracic	2	P	P	A	P
SK2196	Thoracic	2	P	P	P	P
SK2197	Thoracic	2	P	P	P	P
SK2198	Thoracic	1	A	P	P	P
SK2199	Thoracic	1	A	P	P	P
SK2200	Thoracic	2	A	P	P	P
SK2201	Thoracic	2	P	A	A	A
SK2202	Thoracic	1	P	A	A	A
SK2203	Thoracic	2	P	A	A	A
SK2204	Thoracic	1	P	A	A	A
SK2205	Thoracic	1	P	A	A	A
SK2206	Thoracic	1	P	A	A	A
SK2207	Thoracic	1	P	A	A	A
SK2208	Thoracic	1	A	P	P	A
SK2209	Thoracic	2	A	A	P	P
SK2210	Thoracic	2	A	P	A	P
SK2211	Thoracic	2	A	P	P	A
SK2212	Thoracic	2	A	P	P	A
SK2213	Thoracic	1	P	A	A	A
SK2214	Thoracic	2	A	P	A	A
SK2215	Thoracic	1	A	P	A	A
SK2216	Thoracic	2	A	P	A	A
SK2217	Thoracic	1	A	P	A	A
SK2218	Thoracic	2	A	A	P	A

SK2219	Thoracic	2	A	P	A	A
SK2220	Thoracic	2	A	P	A	A
SK2221	Thoracic	2	A	A	P	A
SK2222	Thoracic	1	A	P	A	A
SK2223	Thoracic	1	A	P	A	A
SK2224	Thoracic	1	P	A	A	A
SK2225	Thoracic	1	P	A	A	A
SK2226	Thoracic	1	P	A	A	A
SK2227	Thoracic	1	P	A	A	A
SK2228	Thoracic	2	A	P	A	A
SK2229	Thoracic	2	A	P	A	A
SK2230	Thoracic	2	P	A	A	A
SK2231	Thoracic	2	A	P	A	A
SK2232	Thoracic	2	P	A	A	A
SK2233	Thoracic	2	A	P?	P?	A
SK2234	Thoracic	2	P	A	A	A
SK2235	Thoracic	2	A	A	P	A
SK2236	Thoracic	2	A	P	A	A
SK2237	Thoracic	1	A	P	A	A
SK2238	Thoracic	2	A	P	A	A
SK2241	Thoracic	2	A	P	A	A
SK2242	Thoracic	1	P	P	A	A
SK2245	Thoracic	1	A	A	P	A
SK2247	Thoracic	2	A	P	A	A
SK2252	Thoracic?	1	A	P?	P?	A
SK2259	Thoracic	1	A	P	P	P
SK2261	Thoracic	1	A	A	P	A
SK2262	Thoracic	2	A	P	P	A
SK2263	Thoracic	1	A	P	P	P
SK2264	Thoracic?	2	A	P	P	A
SK2265	Thoracic	1	A	P	A	A
SK2266	Thoracic	2	A	P	A	A
SK2268	Thoracic	1	A	A	P	A
SK2292	Thoracic	1	A	P	P	A
SK2294	Thoracic	2	A	P	A	A
SK2295	Thoracic	2	A	A	P	A
SK2298	Thoracic	1	P	A	A	A
SK2299	Thoracic	2	P	A	A	A
SK2300	Thoracic	2	P	A	A	A
SK2302	Thoracic	2	P	A	A	A
SK2303	Thoracic	1	P	A	A	A
SK2304	Thoracic	1	P	A	A	A

SK2305	Thoracic	2	P	A	A	A
SK2306	Thoracic	1	P	A	A	A
SK2307	Thoracic	1	P	A	A	A
SK2308	Thoracic	2	P	A	A	A
SK2309	Thoracic	1	P	A	A	A
SK2310	Thoracic	1	P	A	A	A
SK2314	Thoracic	2	A	P	A	A
SK2317	Thoracic	2	A	P	A	A
SK2319	Thoracic?	2	A	P?	P?	A
SK2321	Thoracic	2	A	A	P	A
SK2322	Thoracic	2	A	A	P	A
SK2323	Thoracic?	2	P	A	A	A
SK2325	Thoracic	3	P	A	A	A
SK2326	Thoracic	1	P	A	A	A
SK2328	Thoracic	2	P	A	A	A
SK2329	Thoracic	2	A	P	A	A
SK2330	Thoracic	1	P	A	A	A
SK2333	Thoracic	1	P	A	A	A
SK2335	Thoracic	2	P	A	A	A
SK2336	Thoracic	1	P	A	A	A
SK2337	Thoracic	1	P	A	A	A
SK2338	Thoracic	2	A	A	P	A
SK2339	Thoracic	1	P	A	A	A
SK2340	Thoracic?	1	P	A	A	A
SK2341	Thoracic?	2	P	A	A	A
SK2342	Thoracic	1	P	A	A	A
SK2343	Thoracic	2	P	A	A	A
SK2353	Thoracic	1	A	P	A	A
SK2354	Thoracic	1	A	P	A	A
SK2355	Thoracic	1	A	A	P	A
SK2356	Thoracic	1	A	P	A	A
SK2357	Thoracic	1	A	P	P	A
SK2361	Thoracic	1	A	P?	A	A
SK2362	Thoracic	2	A	A	P?	A
SK2364	Thoracic	1	A	A	P	A
SK2370	Thoracic	1	A	A	P	A
SK2381	Thoracic	1	A	A	A	P
SK2384	Thoracic	1	A	A	P	A
SK2385	Thoracic	1	A	P	A	A
SK2386	Thoracic	2	A	A	P	A
SK2389	Thoracic	1	A	P	P	P
SK2397	Thoracic	1	A	P	A	A

SK2399	Thoracic?	2	A	A	P?	A
SK2404	Thoracic	2	A	P	A	A
SK2407	Thoracic	1	A	A	P	A
SK2410	Thoracic	2	A	P	A	A
SK2413	Thoracic	1	A	P	A	A
SK2420	Thoracic	1	A	P	A	A
SK2421	Thoracic	1	A	P	A	A
SK2424	Thoracic?	1	P	A	A	A
SK2427	Thoracic	3	A	A	P	A
SK2432	Thoracic?	2	A	A	P	A
SK2435	Thoracic	1	A	A	P	A
SK2436	Thoracic?	1	A	P?	P?	A
SK2440	Thoracic?	1	A	P?	A	A
SK1705	Thoracic	2	A	P	A	A
SK2598	Thoracic	1	P	A	A	A
TP	**-**	**-**	**57**	**100**	**84**	**49**
TP?	**-**	**-**	**0**	**7**	**7**	**0**
Total	**-**	**-**	**57**	**107**	**91**	**49**
SK	**LB=133**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**
SK2091	Lumbar	3	A	A	P	A
SK2106	Lumbar	1	A	P	P	P
SK2107	Lumbar	2	A	P	P	P
SK2108	Lumbar	1	A	P	P	P
SK2109	Lumbar	1	A	P	P	P
SK2110	Lumbar	1	A	P	P	P
SK2111	Lumbar	1	P	A	P	P
SK2112	Lumbar	2	A	P	P	P
SK2113	Lumbar	2	P	P	P	P
SK2114	Lumbar	2	P	P	P	P
SK2116	Lumbar	1	A	P	P	P
SK2117	Lumbar	2	A	P	P	A
SK2118	Lumbar	2	A	P	P	P
SK2119	Lumbar	2	A	P	P	P
SK2120	Lumbar	1	A	P	P	A
SK2121	Lumbar	2	A	P	P	A
SK2122	Lumbar	1	A	P	P	A
SK2123	Lumbar	1	A	P	A	A
SK2124	Lumbar	2	A	P	A	A

SK2125	Lumbar	2	A	A	P	A
SK2126	Lumbar	1	A	P	A	A
SK2127	Lumbar	2	A	A	P	A
SK2128	Lumbar	2	A	A	P	A
SK2129	Lumbar	2	A	A	P	A
SK2130	Lumbar	2	A	P	A	A
SK2131	Lumbar	2	A	P	A	A
SK2132	Lumbar	2	A	P	A	A
SK2133	Lumbar	1	A	A	P	A
SK2134	Lumbar	1	A	P	P	P
SK2135	Lumbar	2	A	P	P	P
SK2136	Lumbar	1	A	P	P	P
SK2137	Lumbar	2	A	P	P	P
SK2138	Lumbar	2	A	P	P	A
SK2139	Lumbar	2	A	P	P	P
SK2140	Lumbar	2	P	P	P	P
SK2141	Lumbar	1	A	P	P	A
SK2142	Lumbar	2	A	P	P	A
SK2143	Lumbar	1	A	P	P	A
SK2144	Lumbar	2	A	A	P	P
SK2145	Lumbar	2	A	A	P	P
SK2146	Lumbar	2	A	P	A	A
SK2147	Lumbar	1	A	P	A	A
SK2148	Lumbar	2	A	P	A	A
SK2149	Lumbar	1	P	P	A	A
SK2150	Lumbar	2	A	P	P	A
SK2151	Lumbar	2	A	A	P	A
SK2152	Lumbar	2	A	P	P	A
SK2153	Lumbar	2	A	A	P	A
SK2154	Lumbar	3	A	A	P	A
SK2158	Lumbar?	4	A	A	P	A
SK2159	Lumbar	2	P	A	A	A
SK2161	Lumbar	2	A	P	A	A
SK2163	Lumbar	2	A	P	P	P
SK2164	Lumbar	4	A	P	P	A
SK2166	Lumbar	2	A	P	P	P
SK2167	Lumbar	4	A	P	P	A
SK2170	Lumbar	3	A	P	P	P
SK2172	Lumbar	2	A	A	P	A
SK2175	Lumbar	3	A	A	P	A
SK2189	Lumbar	1	P	A	A	A
SK2190	Lumbar	2	A	A	P	A

SK2191	Lumbar	2	A	A	P	A
SK2192	Lumbar	3	A	P	A	A
SK2193	Lumbar	2	A	A	P	A
SK2194	Lumbar	2	A	P	A	A
SK2195	Lumbar	4	A	P	A	A
SK2260	Lumbar	1	A	A	P	P
SK2267	Lumbar	2	A	P	P	A
SK2269	Lumbar	2	A	P	A	A
SK2270	Lumbar	2	A	A	P	A
SK2271	Lumbar	2	A	A	P	A
SK2272	Lumbar	3	A	A	P	A
SK2273	Lumbar	2	A	A	P	A
SK2274	Lumbar?	2	A	P	P	A
SK2275	Lumbar	2	A	P	A	A
SK2276	Lumbar	1	A	A	P	A
SK2277	Lumbar	2	A	P	A	A
SK2278	Lumbar	2	A	A	P	A
SK2279	Lumbar	3	A	P	A	A
SK2280	Lumbar	1	A	A	P	A
SK2281	Lumbar	2	A	P	A	A
SK2293	Lumbar	2	A	A	P	A
SK2296	Lumbar	1	A	P	A	A
SK2297	Lumbar	1	A	P?	P?	A
SK2312	Lumbar	2	A	A	A	P
SK2315	Lumbar?	2	A	P?	P?	A
SK2318	Lumbar	1	P	A	A	A
SK2320	Lumbar	1	P	A	A	A
SK2327	Lumbar	2	A	A	P	A
SK2345	Lumbar?	1	P	A	A	A
SK2351	Lumbar	2	A	P	A	P
SK2352	Lumbar	3	A	A	P	A
SK2358	Lumbar	1	A	A	P	A
SK2359	Lumbar	3	A	P	A	A
SK2371	Lumbar	2	A	A	P	A
SK2372	Lumbar	3	A	A	P	A
SK2373	Lumbar	2	A	A	P	A
SK2374	Lumbar	3	A	P	A	A
SK2375	Lumbar	2	A	A	P	A
SK2376	Lumbar	1	A	A	P	A
SK2377	Lumbar	1	A	A	P?	A
SK2378	Lumbar	2	A	P	A	A
SK2379	Lumbar	2	A	A	P	A

SK2382	Lumbar?	2	A	P	P	A
SK2383	Lumbar	2	A	P	P	A
SK2390	Lumbar	2	A	P	A	A
SK2391	Lumbar?	2	A	A	P	A
SK2392	Lumbar	2	A	P	A	A
SK2393	Lumbar	3	A	P	P	A
SK2394	Lumbar	2	A	A	P	A
SK2396	Lumbar	2	A	A	P	A
SK2398	Lumbar	3	A	A	P	A
SK2402	Lumbar	3	A	A	P	A
SK2403	Lumbar	1	A	A	P	A
SK2405	Lumbar	2	A	P?	A	A
SK2406	Lumbar	2	A	P	A	A
SK2408	Lumbar	2	A	A	P	A
SK2409	Lumbar	3	A	A	P	A
SK2412	Lumbar	1	A	P	A	A
SK2414	Lumbar	1	A	P?	P?	A
SK2418	Lumbar	1	A	A	P	A
SK2422	Lumbar	2	A	A	P	A
SK2425	Lumbar?	2	A	A	P?	A
SK2430	Lumbar	3	A	A	P	A
SK2431	Lumbar	2	A	A	P	A
SK2433	Lumbar	1	P	A	P	A
SK2434	Lumbar	1	A	P?	P?	A
SK2438	Lumbar	2	A	A	P	A
SK2439	Lumbar	2	A	P	A	A
SK2442	Lumbar?	4	A	A	P	A
SK2443	Lumbar	2	A	A	P	A
SK2619	Lumbar	2	A	P	A	A
SK2657	Lumbar	3	A	P	P	P
TP	**-**	**-**	**11**	**68**	**90**	**27**
TP?	**-**	**-**	**0**	**5**	**6**	**0**
Total	**-**	**-**	**11**	**73**	**96**	**27**
SK	**?= 30**	**WG**	**Z1**	**Z2**	**Z3**	**Z4**
SK2155	?	1	P	A	A	A
SK2156	?	1	P	A	A	A
SK2157	?	1	P	A	A	A
SK2239	?	2	P	A	A	A
SK2240	?	1	P	A	A	A
SK2243	?	2	P	A	A	A

SK2244	?	3	A	P?	P?	A
SK2246	?	4	A	P?	P?	A
SK2248	?	2	P	A	A	A
SK2249	?	2	A	P?	P?	A
SK2250	?	2	P	A	A	A
SK2251	?	2	A	A	P	A
SK2253	?	2	A	P?	P?	A
SK2254	?	1	A	A	P	A
SK2255	?	2	A	P?	P?	A
SK2256	?	1	P	A	A	A
SK2257	?	2	A	P?	P?	A
SK2258	?	3	A	P	A	A
SK2344	?	1	P	A	A	A
SK2346	?	1	P	A	A	A
SK2347	?	2	P	A	A	A
SK2348	?	1	P	A	A	A
SK2349	?	1	P	A	A	A
SK2350	?	2	P	A	A	A
SK2380	?	1	P	A	A	A
SK2419	?	1	P	A	A	A
SK2423	?	1	P	A	A	A
SK2426	?	2	P	A	A	A
SK2428	?	1	P	A	A	A
SK2618	?	2	P	A	A	A
TP	**-**	**-**	**21**	**1**	**2**	**0**
TP?	**-**	**-**	**0**	**6**	**6**	**0**
Total	**-**	**-**	**21**	**7**	**8**	**0**

Clavicles

SK	**SL=14**	**WG**	**Z1**	**Z2**	**Z3**
SK1086	L	3	P	A	P
SK1067	L	1	P	P	P
SK1078	L	4	P	P	P
SK1080	L	1	P	P	P
SK1082	L	2	P	P	P
SK1087	L	3	P	P	P
SK1088	L?	5	P	P	P

SK1089	L	5	P?	P	P
SK1090	L	4	A	P	P
SK1093	L	2	P	A	P
SK1094	L	2	P	A	P
SK1097	L?	2	P	A	P
SK1098	L	3	A	P	P
SK1105	L	3	P	P	P
TP	**-**	**-**	**11**	**10**	**14**
TP?	**-**	**-**	**1**	**0**	**0**
Total	**-**	**-**	**12**	**10**	**14**

SK	**SR=20**	**WG**	**Z1**	**Z2**	**Z3**
SK1063	R	2	P	P	P
SK1064	R	3	P	P	P
SK1065	R	1	P	P	P
SK1066	R	2	P	P	P
SK1068	R	1	P	P	P
SK1070	R	3	P?	P	P
SK1071	R	4	P	P	P
SK1072	R	3	P?	P	P
SK1076	R	1	P	P	P
SK1077	R	1	P	P	P
SK1083	R	1	P	P	P
SK1084	R	1	A	P	P
SK1085	R	2	P	A	P?
SK1091	R	2	P	A	P
SK1096	R?	4	A	P	P
SK1099	R?	2	P?	A	P
SK1100	R?	3	A	P	A
SK1101	R	4	P	P	P
SK1102	R	1	A	P	P
SK1103	R?	2	A	A	P
TP	**-**	**-**	**12**	**16**	**18**
TP?	**-**	**-**	**3**	**0**	**1**
Total	**-**	**-**	**15**	**16**	**19**

SK	**S?=8**	**WG**	**Z1**	**Z2**	**Z3**
SK1073	?	2	A	A	P
SK1074	?	4	P?	P	P?

SK1075	?	1	A	P	A
SK1079	?	2	A	A	P
SK1081	?	3	A	A	P
SK1092	?	3	A	A	P
SK1095	?	3	P?	P?	P
SK1104	?	4	A	A	P
TP	**-**	**-**	**0**	**2**	**6**
TP?	**-**	**-**	**2**	**1**	**1**
Total	**-**	**-**	**2**	**3**	**7**

Metacarpals

SK	**SL= 29**	**WG**	**Z1**	**Z2**	**Z3**
SK0908	L	1	P	P	P
SK0924	L	1	P	P	P
SK0929	L?	1	P	P	P
SK0942 B	L	2	A	P	P
SK1383	L	2	A	A	P
SK0927	L	2	P	A	P
SK1378	L	1	A	A	P
SK1380	L	2	A	A	P
SK1390	L	2	A	A	P
SK1552	L?	2	A	A	P
SK1781	L?	2	P	A	P
SK1678	L	2	P	A	P
SK0910	L	1	P	A	P
SK0923	L	1	P	P	P
SK0928	L	2	P	A	P
SK0942 A	L	1	P	A	P
SK1058	L	2	P	A	P
SK1384	L	2	A	A	P
SK1573	L	1	A	A	A
SK0939	L	1	A	P	P
SK1061	L	1	A	A	P
SK1377	L	3	P	A	P

SK1555	L	1	P	A	P
SK1564	L?	2	A	A	P
SK0938	L	1	P	P	P
SK0943	L	1	A	P	P
SK0948	L?	3	A	A	P
SK0969	L?	1	A	A	P
SK1381	L	2	A	A	P
TP	**-**	**-**	**14**	**8**	**28**
TP?	**-**	**-**	**0**	**0**	**0**
Total	**-**	**-**	**14**	**8**	**28**
SK	**SR= 35**	**W G**	**Z1**	**Z2**	**Z3**
SK0907	R	1	P	P	P
SK0933	R	2	P	P	P
SK0944	R?	1	A	P	P
SK1060	R	2	A	P?	P
SK1584	R?	1	P	P	P
SK1590	R	1	A	P	P
SK1761	R?	1	P	A	P
SK0906	R	1	P	A	P
SK0926	R	1	P	A	P
SK0932	R	1	P	A	P
SK0934	R?	1	A	P	P
SK1382	R	2	A	A	P
SK1753	R	1	P	A	A
SK0905	R	1	P	P	P
SK0909	R	1	P	A	P
SK0912	R?	1	P	A	P
SK0921	R	0	P	P	P
SK0931	R	1	P	A	P
SK1062	R	1	P	A	P
SK1376	R	2	A	A	P
SK1379	R	1	A	A	P
SK1392	R?	1	A	A	P
SK1671	R	2	P	A	P
SK0935	R?	1	A	P	P
SK1059	R?	1	P	A	P
SK1561	R	1	P	A	P
SK1578	R	1	P	A	P
SK1623	R	1	P	A	A

SK1747	R	2	P	A	P
SK1969	R	1	P	A	A
SK0937	R	1	P	P	P
SK0940	R	1	P	A	P
SK0941	R	1	P	A	P
SK0982	R?	1	A	A	P
SK1050	R	1	A	A	P
TP	**-**	**-**	**24**	**10**	**32**
TP?	**-**	**-**	**0**	**1**	**0**
Total	**-**	**-**	**24**	**11**	**32**
SK	**S?= 48**	**W G**	**Z1**	**Z2**	**Z3**
SK0914	?	1	P	P	P
SK0936		2	A	A	P
SK0984	?	3	A	A	P
SK1547	?	1	A	P	A
SK1550	?	3	A	A	P
SK1551	?	4	A	A	P
SK1553	?	3	A	A	P
SK1554	?	2	A	A	P
SK1558	?	3	A	A	P
SK1560	?	3	A	A	P
SK1562	?	1	A	A	P
SK1565	?	2	A	A	P
SK1568	?	3	A	A	P
SK1569	?	3	A	A	P
SK1570	?	3	A	A	P
SK1571	?	2	A	A	P
SK1572	?	4	A	A	P
SK1574	?	2	A	A	P
SK1580	?	2	A	P	P
SK1581	?	3	A	A	P
SK1583	?	1	A	A	P
SK1585	?	4	A	A	P
SK1586	?	1	A	A	P
SK1587	?	2	A	A	P
SK1709	?	1	A	A	P
SK1713	?	2	A	A	P
SK1716	?	1	A	A	P
SK1717	?	2	A	P	P

SK1718	?	2	A	A	P
SK1719	?	1	A	A	P
SK1723	?	1	A	P	A
SK1726	?	3	A	A	P
SK1727	?	2	A	A	P
SK1728	?	2	A	A	P
SK1734	?	4	A	A	P
SK1739	?	4	A	A	P
SK1740	?	3	A	A	P
SK1746	?	4	A	A	P
SK1749	?	1	A	P	A
SK1755	?	3	A	A	P
SK1758	?	1	A	A	P
SK1777	?	1	A	P	A
SK1847	?	1	A	P	P
SK1884	?	1	P	A	A
SK1971	?	3	A	A	P
SK1972	?	1	A	A	P
SK2644	?	2	A	P	A
SK0974	?	2	A	A	P
TP	**-**	**-**	**2**	**9**	**42**
TP?	**-**	**-**	**0**	**0**	**0**
Total	**-**	**-**	**2**	**9**	**42**

Metatarsals

SK	**SL=39**	**WG**	**Z1**	**Z2**	**Z3**
SK0945	L	1	A	A	P
SK1592	L	4	P	P	P
SK1603	L	2	A	P	P
SK1659	L	2	P	A	P
SK1659	L	2	P	A	P
SK1660	L	1	A	P	P
SK1660	L	1	A	P	P
SK1661	L	2	A	P	P
SK1661	L	2	A	P	P
SK1663	L	1	A	P	P

SK1663	L	1	A	P	P
SK1679	L?	2	A	P	A
SK1707	L	2	A	P	P
SK1685	L?	1	A	P	A
SK1858	L	3	A	P	A
SK1872	L?	1	A	P	A
SK0957	L	1	P	A	P
SK0970	L?	1	P	A	P
SK1606	L	2	P	A	P
SK1782	L	1	P	A	P
SK0950	L	2	P	A	P
SK1598	L	2	P	P	A
SK1676	L	1	P	A	P
SK0913	L	1	P	A	P
SK1601	L	1	P	P	P
SK1614	L	2	P	A	P
SK1657	L	1	P	A	P
SK1891	L	1	P	A	A
SK1896	L	2	P	A	A
SK2614	L	3	P	A	P
SK0955	L?	1	A	A	P
SK0963	L?	2	P	A	P
SK0967	L?	2	A	A	P
SK0972	L?	1	A	A	P
SK1605	L	2	P	P	P
SK1616	L	2	A	A	P
SK1618	L	2	P	A	P
SK0916	L?	2	P	A	P
SK1622	L?	1	P	A	P
TP	**-**	**-**	**22**	**16**	**32**
TP?	**-**	**-**	**0**	**0**	**0**
Total	**-**	**-**	**22**	**16**	**32**
SK	**SR=50**	**WG**	**Z1**	**Z2**	**Z3**
SK0911	R?	1	P	A	P
SK0920	R?	1	P	A	P
SK0958	R	2	A	A	P
SK1563	R?	3	A	A	P
SK1591	R	2	P	P	P
SK1594	R	1	P	P	P

SK1595	R	1	P	A	P
SK1597	R	1	P	P	P
SK1610	R	1	A	A	P
SK1617	R	2	A	A	P
SK1702	R	2	A	A	P
SK1596	R	2	P	P	P
SK1602	R	2	P	A	P
SK1608	R	2	P	A	P
SK1611	R	2	P	A	P
SK1612	R	1	P	A	P
SK1619	R	2	P	A	P
SK1691	R	2	P	A	P
SK0976	R?	2	P	A	P
SK1588	R	1	P	A	A
SK1593	R	2	P	A	P
SK1609	R	3	P	A	P
SK1654	R	1	P	P	P
SK1688	R	1	P	A	P
SK1559	R?	3	A	A	P
SK1621	R	1	P	P	P
SK1689	R	1	P	A	A
SK1698	R	1	P	P	P
SK1684	R	2	P	A	P
SK0946	R	2	P	A	P
SK0951	R	1	A	A	P
SK0954	R	0	P	A	P
SK0956	R?	1	P	A	P
SK0960	R	1	P	A	P
SK0961	R?	1	P	A	P
SK1556	R?	2	A	A	P
SK1557	R	1	P	A	P
SK1576	R?	2	A	A	P
SK1579	R?	3	A	A	P
SK1599	R	1	P	A	P
SK1600	R	1	P	A	P
SK1604	R	1	P	A	P
SK1613	R	1	P	A	P
SK1680	R	1	P	A	P
SK1708	R	1	P	A	P
SK1892	R?	2	P	A	A
SK1743	R	1	P	A	A
SK0915	R	1	P	P	A

SK1548	R?	1	A	A	P
SK1582	R?	2	A	P	P
TP	**-**	**-**	**38**	**9**	**45**
TP?	**-**	**-**	**0**	**0**	**0**
Total	**-**	**-**	**38**	**9**	**45**
SK	**S?= 44**	**W G**	**Z1**	**Z2**	**Z3**
SK0917	?	3	P	A	P
SK0949	?	2	A	A	P
SK0952	?	0	A	A	P
SK0953	?	4	A	A	P
SK0959	?	2	A	A	P
SK0962	?	2	A	A	P
SK0964	?	4	A	A	P
SK0966	?	2	A	A	P
SK0968	?	3	A	A	P
SK0971	?	2	A	A	P
SK0973	?	1	P	A	P
SK0975	?	3	A	A	P
SK0983	?	3	A	A	P
SK1549	?	1	A	A	P
SK1566	?	4	A	A	P
SK1567	?	3	A	A	P
SK1577	?	1	A	A	P
SK1615	?	3	A	A	P
SK1655	?	1	A	P	P
SK1656	?	1	A	P	P
SK1658	?	2	A	A	P
SK1662	?	2	A	A	P
SK1662	?	2	A	A	P
SK1664	?	1	A	P	P
SK1664	?	1	A	P	P
SK1665	?	1	A	A	P
SK1665	?	1	A	A	P
SK1703	?	2	A	A	P
SK1710	?	1	A	A	P
SK1712	?	2	A	A	P
SK1714	?	1	A	A	P
SK1715	?	2	A	A	P
SK1729	?	3	A	A	P

SK1733	?	1	P	A	A
SK1757	?	1	P	A	A
SK1760	?	1	A	P	A
SK1765	?	1	A	A	P
SK1766	?	4	A	A	P
SK1780	?	3	A	A	P
SK1882	?	2	P	A	A
SK1883	?	2	A	P	A
SK1894	?	1	A	P	A
SK1899	?	1	A	P	A
SK1970	?	2	A	P	A
TP	**-**	**-**	**5**	**9**	**36**
TP?	**-**	**-**	**0**	**0**	**0**
Total	**-**	**-**	**5**	**9**	**36**

Carpals

SK	**SL= 24**	**WG**
SK1759	L?	1
SK1779	L	1
SK1783	L	1
SK1785	L	1
SK1787	L	2
SK1789	L	2
SK1790	L	1
SK1791	L	1
SK1793	L	1
SK1794	L	1
SK1795	L	1
SK1796	L	1
SK1798	L	1
SK1800	L	1
SK1801	L	1
SK1804	L	1
SK1807	L	1
SK1808	L	1
SK1810	L	1

SK1811	L	1
SK1814	L	1
SK1816	L	1
SK1878	L	1
SK1906	L	2
SK	**SR= 21**	**WG**
SK1763	R	1
SK1764	R	1
SK1784	R	1
SK1786	R	1
SK1788	R	1
SK1792	R	2
SK1797	R	1
SK1799	R	1
SK1802	R	1
SK1803	R	1
SK1805	R	2
SK1806	R	2
SK1809	R?	1
SK1812	R	2
SK1813	R	1
SK1815	R	1
SK1817	R	1
SK1895	R	1
SK1897	R	1
SK1968	R?	1
SK2613	R	1

Tarsals

SK	**SL= 33**	**WG**
SK1700	L	1
SK1682	L	1
SK1683	L	1

SK1767	L?	1
SK1818	L	2
SK1820	L	1
SK1821	L	2
SK1822	L	2
SK1823	L	2
SK1824	L	2
SK1825	L	2
SK1827	L?	2
SK1829	L	2
SK1830	L	2
SK1834	L	2
SK1835	L	2
SK1836	L	1
SK1841	L	2
SK1843	L?	2
SK1846	L	2
SK1848	L	2
SK1849	L	3
SK1850	L?	1
SK1853	L	1
SK1856	L	1
SK1859	L	1
SK1869	L	2
SK1873	L	1
SK1890	L	2
SK1900	L	2
SK1904	L	2
SK2616	L	3
SK2617	L	2
SK	**SR= 27**	**WG**
SK1699	R	2
SK1694	R	1
SK1696	R	1
SK1687	R?	1
SK1690	R	1
SK1692	R	1
SK1681	R	1
SK1819	R	1

SK1826	R	1
SK1828	R	2
SK1831	R	2
SK1832	R	1
SK1833	R	1
SK1837	R	1
SK1838	R	2
SK1839	R	1
SK1840	R	1
SK1842	R	1
SK1845	R?	1
SK1852	R	1
SK1862	R	1
SK1864	R	2
SK1866	R	1
SK1868	R	2
SK1879	R	1
SK1905	R	1
SK2615	R?	2
SK	**S?= 7**	**WG**
SK1704	?	1
SK1768	?	1
SK1769	?	1
SK1770	?	2
SK1851	?	1
SK1867	?	1
SK1877	?	1

Tali

SK	**SL= 17**	**WG**	**Z1**	**Z2**	**Z3**
SK1269	L	2	P	P	P
SK1270	L	2	P	P	P
SK1271	L	2	P	P	P

SK1272	L	2	P	P	P
SK1273	L	2	P	P	P
SK1274	L	2	P	P	P?
SK1275	L	2	P	P	P
SK1276	L	2	P	P	P
SK1277	L	2	P	P	P
SK1278	L	2	P	P	A
SK1279	L	2	P	P	P
SK1280	L	2	P	P	P
SK1281	L	2	P	P	A
SK1282	L?	2	P	P	A
SK1283	L?	2	P	P	A
SK1284	L?	2	P	P	P?
SK2645	L?	2	P	P	A
TP	**-**	**-**	**17**	**17**	**10**
TP?	**-**	**-**	**0**	**0**	**2**
Total	**-**	**-**	**17**	**17**	**12**
SK	**SR= 17**	**WG**	**Z1**	**Z2**	**Z3**
SK1256	R	2	P	P	P
SK1257	R	2	P	P	P
SK1258	R	2	P	P	P?
SK1259	R	2	P	P	P
SK1260	R	2	P	P	P
SK1261	R	2	P	P	P
SK1262	R	2	P	P	P
SK1263	R	2	P	P	P
SK1264	R	2	P	P	P?
SK1265	R	3	P	P	A
SK1266	R	2	P	P	P
SK1267	R	2	P	P	A
SK1268	R	2	P	P	P?
SK1285	R?	2	P	P	A
SK1686	R	1	P	P	A
SK1888	R?	2	A	P	A
SK1901	R	2	P	P	A
TP	**-**	**-**	**16**	**17**	**8**
TP?	**-**	**-**	**0**	**0**	**3**
Total	**-**	**-**	**16**	**17**	**11**

SK	**S?= 3**	**WG**	**Z1**	**Z2**	**Z3**
SK1286	?	2	P	P	A
SK1287	?	2	P	P	P?
SK1889	?	1	P	P	A
TP	-	-	3	3	0
TP?	-	-	0	0	1
Total	-	-	3	3	1

Calcanei

SK	**SL= 19**	**WG**	**Z1**	**Z2**	**Z3**
SK1106	L	2	P	P	P
SK1107	L	2	P	P	P
SK1108	L	1	P	P	P
SK1109	L	1	A	P	P
SK1110	L	2	P	P	P
SK1113	L	3	P	P	P
SK1119	L	2	a	a	p
SK1120	L	2	A	P	P
SK1111	L	1	P	P	P
SK1243	L	2	A	P	P
SK1244	L	2	A	A	P
SK1245	L	2	A	A	P
SK1246	L	2	A	P	P
SK1247	L	3	A	P	P
SK1248	L	2	A	P	P
SK1249	L	2	A	A	P
SK1250	L?	2	A	A	P
SK1854	L	1	A	A	P
SK2635	L	1	A	A	P
TP	**-**	**-**	**6**	**12**	**19**
TP?	**-**	**-**	**0**	**0**	**0**
Total	**-**	**-**	**6**	**12**	**19**

SK	**SR= 15**	**WG**	**Z1**	**Z2**	**Z3**
SK1112	R	1	P	P	P
SK1114	R	3	p	p	p
SK1115	R	2	p	p	p
SK1116	R	2	P	P	P
SK1117	R	3	a	p	p
SK1118	R	2	P	P	P
SK1121	R	2	A	P	P
SK1251	R	3	A	P	P
SK1252	R	2	A	A	P
SK1253	R	2	A	P	P
SK1254	R	2	A	A	P
SK1255	R?	2	A	A	P?
SK1693	R	1	A	P	P
SK1855	R?	1	A	A	P
SK2636	R?	1	A	A	P
TP	**-**	**-**	**5**	**10**	**14**
TP?	**-**	**-**	**0**	**0**	**1**
Total	**-**	**-**	**5**	**10**	**15**
SK	**S?= 11**	**WG**	**Z1**	**Z2**	**Z3**
SK1870	?	1	A	A	P?
SK1871	?	1	A	A	A
SK1875	?	1	P	A	A
SK1880	?	2	A	A	A
SK1881	?	2	A	P	P
SK1893	?	1	P	A	A
SK1902	?	2	P	P	A
SK1903	?	2	P	A	A
SK2637	?	2	A	A	A
SK2638	?	3	P	P	A
SK2639	?	1	P	P	A
TP	**-**	**-**	**6**	**4**	**1**
TP?	**-**	**-**	**0**	**0**	**1**
Total	**-**	**-**	**6**	**4**	**2**

Appendix C: Summary of Weathering Results

The weathering results are organized by bone based on the heading Bone 1. The darker outline around cells indicates the bone is statistically more weathered than its comparison on the same row. Significance is also marked by Y for yes, in the significant column. Comparisons were significant if the p-value was less than 0.05 based on the bone fragment totals and median.

Key

Abbreviation	Meaning
Bone 1, 2	Bone fragments compared against each other
M	Median bone weathering score
Total # BF	The total number of bone fragments
Significant	P-value is less than 0.05, so the difference between bones is statistically significant.
Y	There is a statistically significant difference between bones
N	There is no statistically significant difference between bones
Cranial Frags	Cranial Fragments
*	Error report from Minitab 16, bone excluded from analysis

Bone 1	**M**	**Total # BF**	**Bone 2**	**M**	**Total # BF**	**P-value (0.05)**	**Significant (Y/N)**
L Clavicles	3	14	R Clavicle	2	20	0.1165	N
L Clavicles	3	14	L Femora	2	42	0.0029	Y
L Clavicles	3	14	R Femora	1	40	0.0004	Y
L Clavicles	3	14	L Tibiae	2	35	0.0039	Y
L Clavicles	3	14	R Tibiae	2	36	0.0019	Y
L Clavicles	3	14	L Fibulae	2	29	0.4550	N
L Clavicles	3	14	R Fibulae	2	32	0.2549	N
L Clavicles	3	14	L Humeri	2	28	0.0836	N
L Clavicles	3	14	R Humeri	2	31	0.0173	Y
L Clavicles	3	14	L Ulnae	2	27	0.0605	N

L Clavicles	3	14	R Ulnae	2	31	0.0920	N
L Clavicles	3	14	L Radii	2	24	0.1505	N
L Clavicles	3	14	R Radii	3	31	0.4324	N
L Clavicles	3	14	L Scapulae	2	36	0.0345	Y
L Clavicles	3	14	R Scapulae	2	29	0.0124	Y
L Clavicles	3	14	L Ribs	1	110	0.0000	Y
L Clavicles	3	14	R Ribs	1	103	0.0000	Y
L Clavicles	3	14	Vertebrae C	2	87	0.0001	Y
L Clavicles	3	14	Vertebrae T	1	186	0.0000	Y
L Clavicles	3	14	Vertebrae L	2	133	0.0035	Y
L Clavicles	3	14	L Metacarpals	2	29	0.0009	Y
L Clavicles	3	14	R Metacarpals	1	35	0.0000	Y
L Clavicles	3	14	L Metatarsals	2	39	0.0008	Y
L Clavicles	3	14	R Metatarsals	1	50	0.0001	Y
L Clavicles	3	14	L Carpals	1	24	0.0000	Y
L Clavicles	3	14	R Carpals	1	21	0.0000	Y
L Clavicles	3	14	L Tarsals	2	33	0.0018	Y
L Clavicles	3	14	R Tarsals	1	27	0.0000	Y
L Clavicles	3	14	L Talus	*	*	*	*
L Clavicles	3	14	R Talus	2	17	0.0247	Y
L Clavicles	3	14	L Calcanei	2	19	0.0132	Y
L Clavicles	3	14	R Calcanei	2	15	0.0414	Y
L Clavicles	3	14	Sternums	2.5	6	0.7660	N
L Clavicles	3	14	L Innominates	2	48	0.0435	Y
L Clavicles	3	14	R Innominates	2	44	0.1623	N
L Clavicles	3	14	Sacra	2	15	0.0049	Y
L Clavicles	3	14	L Patellae	2	12	0.0381	Y
L Clavicles	3	14	R Patellae	2	13	0.1884	N
L Clavicles	3	14	Mandibles	1	32	0.0003	Y
L Clavicles	3	14	Maxillae	1	25	0.0001	Y
L Clavicles	3	14	Cranial Frags	2	163	0.0025	Y
R Clavicles	2	20	L Femora	2	42	0.1748	N
R Clavicles	2	20	R Femora	1	40	0.0438	Y
R Clavicles	2	20	L Tibiae	2	35	0.2038	N
R Clavicles	2	20	R Tibiae	2	36	0.1510	N
R Clavicles	2	20	L Fibulae	2	29	0.1738	N
R Clavicles	2	20	R Fibulae	2	32	0.3500	N
R Clavicles	2	20	L Humeri	2	28	1.0000	N
R Clavicles	2	20	R Humeri	2	31	0.4302	N

R Clavicles	2	20	L Ulnae	2	27	0.9461	N
R Clavicles	2	20	R Ulnae	2	31	0.8557	N
R Clavicles	2	20	L Radii	2	24	0.6657	N
R Clavicles	2	20	R Radii	3	31	0.2078	N
R Clavicles	2	20	L Scapulae	2	36	0.9134	N
R Clavicles	2	20	R Scapulae	2	29	0.4559	N
R Clavicles	2	20	L Ribs	1	110	0.0171	Y
R Clavicles	2	20	R Ribs	1	103	0.0042	Y
R Clavicles	2	20	Vertebrae C	2	87	0.0459	Y
R Clavicles	2	20	Vertebrae T	1	186	0.0052	Y
R Clavicles	2	20	Vertebrae L	2	133	0.5527	N
R Clavicles	2	20	L Metacarpals	2	29	0.0777	N
R Clavicles	2	20	R Metacarpals	1	35	0.0001	Y
R Clavicles	2	20	L Metatarsals	2	39	0.0898	N
R Clavicles	2	20	R Metatarsals	1	50	0.0195	Y
R Clavicles	2	20	L Carpals	1	24	0.0002	Y
R Clavicles	2	20	R Carpals	1	21	0.0012	Y
R Clavicles	2	20	L Tarsals	2	33	0.2224	N
R Clavicles	2	20	R Tarsals	1	27	0.0017	N
R Clavicles	2	20	L Talus	*	*	*	*
R Clavicles	2	20	R Talus	2	17	0.9792	N
R Clavicles	2	20	L Calcanei	2	19	0.5073	N
R Clavicles	2	20	R Calcanei	2	15	0.7117	N
R Clavicles	2	20	Sternums	2.5	6	0.4118	N
R Clavicles	2	20	L Innominates	2	48	0.7935	N
R Clavicles	2	20	R Innominates	2	44	0.2640	N
R Clavicles	2	20	Sacra	2	15	0.1557	N
R Clavicles	2	20	L Patellae	2	12	0.7544	N
R Clavicles	2	20	R Patellae	2	13	0.6127	N
R Clavicles	2	20	Mandibles	1	32	0.0316	Y
R Clavicles	2	20	Maxillae	1	25	0.0055	Y
R Clavicles	2	20	Cranial Frags	2	163	0.3770	N
L Femora	2	42	R Femora	1	40	0.3518	N
L Femora	2	42	L Tibiae	2	35	0.9779	N
L Femora	2	42	R Tibiae	2	36	0.9091	N
L Femora	2	42	L Fibulae	2	29	0.0005	Y
L Femora	2	42	R Fibulae	2	32	0.0027	Y
L Femora	2	42	L Humeri	2	28	0.1138	N
L Femora	2	42	R Humeri	2	31	0.5590	N
L Femora	2	42	L Ulnae	2	27	0.1176	N

L Femora	2	42	R Ulnae	2	31	0.0432	Y
L Femora	2	42	L Radii	2	24	0.0333	Y
L Femora	2	42	R Radii	3	31	0.0007	Y
L Femora	2	42	L Scapulae	2	36	0.0929	N
L Femora	2	42	R Scapulae	2	29	0.5007	N
L Femora	2	42	L Ribs	1	110	0.2333	N
L Femora	2	42	R Ribs	1	103	0.0584	N
L Femora	2	42	Vertebrae C	2	87	0.5354	N
L Femora	2	42	Vertebrae T	1	186	0.0886	N
L Femora	2	42	Vertebrae L	2	133	0.1098	N
L Femora	2	42	L Metacarpals	2	29	0.5311	N
L Femora	2	42	R Metacarpals	1	35	0.0004	Y
L Femora	2	42	L Metatarsals	2	39	0.6460	N
L Femora	2	42	R Metatarsals	1	50	0.1883	N
L Femora	2	42	L Carpals	1	24	0.0009	Y
L Femora	2	42	R Carpals	1	21	0.0064	Y
L Femora	2	42	L Tarsals	2	33	0.8024	N
L Femora	2	42	R Tarsals	1	27	0.0117	Y
L Femora	2	42	L Talus	*	*	*	*
L Femora	2	42	R Talus	2	17	0.1108	N
L Femora	2	42	L Calcanei	2	19	0.4642	N
L Femora	2	42	R Calcanei	2	15	0.3401	N
L Femora	2	42	Sternums	2.5	6	0.0744	N
L Femora	2	42	L Innominates	2	48	0.0162	Y
L Femora	2	42	R Innominates	2	44	0.0004	Y
L Femora	2	42	Sacra	2	15	0.6717	N
L Femora	2	42	L Patellae	2	12	0.3287	N
L Femora	2	42	R Patellae	2	13	0.0371	Y
L Femora	2	42	Mandibles	1	32	0.2637	N
L Femora	2	42	Maxillae	1	25	0.0387	Y
L Femora	2	42	Cranial Frags	2	163	0.2857	N
R Femora	1	40	L Tibiae	2	35	0.4115	N
R Femora	1	40	R Tibiae	2	36	0.4047	N
R Femora	1	40	L Fibulae	2	29	0.0000	Y
R Femora	1	40	R Fibulae	2	32	0.0001	Y
R Femora	1	40	L Humeri	2	28	0.0170	Y
R Femora	1	40	R Humeri	2	31	0.1608	N
R Femora	1	40	L Ulnae	2	27	0.0155	Y
R Femora	1	40	R Ulnae	2	31	0.0037	Y

R Femora	1	40	L Radii	2	24	0.0033	Y
R Femora	1	40	R Radii	3	31	0.0000	Y
R Femora	1	40	L Scapulae	2	36	0.0077	Y
R Femora	1	40	R Scapulae	2	29	0.1104	N
R Femora	1	40	L Ribs	1	110	0.9962	N
R Femora	1	40	R Ribs	1	103	0.4605	N
R Femora	1	40	Vertebrae C	2	87	0.5675	N
R Femora	1	40	Vertebrae T	1	186	0.6783	N
R Femora	1	40	Vertebrae L	2	133	0.0034	Y
R Femora	1	40	L Metacarpals	2	29	0.7874	N
R Femora	1	40	R Metacarpals	1	35	0.0058	Y
R Femora	1	40	L Metatarsals	2	39	0.6136	N
R Femora	1	40	R Metatarsals	1	50	0.7382	N
R Femora	1	40	L Carpals	1	24	0.0075	Y
R Femora	1	40	R Carpals	1	21	0.0374	Y
R Femora	1	40	L Tarsals	2	33	0.1904	N
R Femora	1	40	R Tarsals	1	27	0.0769	N
R Femora	1	40	L Talus	*	*	*	*
R Femora	1	40	R Talus	2	17	0.0081	Y
R Femora	1	40	L Calcanei	2	19	0.0990	N
R Femora	1	40	R Calcanei	2	15	0.0783	N
R Femora	1	40	Sternums	2.5	6	0.0249	Y
R Femora	1	40	L Innominates	2	48	0.0004	Y
R Femora	1	40	R Innominates	2	44	0.0000	Y
R Femora	1	40	Sacra	2	15	0.7698	N
R Femora	1	40	L Patellae	2	12	0.0692	N
R Femora	1	40	R Patellae	2	13	0.0035	Y
R Femora	1	40	Mandibles	1	32	0.8442	N
R Femora	1	40	Maxillae	1	25	0.1945	N
R Femora	1	40	Cranial Frags	2	163	0.0150	Y
L Tibiae	2	35	R Tibiae	2	36	0.9850	N
L Tibiae	2	35	L Fibulae	2	29	0.0008	Y
L Tibiae	2	35	R Fibulae	2	32	0.0035	Y
L Tibiae	2	35	L Humeri	2	28	0.1226	N
L Tibiae	2	35	R Humeri	2	31	0.5693	N
L Tibiae	2	35	L Ulnae	2	27	0.1208	N
L Tibiae	2	35	R Ulnae	2	31	0.0478	N
L Tibiae	2	35	L Radii	2	24	0.0349	Y
L Tibiae	2	35	R Radii	3	31	0.0013	Y

L Tibiae	2	35	L Scapulae	2	36	0.0841	N
L Tibiae	2	35	R Scapulae	2	29	0.4378	N
L Tibiae	2	35	L Ribs	1	110	0.3094	N
L Tibiae	2	35	R Ribs	1	103	0.0870	N
L Tibiae	2	35	Vertebrae C	2	87	0.6625	N
L Tibiae	2	35	Vertebrae T	1	186	0.1411	N
L Tibiae	2	35	Vertebrae L	2	133	0.0882	N
L Tibiae	2	35	L Metacarpals	2	29	0.6130	N
L Tibiae	2	35	R Metacarpals	1	35	0.0006	Y
L Tibiae	2	35	L Metatarsals	2	39	0.7336	N
L Tibiae	2	35	R Metatarsals	1	50	0.2339	N
L Tibiae	2	35	L Carpals	1	24	0.0010	Y
L Tibiae	2	35	R Carpals	1	21	0.0070	Y
L Tibiae	2	35	L Tarsals	2	33	0.6631	N
L Tibiae	2	35	R Tarsals	1	27	0.0143	Y
L Tibiae	2	35	L Talus	*	*	*	*
L Tibiae	2	35	R Talus	2	17	0.0593	N
L Tibiae	2	35	L Calcanei	2	19	0.3707	N
L Tibiae	2	35	R Calcanei	2	15	0.2908	N
L Tibiae	2	35	Sternums	2.5	6	0.0717	N
L Tibiae	2	35	L Innominates	2	48	0.0131	Y
L Tibiae	2	35	R Innominates	2	44	0.0003	Y
L Tibiae	2	35	Sacra	2	15	0.7447	N
L Tibiae	2	35	L Patellae	2	12	0.2431	N
L Tibiae	2	35	R Patellae	2	13	0.0275	Y
L Tibiae	2	35	Mandibles	1	32	0.3247	N
L Tibiae	2	35	Maxillae	1	25	0.0476	Y
L Tibiae	2	35	Cranial Frags	2	163	0.2223	N
R Tibiae	2	36	L Fibulae	2	29	0.0002	Y
R Tibiae	2	36	R Fibulae	2	32	0.0014	Y
R Tibiae	2	36	L Humeri	2	28	0.0859	N
R Tibiae	2	36	R Humeri	2	31	0.4759	N
R Tibiae	2	36	L Ulnae	2	27	0.0834	N
R Tibiae	2	36	R Ulnae	2	31	0.0250	Y
R Tibiae	2	36	L Radii	2	24	0.0222	Y
R Tibiae	2	36	R Radii	3	31	0.0003	Y
R Tibiae	2	36	L Scapulae	2	36	0.0628	N
R Tibiae	2	36	R Scapulae	2	29	0.4172	N
R Tibiae	2	36	L Ribs	1	110	0.2791	N
R Tibiae	2	36	R Ribs	1	103	0.0732	N

R Tibiae	2	36	Vertebrae C	2	87	0.6169	N
R Tibiae	2	36	Vertebrae T	1	186	0.1173	N
R Tibiae	2	36	Vertebrae L	2	133	0.0732	N
R Tibiae	2	36	L Metacarpals	2	29	0.5899	N
R Tibiae	2	36	R Metacarpals	1	35	0.0004	Y
R Tibiae	2	36	L Metatarsals	2	39	0.7124	N
R Tibiae	2	36	R Metatarsals	1	50	0.2207	N
R Tibiae	2	36	L Carpals	1	24	0.0007	Y
R Tibiae	2	36	R Carpals	1	21	0.0054	Y
R Tibiae	2	36	L Tarsals	2	33	0.6837	N
R Tibiae	2	36	R Tarsals	1	27	0.0109	Y
R Tibiae	2	36	L Talus	*	*	*	*
R Tibiae	2	36	R Talus	2	17	0.0598	N
R Tibiae	2	36	L Calcanei	2	19	0.3646	N
R Tibiae	2	36	R Calcanei	2	15	0.2607	N
R Tibiae	2	36	Sternums	2.5	6	0.0555	N
R Tibiae	2	36	L Innominates	2	48	0.0084	Y
R Tibiae	2	36	R Innominates	2	44	0.0001	Y
R Tibiae	2	36	Sacra	2	15	0.7245	N
R Tibiae	2	36	L Patellae	2	12	0.2422	N
R Tibiae	2	36	R Patellae	2	13	0.0189	Y
R Tibiae	2	36	Mandibles	1	32	0.2025	N
R Tibiae	2	36	Maxillae	1	25	0.0381	Y
R Tibiae	2	36	Cranial Frags	2	163	0.1835	N
L Fibulae	2	29	R Fibulae	2	32	0.5601	N
L Fibulae	2	29	L Humeri	2	28	0.1117	N
L Fibulae	2	29	R Humeri	2	31	0.0117	Y
L Fibulae	2	29	L Ulnae	2	27	0.0776	Y
L Fibulae	2	29	R Ulnae	2	31	0.1652	N
L Fibulae	2	29	L Radii	2	24	0.2558	N
L Fibulae	2	29	R Radii	3	31	1.0000	N
L Fibulae	2	29	L Scapulae	2	36	0.0322	Y
L Fibulae	2	29	R Scapulae	2	29	0.0049	Y
L Fibulae	2	29	L Ribs	1	110	0.0000	Y
L Fibulae	2	29	R Ribs	1	103	0.0000	Y
L Fibulae	2	29	Vertebrae C	2	87	0.0000	Y
L Fibulae	2	29	Vertebrae T	1	186	0.0000	Y
L Fibulae	2	29	Vertebrae L	2	133	0.0006	Y
L Fibulae	2	29	L Metacarpals	2	29	0.0001	Y

L Fibulae	2	29	R Metacarpals	1	35	0.0000	Y
L Fibulae	2	29	L Metatarsals	2	39	0.0000	Y
L Fibulae	2	29	R Metatarsals	1	50	0.0000	Y
L Fibulae	2	29	L Carpals	1	24	0.0000	Y
L Fibulae	2	29	R Carpals	1	21	0.0000	Y
L Fibulae	2	29	L Tarsals	2	33	0.0002	Y
L Fibulae	2	29	R Tarsals	1	27	0.0000	Y
L Fibulae	2	29	L Talus	*	*	*	*
L Fibulae	2	29	R Talus	2	17	0.0214	Y
L Fibulae	2	29	L Calcanei	2	19	0.0064	Y
L Fibulae	2	29	R Calcanei	2	15	0.0366	Y
L Fibulae	2	29	Sternums	2.5	6	0.9631	N
L Fibulae	2	29	L Innominates	2	48	0.0507	N
L Fibulae	2	29	R Innominates	2	44	0.3517	N
L Fibulae	2	29	Sacra	2	15	0.0012	Y
L Fibulae	2	29	L Patellae	2	12	0.0302	Y
L Fibulae	2	29	R Patellae	2	13	0.3097	N
L Fibulae	2	29	Mandibles	1	32	0.0000	Y
L Fibulae	2	29	Maxillae	1	25	0.0000	Y
L Fibulae	2	29	Cranial Frags	2	163	0.0003	Y
R Fibulae	2	32	L Humeri	2	28	0.2691	N
R Fibulae	2	32	R Humeri	2	31	0.0387	Y
R Fibulae	2	32	L Ulnae	2	27	0.2101	N
R Fibulae	2	32	R Ulnae	2	31	0.4019	N
R Fibulae	2	32	L Radii	2	24	0.5336	N
R Fibulae	2	32	R Radii	3	31	0.5600	N
R Fibulae	2	32	L Scapulae	2	36	0.1140	N
R Fibulae	2	32	R Scapulae	2	29	0.0199	Y
R Fibulae	2	32	L Ribs	1	110	0.0000	Y
R Fibulae	2	32	R Ribs	1	103	0.0000	Y
R Fibulae	2	32	Vertebrae C	2	87	0.0000	Y
R Fibulae	2	32	Vertebrae T	1	186	0.0000	Y
R Fibulae	2	32	Vertebrae L	2	133	0.0053	Y
R Fibulae	2	32	L Metacarpals	2	29	0.0004	Y
R Fibulae	2	32	R Metacarpals	1	35	0.0000	Y
R Fibulae	2	32	L Metatarsals	2	39	0.0003	Y
R Fibulae	2	32	R Metatarsals	1	50	0.0000	Y
R Fibulae	2	32	L Carpals	1	24	0.0000	Y

R Fibulae	2	32	R Carpals	1	21	0.0000	Y
R Fibulae	2	32	L Tarsals	2	33	0.0015	Y
R Fibulae	2	32	R Tarsals	1	27	0.0000	Y
R Fibulae	2	32	L Talus	*	*	*	*
R Fibulae	2	32	R Talus	2	17	0.0859	N
R Fibulae	2	32	L Calcanei	2	19	0.0258	Y
R Fibulae	2	32	R Calcanei	2	15	0.1026	N
R Fibulae	2	32	Sternums	2.5	6	0.7349	N
R Fibulae	2	32	L Innominates	2	48	0.1907	N
R Fibulae	2	32	R Innominates	2	44	0.8208	N
R Fibulae	2	32	Sacra	2	15	0.0043	Y
R Fibulae	2	32	L Patellae	2	12	0.0892	N
R Fibulae	2	32	R Patellae	2	13	0.6077	N
R Fibulae	2	32	Mandibles	1	32	0.0000	Y
R Fibulae	2	32	Maxillae	1	25	0.0000	Y
R Fibulae	2	32	Cranial Frags	2	163	0.0025	Y
L Humeri	2	28	R Humeri	2	31	0.3763	N
L Humeri	2	28	L Ulnae	2	27	0.9436	N
L Humeri	2	28	R Ulnae	2	31	0.7736	N
L Humeri	2	28	L Radii	2	24	0.6438	N
L Humeri	2	28	R Radii	3	31	0.1220	N
L Humeri	2	28	L Scapulae	2	36	0.8521	N
L Humeri	2	28	R Scapulae	2	29	0.3429	N
L Humeri	2	28	L Ribs	1	110	0.0031	Y
L Humeri	2	28	R Ribs	1	103	0.0005	Y
L Humeri	2	28	Vertebrae C	2	87	0.0120	Y
L Humeri	2	28	Vertebrae T	1	186	0.0005	Y
L Humeri	2	28	Vertebrae L	2	133	0.4008	N
L Humeri	2	28	L Metacarpals	2	29	0.0355	Y
L Humeri	2	28	R Metacarpals	1	35	0.0000	Y
L Humeri	2	28	L Metatarsals	2	39	0.0391	Y
L Humeri	2	28	R Metatarsals	1	50	0.0054	Y
L Humeri	2	28	L Carpals	1	24	0.0000	Y
L Humeri	2	28	R Carpals	1	21	0.0003	Y
L Humeri	2	28	L Tarsals	2	33	0.1246	Y
L Humeri	2	28	R Tarsals	1	27	0.0003	Y
L Humeri	2	28	L Talus	*	*	*	*
L Humeri	2	28	R Talus	2	17	0.8271	N
L Humeri	2	28	L Calcanei	2	19	0.3912	N

L Humeri	2	28	R Calcanei	2	15	0.6372	N
L Humeri	2	28	Sternums	2.5	6	0.3825	N
L Humeri	2	28	L Innominates	2	48	0.8256	N
L Humeri	2	28	R Innominates	2	44	0.2253	N
L Humeri	2	28	Sacra	2	15	0.0963	Y
L Humeri	2	28	L Patellae	2	12	0.6364	N
L Humeri	2	28	R Patellae	2	13	0.5929	N
L Humeri	2	28	Mandibles	1	32	0.0105	Y
L Humeri	2	28	Maxillae	1	25	0.0014	Y
L Humeri	2	28	Cranial Frags	2	163	0.2551	N
R Humeri	2	31	L Ulnae	2	27	0.4075	N
R Humeri	2	31	R Ulnae	2	31	0.2275	N
R Humeri	2	31	L Radii	2	24	0.1733	N
R Humeri	2	31	R Radii	3	31	0.0137	Y
R Humeri	2	31	L Scapulae	2	36	0.4055	N
R Humeri	2	31	R Scapulae	2	29	1.0000	N
R Humeri	2	31	L Ribs	1	110	0.0804	N
R Humeri	2	31	R Ribs	1	103	0.0207	Y
R Humeri	2	31	Vertebrae C	2	87	0.1970	N
R Humeri	2	31	Vertebrae T	1	186	0.0266	Y
R Humeri	2	31	Vertebrae L	2	133	0.6210	N
R Humeri	2	31	L Metacarpals	2	29	0.2554	N
R Humeri	2	31	R Metacarpals	1	35	0.0004	Y
R Humeri	2	31	L Metatarsals	2	39	0.3050	N
R Humeri	2	31	R Metatarsals	1	50	0.0799	Y
R Humeri	2	31	L Carpals	1	24	0.0009	Y
R Humeri	2	31	R Carpals	1	21	0.0048	Y
R Humeri	2	31	L Tarsals	2	33	0.6424	N
R Humeri	2	31	R Tarsals	1	27	0.0070	Y
R Humeri	2	31	L Talus	*	*	*	*
R Humeri	2	31	R Talus	2	17	0.4611	N
R Humeri	2	31	L Calcanei	2	19	0.9660	N
R Humeri	2	31	R Calcanei	2	15	0.7473	N
R Humeri	2	31	Sternums	2.5	6	0.1739	N
R Humeri	2	31	L Innominates	2	48	0.1719	N
R Humeri	2	31	R Innominates	2	44	0.0182	Y
R Humeri	2	31	Sacra	2	15	0.3889	N
R Humeri	2	31	L Patellae	2	12	0.7513	N
R Humeri	2	31	R Patellae	2	13	0.1832	N
R Humeri	2	31	Mandibles	1	32	0.1159	N

R Humeri	2	31	Maxillae	1	25	0.0206	Y
R Humeri	2	31	Cranial Frags	2	163	0.8822	N
L Ulnae	2	27	R Ulnae	2	31	0.6803	N
L Ulnae	2	27	L Radii	2	24	0.5769	N
L Ulnae	2	27	R Radii	3	31	0.0828	N
L Ulnae	2	27	L Scapulae	2	36	0.8998	N
L Ulnae	2	27	R Scapulae	2	29	0.3448	N
L Ulnae	2	27	L Ribs	1	110	0.0026	Y
L Ulnae	2	27	R Ribs	1	103	0.0004	Y
L Ulnae	2	27	Vertebrae C	2	87	0.0103	Y
L Ulnae	2	27	Vertebrae T	1	186	0.0004	Y
L Ulnae	2	27	Vertebrae L	2	133	0.4198	N
L Ulnae	2	27	L Metacarpals	2	29	0.0314	Y
L Ulnae	2	27	R Metacarpals	1	35	0.0000	Y
L Ulnae	2	27	L Metatarsals	2	39	0.0354	Y
L Ulnae	2	27	R Metatarsals	1	50	0.0047	Y
L Ulnae	2	27	L Carpals	1	24	0.0000	Y
L Ulnae	2	27	R Carpals	1	21	0.0002	Y
L Ulnae	2	27	L Tarsals	2	33	0.1156	N
L Ulnae	2	27	R Tarsals	1	27	0.0002	Y
L Ulnae	2	27	L Talus	*	*	*	*
L Ulnae	2	27	R Talus	2	17	0.8293	N
L Ulnae	2	27	L Calcanei	2	19	0.3860	N
L Ulnae	2	27	R Calcanei	2	15	0.6544	N
L Ulnae	2	27	Sternums	2.5	6	0.3386	N
L Ulnae	2	27	L Innominates	2	48	0.7645	N
L Ulnae	2	27	R Innominates	2	44	0.1778	N
L Ulnae	2	27	Sacra	2	15	0.0876	N
L Ulnae	2	27	L Patellae	2	12	0.6334	N
L Ulnae	2	27	R Patellae	2	13	0.5360	N
L Ulnae	2	27	Mandibles	1	32	0.0086	Y
L Ulnae	2	27	Maxillae	1	25	0.0010	Y
L Ulnae	2	27	Cranial Frags	2	163	0.2717	N
R Ulnae	2	31	L Radii	2	24	0.8791	N
R Ulnae	2	31	R Radii	3	31	0.1565	N
R Ulnae	2	31	L Scapulae	2	36	0.5087	N
R Ulnae	2	31	R Scapulae	2	29	0.1449	N
R Ulnae	2	31	L Ribs	1	110	0.0002	Y
R Ulnae	2	31	R Ribs	1	103	0.0000	Y
R Ulnae	2	31	Vertebrae C	2	87	0.0011	Y

R Ulnae	2	31	Vertebrae T	1	186	0.0000	Y
R Ulnae	2	31	Vertebrae L	2	133	0.1134	N
R Ulnae	2	31	L Metacarpals	2	29	0.0083	Y
R Ulnae	2	31	R Metacarpals	1	35	0.0000	Y
R Ulnae	2	31	L Metatarsals	2	39	0.0085	Y
R Ulnae	2	31	R Metatarsals	1	50	0.0009	Y
R Ulnae	2	31	L Carpals	1	24	0.0000	Y
R Ulnae	2	31	R Carpals	1	21	0.0001	Y
R Ulnae	2	31	L Tarsals	2	33	0.0274	Y
R Ulnae	2	31	R Tarsals	1	27	0.0001	Y
R Ulnae	2	31	L Talus	*	*	*	*
R Ulnae	2	31	R Talus	2	17	0.3560	N
R Ulnae	2	31	L Calcanei	2	19	0.1552	N
R Ulnae	2	31	R Calcanei	2	15	0.3632	N
R Ulnae	2	31	Sternums	2.5	6	0.4577	N
R Ulnae	2	31	L Innominates	2	48	0.7454	N
R Ulnae	2	31	R Innominates	2	44	0.4847	N
R Ulnae	2	31	Sacra	2	15	0.0351	Y
R Ulnae	2	31	L Patellae	2	12	0.3098	N
R Ulnae	2	31	R Patellae	2	13	0.9011	N
R Ulnae	2	31	Mandibles	1	32	0.0018	Y
R Ulnae	2	31	Maxillae	1	25	0.0003	Y
R Ulnae	2	31	Cranial Frags	2	163	0.0692	N
L Radii	2	24	R Radii	3	31	0.2761	N
L Radii	2	24	L Scapulae	2	36	0.4607	N
L Radii	2	24	R Scapulae	2	29	0.1371	N
L Radii	2	24	L Ribs	1	110	0.0003	Y
L Radii	2	24	R Ribs	1	103	0.0000	Y
L Radii	2	24	Vertebrae C	2	87	0.0014	Y
L Radii	2	24	Vertebrae T	1	186	0.0000	Y
L Radii	2	24	Vertebrae L	2	133	0.1252	N
L Radii	2	24	L Metacarpals	2	29	0.0074	Y
L Radii	2	24	R Metacarpals	1	35	0.0000	Y
L Radii	2	24	L Metatarsals	2	39	0.0076	Y
L Radii	2	24	R Metatarsals	1	50	0.0008	Y
L Radii	2	24	L Carpals	1	24	0.0000	Y
L Radii	2	24	R Carpals	1	21	0.0000	Y
L Radii	2	24	L Tarsals	2	33	0.0303	Y
L Radii	2	24	R Tarsals	1	27	0.0000	Y

L Radii	2	24	L Talus	*	*	*	*
L Radii	2	24	R Talus	2	17	0.0000	Y
L Radii	2	24	L Calcanei	2	19	0.1628	N
L Radii	2	24	R Calcanei	2	15	0.3514	N
L Radii	2	24	Sternums	2.5	6	0.5114	N
L Radii	2	24	L Innominates	2	48	0.7180	N
L Radii	2	24	R Innominates	2	44	0.5135	N
L Radii	2	24	Sacra	2	15	0.0302	Y
L Radii	2	24	L Patellae	2	12	0.3437	N
L Radii	2	24	R Patellae	2	13	0.8900	N
L Radii	2	24	Mandibles	1	32	0.0016	Y
L Radii	2	24	Maxillae	1	25	0.0002	Y
L Radii	2	24	Cranial Frags	2	163	0.0724	N
R Radii	3	31	L Scapulae	2	36	0.0357	Y
R Radii	3	31	R Scapulae	2	29	0.0061	Y
R Radii	3	31	L Ribs	1	110	0.0000	Y
R Radii	3	31	R Ribs	1	103	0.0000	Y
R Radii	3	31	Vertebrae C	2	87	0.0000	Y
R Radii	3	31	Vertebrae T	1	186	0.0000	Y
R Radii	3	31	Vertebrae L	2	133	0.0006	Y
R Radii	3	31	L Metacarpals	2	29	0.0001	Y
R Radii	3	31	R Metacarpals	1	35	0.0000	Y
R Radii	3	31	L Metatarsals	2	39	1.0000	N
R Radii	3	31	R Metatarsals	1	50	0.0000	Y
R Radii	3	31	L Carpals	1	24	0.0000	Y
R Radii	3	31	R Carpals	1	21	0.0000	Y
R Radii	3	31	L Tarsals	2	33	0.0003	Y
R Radii	3	31	R Tarsals	1	27	0.0000	Y
R Radii	3	31	L Talus	*	*	*	*
R Radii	3	31	R Talus	2	17	0.0227	Y
R Radii	3	31	L Calcanei	2	19	0.0077	Y
R Radii	3	31	R Calcanei	2	15	0.0394	Y
R Radii	3	31	Sternums	2.5	6	0.9651	N
R Radii	3	31	L Innominates	2	48	0.0524	N
R Radii	3	31	R Innominates	2	44	0.3344	N
R Radii	3	31	Sacra	2	15	0.0018	Y
R Radii	3	31	L Patellae	2	12	0.0327	Y
R Radii	3	31	R Patellae	2	13	0.2887	N

R Radii	3	31	Mandibles	1	32	0.0000	Y
R Radii	3	31	Maxillae	1	25	0.0000	Y
R Radii	3	31	Cranial Frags	2	163	0.0003	Y
L Scapulae	2	36	R Scapulae	2	29	0.3415	N
L Scapulae	2	36	L Ribs	1	110	0.0006	Y
L Scapulae	2	36	R Ribs	1	103	0.0000	Y
L Scapulae	2	36	Vertebrae C	2	87	0.0040	Y
L Scapulae	2	36	Vertebrae T	1	186	0.0000	Y
L Scapulae	2	36	Vertebrae L	2	133	0.4559	N
L Scapulae	2	36	L Metacarpals	2	29	0.0189	Y
L Scapulae	2	36	R Metacarpals	1	35	0.0000	Y
L Scapulae	2	36	L Metatarsals	2	39	0.0204	Y
L Scapulae	2	36	R Metatarsals	1	50	0.0016	Y
L Scapulae	2	36	L Carpals	1	24	0.0000	Y
L Scapulae	2	36	R Carpals	1	21	0.0000	Y
L Scapulae	2	36	L Tarsals	2	33	0.0999	N
L Scapulae	2	36	R Tarsals	1	27	0.0000	Y
L Scapulae	2	36	L Talus	*	*	*	*
L Scapulae	2	36	R Talus	2	17	0.9912	N
L Scapulae	2	36	L Calcanei	2	19	0.4108	N
L Scapulae	2	36	R Calcanei	2	15	0.7188	N
L Scapulae	2	36	Sternums	2.5	6	0.2635	N
L Scapulae	2	36	L Innominates	2	48	0.5831	N
L Scapulae	2	36	R Innominates	2	44	0.0731	N
L Scapulae	2	36	Sacra	2	15	0.0673	N
L Scapulae	2	36	L Patellae	2	12	0.7104	N
L Scapulae	2	36	R Patellae	2	13	0.3712	N
L Scapulae	2	36	Mandibles	1	32	0.0037	Y
L Scapulae	2	36	Maxillae	1	25	0.0003	Y
L Scapulae	2	36	Cranial Frags	2	163	0.2687	N
R Scapulae	2	29	L Ribs	1	110	0.0427	Y
R Scapulae	2	29	R Ribs	1	103	0.0078	Y
R Scapulae	2	29	Vertebrae C	2	87	0.1343	N
R Scapulae	2	29	Vertebrae T	1	186	0.0116	Y
R Scapulae	2	29	Vertebrae L	2	133	0.5590	N
R Scapulae	2	29	L Metacarpals	2	29	0.1880	N
R Scapulae	2	29	R Metacarpals	1	35	0.0000	Y
R Scapulae	2	29	L Metatarsals	2	39	0.2245	N
R Scapulae	2	29	R Metatarsals	1	50	0.0451	Y

R Scapulae	2	29	L Carpals	1	24	0.0001	Y
R Scapulae	2	29	R Carpals	1	21	0.0009	Y
R Scapulae	2	29	L Tarsals	2	33	0.6239	N
R Scapulae	2	29	R Tarsals	1	27	0.0015	Y
R Scapulae	2	29	L Talus	*	*	*	*
R Scapulae	2	29	R Talus	2	17	0.3005	N
R Scapulae	2	29	L Calcanei	2	19	0.9067	N
R Scapulae	2	29	R Calcanei	2	15	0.6654	N
R Scapulae	2	29	Sternums	2.5	6	0.1330	N
R Scapulae	2	29	L Innominates	2	48	0.1105	N
R Scapulae	2	29	R Innominates	2	44	0.0056	Y
R Scapulae	2	29	Sacra	2	15	0.3154	N
R Scapulae	2	29	L Patellae	2	12	0.6417	N
R Scapulae	2	29	R Patellae	2	13	0.0948	N
R Scapulae	2	29	Mandibles	1	32	0.0672	N
R Scapulae	2	29	Maxillae	1	25	0.0065	Y
R Scapulae	2	29	Cranial Frags	2	163	0.8411	N
L Ribs	1	110	R Ribs	1	103	0.2894	N
L Ribs	1	110	Vertebrae C	2	87	0.3975	N
L Ribs	1	110	Vertebrae T	1	186	0.5411	N
L Ribs	1	110	Vertebrae L	2	133	0.0000	Y
L Ribs	1	110	L Metacarpals	2	29	0.7170	N
L Ribs	1	110	R Metacarpals	1	35	0.0006	Y
L Ribs	1	110	L Metatarsals	2	39	0.5039	N
L Ribs	1	110	R Metatarsals	1	50	0.6573	N
L Ribs	1	110	L Carpals	1	24	0.0013	Y
L Ribs	1	110	R Carpals	1	21	0.0123	Y
L Ribs	1	110	L Tarsals	2	33	0.0844	N
L Ribs	1	110	R Tarsals	1	27	0.0295	Y
L Ribs	1	110	L Talus	*	*	*	*
L Ribs	1	110	R Talus	2	17	0.0012	Y
L Ribs	1	110	L Calcanei	2	19	0.0402	Y
L Ribs	1	110	R Calcanei	2	15	0.0332	Y
L Ribs	1	110	Sternums	2.5	6	0.0116	Y
L Ribs	1	110	L Innominates	2	48	0.0000	Y
L Ribs	1	110	R Innominates	2	44	0.0000	Y
L Ribs	1	110	Sacra	2	15	0.7092	N
L Ribs	1	110	L Patellae	2	12	0.0381	Y
L Ribs	1	110	R Patellae	2	13	0.0005	Y

L Ribs	1	110	Mandibles	1	32	0.8163	N
L Ribs	1	110	Maxillae	1	25	0.1118	N
L Ribs	1	110	Cranial Frags	2	163	0.0002	Y
R Ribs	1	103	Vertebrae C	2	87	0.0653	N
R Ribs	1	103	Vertebrae T	1	186	0.5476	N
R Ribs	1	103	Vertebrae L	2	133	0.0000	Y
R Ribs	1	103	L Metacarpals	2	29	0.2916	N
R Ribs	1	103	R Metacarpals	1	35	0.0059	Y
R Ribs	1	103	L Metatarsals	2	39	0.1519	N
R Ribs	1	103	R Metatarsals	1	50	0.7183	N
R Ribs	1	103	L Carpals	1	24	0.0087	Y
R Ribs	1	103	R Carpals	1	21	0.0541	N
R Ribs	1	103	L Tarsals	2	33	0.0141	Y
R Ribs	1	103	R Tarsals	1	27	0.1304	N
R Ribs	1	103	L Talus	*	*	*	*
R Ribs	1	103	R Talus	2	17	0.0001	Y
R Ribs	1	103	L Calcanei	2	19	0.0085	Y
R Ribs	1	103	R Calcanei	2	15	0.0086	Y
R Ribs	1	103	Sternums	2.5	6	0.0053	Y
R Ribs	1	103	L Innominates	2	48	0.0000	Y
R Ribs	1	103	R Innominates	2	44	0.0000	Y
R Ribs	1	103	Sacra	2	15	0.3652	N
R Ribs	1	103	L Patellae	2	12	0.0071	Y
R Ribs	1	103	R Patellae	2	13	0.0001	Y
R Ribs	1	103	Mandibles	1	32	0.6186	N
R Ribs	1	103	Maxillae	1	25	0.3514	N
R Ribs	1	103	Cranial Frags	2	163	0.0000	Y
Vertebrae C	2	87	Vertebrae T	1	186	0.1271	N
Vertebrae C	2	87	Vertebrae L	2	133	0.0008	Y
Vertebrae C	2	87	L Metacarpals	2	29	0.8460	N
Vertebrae C	2	87	R Metacarpals	1	35	0.0001	Y
Vertebrae C	2	87	L Metatarsals	2	39	0.9716	N
Vertebrae C	2	87	R Metatarsals	1	50	0.2834	N
Vertebrae C	2	87	L Carpals	1	24	0.0002	Y
Vertebrae C	2	87	R Carpals	1	21	0.0029	Y
Vertebrae C	2	87	L Tarsals	2	33	0.2666	N
Vertebrae C	2	87	R Tarsals	1	27	0.0068	Y
Vertebrae C	2	87	L Talus	*	*	*	*

Vertebrae C	2	87	R Talus	2	17	0.0050	Y
Vertebrae C	2	87	L Calcanei	2	19	0.1120	N
Vertebrae C	2	87	R Calcanei	2	15	0.0799	N
Vertebrae C	2	87	Sternums	2.5	6	0.0182	Y
Vertebrae C	2	87	L Innominates	2	48	0.0001	Y
Vertebrae C	2	87	R Innominates	2	44	0.0000	Y
Vertebrae C	2	87	Sacra	2	15	0.9617	N
Vertebrae C	2	87	L Patellae	2	12	0.0688	N
Vertebrae C	2	87	R Patellae	2	13	0.0014	Y
Vertebrae C	2	87	Mandibles	1	32	0.4077	N
Vertebrae C	2	87	Maxillae	1	25	0.0337	Y
Vertebrae C	2	87	Cranial Frags	2	163	0.0066	Y
Vertebrae T	1	186	Vertebrae L	2	133	0.0000	Y
Vertebrae T	1	186	L Metacarpals	2	29	0.4467	N
Vertebrae T	1	186	R Metacarpals	1	35	0.0010	Y
Vertebrae T	1	186	L Metatarsals	2	39	0.2542	N
Vertebrae T	1	186	R Metatarsals	1	50	0.9714	N
Vertebrae T	1	186	L Carpals	1	24	0.0022	Y
Vertebrae T	1	186	R Carpals	1	21	0.0202	Y
Vertebrae T	1	186	L Tarsals	2	33	0.0241	Y
Vertebrae T	1	186	R Tarsals	1	27	0.0506	N
Vertebrae T	1	186	L Talus	*	*	*	*
Vertebrae T	1	186	R Talus	2	17	0.0002	Y
Vertebrae T	1	186	L Calcanei	2	19	0.0131	N
Vertebrae T	1	186	R Calcanei	2	15	0.0120	N
Vertebrae T	1	186	Sternums	2.5	6	0.0060	Y
Vertebrae T	1	186	L Innominates	2	48	0.0000	Y
Vertebrae T	1	186	R Innominates	2	44	0.0000	Y
Vertebrae T	1	186	Sacra	2	15	0.5019	N
Vertebrae T	1	186	L Patellae	2	12	0.0106	Y
Vertebrae T	1	186	R Patellae	2	13	0.0001	Y
Vertebrae T	1	186	Mandibles	1	32	0.8896	N
Vertebrae T	1	186	Maxillae	1	25	0.1806	N
Vertebrae T	1	186	Cranial Frags	2	163	0.0000	Y
Vertebrae L	2	133	L Metacarpals	2	29	0.0159	Y
Vertebrae L	2	133	R Metacarpals	1	35	0.0000	Y
Vertebrae L	2	133	L Metatarsals	2	39	0.0155	Y
Vertebrae L	2	133	R Metatarsals	1	50	0.0003	Y

Vertebrae L	2	133	L Carpals	1	24	0.0000	Y
Vertebrae L	2	133	R Carpals	1	21	0.0000	Y
Vertebrae L	2	133	L Tarsals	2	33	0.1668	N
Vertebrae L	2	133	R Tarsals	1	27	0.0000	Y
Vertebrae L	2	133	L Talus	*	*	*	*
Vertebrae L	2	133	R Talus	2	17	0.4925	N
Vertebrae L	2	133	L Calcanei	2	19	0.7038	N
Vertebrae L	2	133	R Calcanei	2	15	0.9178	N
Vertebrae L	2	133	Sternums	2.5	6	0.1158	N
Vertebrae L	2	133	L Innominates	2	48	0.0982	N
Vertebrae L	2	133	R Innominates	2	44	0.0009	Y
Vertebrae L	2	133	Sacra	2	15	0.0828	N
Vertebrae L	2	133	L Patellae	2	12	0.9159	N
Vertebrae L	2	133	R Patellae	2	13	0.0976	N
Vertebrae L	2	133	Mandibles	1	32	0.0016	Y
Vertebrae L	2	133	Maxillae	1	25	0.0000	Y
Vertebrae L	2	133	Cranial Frags	2	163	0.5224	N
L Metacarpals	2	29	R Metacarpals	1	35	0.0023	Y
L Metacarpals	2	29	L Metatarsals	2	39	0.8462	N
L Metacarpals	2	29	R Metatarsals	1	50	0.5353	N
L Metacarpals	2	29	L Carpals	1	24	0.0027	Y
L Metacarpals	2	29	R Carpals	1	21	0.0172	Y
L Metacarpals	2	29	L Tarsals	2	33	0.3077	N
L Metacarpals	2	29	R Tarsals	1	27	0.0392	Y
L Metacarpals	2	29	L Talus	*	*	*	*
L Metacarpals	2	29	R Talus	2	17	0.0115	Y
L Metacarpals	2	29	L Calcanei	2	19	0.1496	N
L Metacarpals	2	29	R Calcanei	2	15	0.1132	N
L Metacarpals	2	29	Sternums	2.5	6	0.0300	Y
L Metacarpals	2	29	L Innominates	2	48	0.0016	Y
L Metacarpals	2	29	R Innominates	2	44	0.0000	Y
L Metacarpals	2	29	Sacra	2	15	0.9447	N
L Metacarpals	2	29	L Patellae	2	12	0.0929	N
L Metacarpals	2	29	R Patellae	2	13	0.0049	Y
L Metacarpals	2	29	Mandibles	1	32	0.6300	N
L Metacarpals	2	29	Maxillae	1	25	0.1141	N
L Metacarpals	2	29	Cranial Frags	2	163	0.0534	N
R Metacarpals	1	35	L Metatarsals	2	39	0.0007	Y
R Metacarpals	1	35	R Metatarsals	1	50	0.0090	Y

R Metacarpals	1	35	L Carpals	1	24	0.8403	N
R Metacarpals	1	35	R Carpals	1	21	0.7128	N
R Metacarpals	1	35	L Tarsals	2	33	0.0000	Y
R Metacarpals	1	35	R Tarsals	1	27	0.3185	N
R Metacarpals	1	35	L Talus	*	*	*	*
R Metacarpals	1	35	R Talus	2	17	0.0000	Y
R Metacarpals	1	35	L Calcanei	2	19	0.0000	Y
R Metacarpals	1	35	R Calcanei	2	15	0.0001	Y
R Metacarpals	1	35	Sternums	2.5	6	0.0003	Y
R Metacarpals	1	35	L Innominates	2	48	0.0000	Y
R Metacarpals	1	35	R Innominates	2	44	0.0000	Y
R Metacarpals	1	35	Sacra	2	15	0.0075	Y
R Metacarpals	1	35	L Patellae	2	12	0.0000	Y
R Metacarpals	1	35	R Patellae	2	13	0.0000	Y
R Metacarpals	1	35	Mandibles	1	32	0.0065	Y
R Metacarpals	1	35	Maxillae	1	25	0.1455	N
R Metacarpals	1	35	Cranial Frags	2	163	0.0000	Y
L Metatarsals	2	39	R Metatarsals	1	50	0.3687	N
L Metatarsals	2	39	L Carpals	1	24	0.0010	Y
L Metatarsals	2	39	R Carpals	1	21	0.0082	Y
L Metatarsals	2	39	L Tarsals	2	33	0.3796	N
L Metatarsals	2	39	R Tarsals	1	27	0.0184	Y
L Metatarsals	2	39	L Talus	*	*	*	*
L Metatarsals	2	39	R Talus	2	17	0.0148	Y
L Metatarsals	2	39	L Calcanei	2	19	0.1821	N
L Metatarsals	2	39	R Calcanei	2	15	0.1355	N
L Metatarsals	2	39	Sternums	2.5	6	0.0327	Y
L Metatarsals	2	39	L Innominates	2	48	0.0014	Y
L Metatarsals	2	39	R Innominates	2	44	0.0000	Y
L Metatarsals	2	39	Sacra	2	15	0.9484	N
L Metatarsals	2	39	L Patellae	2	12	0.1130	N
L Metatarsals	2	39	R Patellae	2	13	0.0056	Y
L Metatarsals	2	39	Mandibles	1	32	0.4702	N
L Metatarsals	2	39	Maxillae	1	25	0.0642	N
L Metatarsals	2	39	Cranial Frags	2	163	0.0576	N
R Metatarsals	1	50	L Carpals	1	24	0.0113	Y
R Metatarsals	1	50	R Carpals	1	21	0.0556	N
R Metatarsals	1	50	L Tarsals	2	33	0.0784	N
R Metatarsals	1	50	R Tarsals	1	27	0.1190	N

R Metatarsals	1	50	L Talus	*	*	*	*
R Metatarsals	1	50	R Talus	2	17	0.0021	Y
R Metatarsals	1	50	L Calcanei	2	19	0.0418	Y
R Metatarsals	1	50	R Calcanei	2	15	0.0359	Y
R Metatarsals	1	50	Sternums	2.5	6	0.0145	Y
R Metatarsals	1	50	L Innominates	2	48	0.0000	Y
R Metatarsals	1	50	R Innominates	2	44	0.0000	Y
R Metatarsals	1	50	Sacra	2	15	0.5656	N
R Metatarsals	1	50	L Patellae	2	12	0.0307	Y
R Metatarsals	1	50	R Patellae	2	13	0.0010	Y
R Metatarsals	1	50	Mandibles	1	32	0.8976	N
R Metatarsals	1	50	Maxillae	1	25	0.2893	N
R Metatarsals	1	50	Cranial Frags	2	163	0.0018	Y
L Carpals	1	24	R Carpals	1	21	0.5621	N
L Carpals	1	24	L Tarsals	1	21	0.0001	Y
L Carpals	1	24	R Tarsals	1	27	0.2381	N
L Carpals	1	24	L Talus	*	*	*	*
L Carpals	1	24	R Talus	2	17	0.0000	Y
L Carpals	1	24	L Calcanei	2	19	0.0001	Y
L Carpals	1	24	R Calcanei	2	15	0.0001	Y
L Carpals	1	24	Sternums	2.5	6	0.0002	Y
L Carpals	1	24	L Innominates	2	48	0.0000	Y
L Carpals	1	24	R Innominates	2	44	0.0000	Y
L Carpals	1	24	Sacra	2	15	0.0060	Y
L Carpals	1	24	L Patellae	2	12	0.0000	Y
L Carpals	1	24	R Patellae	2	13	0.0000	Y
L Carpals	1	24	Mandibles	1	32	0.0067	Y
L Carpals	1	24	Maxillae	1	25	0.1085	N
L Carpals	1	24	Cranial Frags	2	163	0.0000	N
R Carpals	1	21	L Tarsals	2	33	0.0007	N
R Carpals	1	21	R Tarsals	1	27	0.5876	N
R Carpals	1	21	L Talus	*	*	*	*
R Carpals	1	21	R Talus	2	17	0.0000	Y
R Carpals	1	21	L Calcanei	2	19	0.0005	Y
R Carpals	1	21	R Calcanei	2	15	0.0008	Y
R Carpals	1	21	Sternums	2.5	6	0.0013	Y
R Carpals	1	21	L Innominates	2	48	0.0000	Y
R Carpals	1	21	R Innominates	2	44	0.0000	Y

R Carpals	1	21	Sacra	2	15	0.0303	Y
R Carpals	1	21	L Patellae	2	12	0.0004	Y
R Carpals	1	21	R Patellae	2	13	0.0000	Y
R Carpals	1	21	Mandibles	1	32	0.0385	Y
R Carpals	1	21	Maxillae	1	25	0.3315	N
R Carpals	1	21	Cranial Frags	2	163	0.0000	Y
L Tarsals	1	21	R Tarsals	1	21	0.0015	Y
L Tarsals	1	21	L Talus	*	*	*	*
L Tarsals	1	21	R Talus	2	17	0.0679	N
L Tarsals	1	21	L Calcanei	2	19	0.5139	N
L Tarsals	1	21	R Calcanei	2	15	0.3355	N
L Tarsals	1	21	Sternums	2.5	6	0.0489	Y
L Tarsals	1	21	L Innominates	2	48	0.0135	Y
L Tarsals	1	21	R Innominates	2	44	0.0001	Y
L Tarsals	1	21	Sacra	2	15	0.4544	N
L Tarsals	1	21	L Patellae	2	12	0.3069	N
L Tarsals	1	21	R Patellae	2	13	0.0151	Y
L Tarsals	1	21	Mandibles	1	32	0.1079	N
L Tarsals	1	21	Maxillae	1	25	0.0073	Y
L Tarsals	1	21	Cranial Frags	2	163	0.3581	N
R Tarsals	1	21	L Talus	*	*	*	*
R Tarsals	1	21	R Talus	2	17	0.0000	Y
R Tarsals	1	21	L Calcanei	2	19	0.0010	Y
R Tarsals	1	21	R Calcanei	2	15	0.0015	Y
R Tarsals	1	21	Sternums	2.5	6	0.0019	Y
R Tarsals	1	21	L Innominates	2	48	0.0000	Y
R Tarsals	1	21	R Innominates	2	44	0.0000	Y
R Tarsals	1	21	Sacra	2	15	0.0660	N
R Tarsals	1	21	L Patellae	2	12	0.0008	Y
R Tarsals	1	21	R Patellae	2	13	0.0000	Y
R Tarsals	1	21	Mandibles	1	32	0.0910	N
R Tarsals	1	21	Maxillae	1	25	0.6407	N
R Tarsals	1	21	Cranial Frags	2	163	0.0000	Y
L Talus	*	*	R Talus	2	17	*	*
L Talus	*	*	L Calcanei	2	19	*	*
L Talus	*	*	R Calcanei	2	15	*	*
L Talus	*	*	Sternums	2.5	6	*	*
L Talus	*	*	L Innominates	2	48	*	*
L Talus	*	*	R Innominates	2	44	*	*

L Talus	*	*	Sacra	2	15	*	*
L Talus	*	*	L Patellae	2	12	*	*
L Talus	*	*	R Patellae	2	13	*	*
L Talus	*	*	Mandibles	1	32	*	*
L Talus	*	*	Maxillae	1	25	*	*
L Talus	*	*	Cranial Frags	2	163	*	*
R Talus	2	17	L Calcanei	2	17	0.3254	N
R Talus	2	17	R Calcanei	2	17	0.7198	N
R Talus	2	17	Sternums	2.5	6	0.1462	N
R Talus	2	17	L Innominates	2	48	0.5572	N
R Talus	2	17	R Innominates	2	44	0.0506	N
R Talus	2	17	Sacra	2	15	0.0272	Y
R Talus	2	17	L Patellae	2	12	0.6135	N
R Talus	2	17	R Patellae	2	13	0.1828	N
R Talus	2	17	Mandibles	1	32	0.0019	Y
R Talus	2	17	Maxillae	1	25	0.0001	Y
R Talus	2	17	Cranial Frags	2	163	0.3496	N
L Calcanei	2	17	R Calcanei	2	15	0.7230	N
L Calcanei	2	17	Sternums	2.5	6	0.1193	N
L Calcanei	2	17	L Innominates	2	48	0.1529	N
L Calcanei	2	17	R Innominates	2	44	0.0086	Y
L Calcanei	2	17	Sacra	2	15	0.2471	N
L Calcanei	2	17	L Patellae	2	12	0.7117	N
L Calcanei	2	17	R Patellae	2	13	0.0867	N
L Calcanei	2	17	Mandibles	1	32	0.0507	N
L Calcanei	2	17	Maxillae	1	25	0.0043	Y
L Calcanei	2	17	Cranial Frags	2	163	0.9561	N
R Calcanei	2	15	Sternums	2.5	6	0.2254	N
R Calcanei	2	15	L Innominates	2	48	0.4065	N
R Calcanei	2	15	R Innominates	2	44	0.0649	N
R Calcanei	2	15	Sacra	2	15	0.1929	N
R Calcanei	2	15	L Patellae	2	12	1.0000	N
R Calcanei	2	15	R Patellae	2	13	0.2551	N
R Calcanei	2	15	Mandibles	1	32	0.0422	Y
R Calcanei	2	15	Maxillae	1	25	0.0052	Y
R Calcanei	2	15	Cranial Frags	2	163	0.7205	N
Sternums	2.5	6	L Innominates	2	48	0.3219	N
Sternums	2.5	6	R Innominates	2	44	0.6217	N
Sternums	2.5	6	Sacra	2	15	0.0542	N
Sternums	2.5	6	L Patellae	2	12	0.1806	N
Sternums	2.5	6	R Patellae	2	13	0.5620	N

Sternums	2.5	6	Mandibles	1	32	0.0150	Y
Sternums	2.5	6	Maxillae	1	25	0.0044	Y
Sternums	2.5	6	Cranial Frags	2	163	0.1033	N
L Innominates	2	48	R Innominates	2	44	0.1564	N
L Innominates	2	48	Sacra	2	15	0.0141	Y
L Innominates	2	48	L Patellae	2	12	0.3836	N
L Innominates	2	48	R Patellae	2	13	0.5568	N
L Innominates	2	48	Mandibles	1	32	0.0001	Y
L Innominates	2	48	Maxillae	1	25	0.0000	Y
L Innominates	2	48	Cranial Frags	2	163	0.0424	Y
R Innominates	2	44	Sacra	2	15	0.0005	Y
R Innominates	2	44	L Patellae	2	12	0.0495	Y
R Innominates	2	44	R Patellae	2	13	0.7140	N
R Innominates	2	44	Mandibles	1	32	0.0000	Y
R Innominates	2	44	Maxillae	1	25	0.0000	Y
R Innominates	2	44	Cranial Frags	2	163	0.0003	Y
Sacra	2	15	L Patellae	2	12	0.1523	N
Sacra	2	15	R Patellae	2	13	0.0156	Y
Sacra	2	15	Mandibles	1	32	0.6322	N
Sacra	2	15	Maxillae	1	25	0.1554	N
Sacra	2	15	Cranial Frags	2	163	0.1736	N
L Patellae	2	12	R Patellae	2	13	0.1753	N
L Patellae	2	12	Mandibles	1	32	0.0314	Y
L Patellae	2	12	Maxillae	1	25	0.0029	Y
L Patellae	2	12	Cranial Frags	2	163	0.7284	N
R Patellae	2	13	Mandibles	1	32	0.0011	Y
R Patellae	2	13	Maxillae	1	25	0.0001	Y
R Patellae	2	13	Cranial Frags	2	163	0.0741	N
Mandibles	1	32	Maxillae	1	25	0.2359	N
Mandibles	1	32	Cranial Frags	2	163	0.0084	Y
Maxillae	1	25	Cranial Frags	2	163	0.0003	Y

Appendix D: Significant Weathering Results

The weathering results are organized by bone based on the heading Bone 1. All of the comparisons in this table are statistically significant. Significance marked by Y for yes in the significant column, and the darker cell outline indicates which bone is more weathered than its comparison on the same row. Comparisons were significant if the p-value was less than 0.05 based on the bone fragment totals and median data.

Key

Abbreviation	**Meaning**
Bone 1, 2	Bone fragments compared against each other
M	Median bone weathering score
Total # BF	The total number of bone fragments
Significant	P-value is less than 0.05, so the difference between bones is statistically significant.
Y	There is a statistically significant difference between bones
N	There is no statistically significant difference between bones
Cranial Frags	Cranial Fragments
*	Error report from Minitab 16, bone excluded from analysis

Bone 1	**M**	**Total # BF**	**Bone 2**	**M**	**Total # BF**	**P-value (0.05)**	**Significant (Y/N)**
L Clavicles	3	14	L Femora	2	42	0.0029	Y
L Clavicles	3	14	R Femora	1	40	0.0004	Y
L Clavicles	3	14	L Tibiae	2	35	0.0039	Y
L Clavicles	3	14	R Tibiae	2	36	0.0019	Y
L Clavicles	3	14	R Humeri	2	31	0.0173	Y
L Clavicles	3	14	L Scapulae	2	36	0.0345	Y
L Clavicles	3	14	R Scapulae	2	29	0.0124	Y
L Clavicles	3	14	L Ribs	1	110	0.0000	Y
L Clavicles	3	14	R Ribs	1	103	0.0000	Y
L Clavicles	3	14	Vertebrae C	2	87	0.0001	Y

L Clavicles	3	14	Vertebrae T	1	186	0.0000	Y
L Clavicles	3	14	Vertebrae L	2	133	0.0035	Y
L Clavicles	3	14	L Metacarpals	2	29	0.0009	Y
L Clavicles	3	14	R Metacarpals	1	35	0.0000	Y
L Clavicles	3	14	L Metatarsals	2	39	0.0008	Y
L Clavicles	3	14	R Metatarsals	1	50	0.0001	Y
L Clavicles	3	14	L Carpals	1	24	0.0000	Y
L Clavicles	3	14	R Carpals	1	21	0.0000	Y
L Clavicles	3	14	L Tarsals	2	33	0.0018	Y
L Clavicles	3	14	R Tarsals	1	27	0.0000	Y
L Clavicles	3	14	R Tali	2	17	0.0247	Y
L Clavicles	3	14	L Calcanei	2	19	0.0132	Y
L Clavicles	3	14	R Calcanei	2	15	0.0414	Y
L Clavicles	3	14	L Innominates	2	48	0.0435	Y
L Clavicles	3	14	Sacra	2	15	0.0049	Y
L Clavicles	3	14	L Patellae	2	12	0.0381	Y
L Clavicles	3	14	Mandibles	1	32	0.0003	Y
L Clavicles	3	14	Maxillae	1	25	0.0001	Y
L Clavicles	3	14	Cranial Frags	2	163	0.0025	Y
R Clavicles	2	20	R Femora	1	40	0.0438	Y
R Clavicles	2	20	L Ribs	1	110	0.0171	Y
R Clavicles	2	20	R Ribs	1	103	0.0042	Y
R Clavicles	2	20	Vertebrae C	2	87	0.0459	Y
R Clavicles	2	20	Vertebrae T	1	186	0.0052	Y
R Clavicles	2	20	R Metacarpals	1	35	0.0001	Y
R Clavicles	2	20	R Metatarsals	1	50	0.0195	Y
R Clavicles	2	20	L Carpals	1	24	0.0002	Y
R Clavicles	2	20	R Carpals	1	21	0.0012	Y
R Clavicles	2	20	Mandibles	1	32	0.0316	Y
R Clavicles	2	20	Maxillae	1	25	0.0055	Y
L Femora	2	42	L Fibulae	2	29	0.0005	Y
L Femora	2	42	R Fibulae	2	32	0.0027	Y
L Femora	2	42	R Ulnae	2	31	0.0432	Y
L Femora	2	42	L Radii	2	24	0.0333	Y
L Femora	2	42	R Radii	3	31	0.0007	Y
L Femora	2	42	R Metacarpals	1	35	0.0004	Y
L Femora	2	42	L Carpals	1	24	0.0009	Y
L Femora	2	42	R Carpals	1	21	0.0064	Y

L Femora	2	42	R Tarsals	1	27	0.0117	Y
L Femora	2	42	L Innominates	2	48	0.0162	Y
L Femora	2	42	R Innominates	2	44	0.0004	Y
L Femora	2	42	R Patellae	2	13	0.0371	Y
L Femora	2	42	Maxillae	1	25	0.0387	Y
R Femora	1	40	L Fibulae	2	29	0.0000	Y
R Femora	1	40	R Fibulae	2	32	0.0001	Y
R Femora	1	40	L Humeri	2	28	0.0170	Y
R Femora	1	40	L Ulnae	2	27	0.0155	Y
R Femora	1	40	R Ulnae	2	31	0.0037	Y
R Femora	1	40	L Radii	2	24	0.0033	Y
R Femora	1	40	R Radii	3	31	0.0000	Y
R Femora	1	40	L Scapulae	2	36	0.0077	Y
R Femora	1	40	Vertebrae L	2	133	0.0034	Y
R Femora	1	40	R Metacarpals	1	35	0.0058	Y
R Femora	1	40	L Carpals	1	24	0.0075	Y
R Femora	1	40	R Carpals	1	21	0.0374	Y
R Femora	1	40	R Tali	2	17	0.0081	Y
R Femora	1	40	Sternums	2.5	6	0.0249	Y
R Femora	1	40	L Innominates	2	48	0.0004	Y
R Femora	1	40	R Innominates	2	44	0.0000	Y
R Femora	1	40	R Patellae	2	13	0.0035	Y
R Femora	1	40	Cranial Frags	2	163	0.0150	Y
L Tibiae	2	35	L Fibulae	2	29	0.0008	Y
L Tibiae	2	35	R Fibulae	2	32	0.0035	Y
L Tibiae	2	35	L Radii	2	24	0.0349	Y
L Tibiae	2	35	R Radii	3	31	0.0013	Y
L Tibiae	2	35	R Metacarpals	1	35	0.0006	Y
L Tibiae	2	35	L Carpals	1	24	0.0010	Y
L Tibiae	2	35	R Carpals	1	21	0.0070	Y
L Tibiae	2	35	R Tarsals	1	27	0.0143	Y
L Tibiae	2	35	L Innominates	2	48	0.0131	Y
L Tibiae	2	35	R Innominates	2	44	0.0003	Y
L Tibiae	2	35	R Patellae	2	13	0.0275	Y
L Tibiae	2	35	Maxillae	1	25	0.0476	Y
R Tibiae	2	36	L Fibulae	2	29	0.0002	Y
R Tibiae	2	36	R Fibulae	2	32	0.0014	Y
R Tibiae	2	36	R Ulnae	2	31	0.0250	Y

R Tibiae	2	36	L Radii	2	24	0.0222	Y
R Tibiae	2	36	R Radii	3	31	0.0003	Y
R Tibiae	2	36	R Metacarpals	1	35	0.0004	Y
R Tibiae	2	36	L Carpals	1	24	0.0007	Y
R Tibiae	2	36	R Carpals	1	21	0.0054	Y
R Tibiae	2	36	R Tarsals	1	27	0.0109	Y
R Tibiae	2	36	L Innominates	2	48	0.0084	Y
R Tibiae	2	36	R Innominates	2	44	0.0001	Y
R Tibiae	2	36	R Patellae	2	13	0.0189	Y
R Tibiae	2	36	Maxillae	1	25	0.0381	Y
L Fibulae	2	29	R Humeri	2	31	0.0117	Y
L Fibulae	2	29	L Ulnae	2	27	0.0776	Y
L Fibulae	2	29	L Scapulae	2	36	0.0322	Y
L Fibulae	2	29	R Scapulae	2	29	0.0049	Y
L Fibulae	2	29	L Ribs	1	110	0.0000	Y
L Fibulae	2	29	R Ribs	1	103	0.0000	Y
L Fibulae	2	29	Vertebrae C	2	87	0.0000	Y
L Fibulae	2	29	Vertebrae T	1	186	0.0000	Y
L Fibulae	2	29	Vertebrae L	2	133	0.0006	Y
L Fibulae	2	29	L Metacarpals	2	29	0.0001	Y
L Fibulae	2	29	R Metacarpals	1	35	0.0000	Y
L Fibulae	2	29	L Metatarsals	2	39	0.0000	Y
L Fibulae	2	29	R Metatarsals	1	50	0.0000	Y
L Fibulae	2	29	L Carpals	1	24	0.0000	Y
L Fibulae	2	29	R Carpals	1	21	0.0000	Y
L Fibulae	2	29	L Tarsals	2	33	0.0002	Y
L Fibulae	2	29	R Tarsals	1	27	0.0000	Y
L Fibulae	2	29	R Tali	2	17	0.0214	Y
L Fibulae	2	29	L Calcanei	2	19	0.0064	Y
L Fibulae	2	29	R Calcanei	2	15	0.0366	Y
L Fibulae	2	29	Sacra	2	15	0.0012	Y
L Fibulae	2	29	L Patellae	2	12	0.0302	Y
L Fibulae	2	29	Mandibles	1	32	0.0000	Y
L Fibulae	2	29	Maxillae	1	25	0.0000	Y
L Fibulae	2	29	Cranial Frags	2	163	0.0003	Y
R Fibulae	2	32	R Humeri	2	31	0.0387	Y
R Fibulae	2	32	R Scapulae	2	29	0.0199	Y
R Fibulae	2	32	L Ribs	1	110	0.0000	Y

R Fibulae	2	32	R Ribs	1	103	0.0000	Y
R Fibulae	2	32	Vertebrae C	2	87	0.0000	Y
R Fibulae	2	32	Vertebrae T	1	186	0.0000	Y
R Fibulae	2	32	Vertebrae L	2	133	0.0053	Y
R Fibulae	2	32	L Metacarpals	2	29	0.0004	Y
R Fibulae	2	32	R Metacarpals	1	35	0.0000	Y
R Fibulae	2	32	L Metatarsals	2	39	0.0003	Y
R Fibulae	2	32	R Metatarsals	1	50	0.0000	Y
R Fibulae	2	32	L Carpals	1	24	0.0000	Y
R Fibulae	2	32	R Carpals	1	21	0.0000	Y
R Fibulae	2	32	L Tarsals	2	33	0.0015	Y
R Fibulae	2	32	R Tarsals	1	27	0.0000	Y
R Fibulae	2	32	L Calcanei	2	19	0.0258	Y
R Fibulae	2	32	Sacra	2	15	0.0043	Y
R Fibulae	2	32	Mandibles	1	32	0.0000	Y
R Fibulae	2	32	Maxillae	1	25	0.0000	Y
R Fibulae	2	32	Cranial Frags	2	163	0.0025	Y
L Humeri	2	28	L Ribs	1	110	0.0031	Y
L Humeri	2	28	R Ribs	1	103	0.0005	Y
L Humeri	2	28	Vertebrae C	2	87	0.0120	Y
L Humeri	2	28	Vertebrae T	1	186	0.0005	Y
L Humeri	2	28	L Metacarpals	2	29	0.0355	Y
L Humeri	2	28	R Metacarpals	1	35	0.0000	Y
L Humeri	2	28	L Metatarsals	2	39	0.0391	Y
L Humeri	2	28	R Metatarsals	1	50	0.0054	Y
L Humeri	2	28	L Carpals	1	24	0.0000	Y
L Humeri	2	28	R Carpals	1	21	0.0003	Y
L Humeri	2	28	L Tarsals	2	33	0.1246	Y
L Humeri	2	28	R Tarsals	1	27	0.0003	Y
L Humeri	2	28	Sacra	2	15	0.0963	Y
L Humeri	2	28	Mandibles	1	32	0.0105	Y
L Humeri	2	28	Maxillae	1	25	0.0014	Y
R Humeri	2	31	R Radii	3	31	0.0137	Y
R Humeri	2	31	R Ribs	1	103	0.0207	Y
R Humeri	2	31	Vertebrae T	1	186	0.0266	Y
R Humeri	2	31	R Metacarpals	1	35	0.0004	Y
R Humeri	2	31	R Metatarsals	1	50	0.0799	Y
R Humeri	2	31	L Carpals	1	24	0.0009	Y

R Humeri	2	31	R Carpals	1	21	0.0048	Y
R Humeri	2	31	R Tarsals	1	27	0.0070	Y
R Humeri	2	31	R Innominates	2	44	0.0182	Y
R Humeri	2	31	Maxillae	1	25	0.0206	Y
L Ulnae	2	27	L Ribs	1	110	0.0026	Y
L Ulnae	2	27	R Ribs	1	103	0.0004	Y
L Ulnae	2	27	Vertebrae C	2	87	0.0103	Y
L Ulnae	2	27	Vertebrae T	1	186	0.0004	Y
L Ulnae	2	27	L Metacarpals	2	29	0.0314	Y
L Ulnae	2	27	R Metacarpals	1	35	0.0000	Y
L Ulnae	2	27	L Metatarsals	2	39	0.0354	Y
L Ulnae	2	27	R Metatarsals	1	50	0.0047	Y
L Ulnae	2	27	L Carpals	1	24	0.0000	Y
L Ulnae	2	27	R Carpals	1	21	0.0002	Y
L Ulnae	2	27	R Tarsals	1	27	0.0002	Y
L Ulnae	2	27	Mandibles	1	32	0.0086	Y
L Ulnae	2	27	Maxillae	1	25	0.0010	Y
R Ulnae	2	31	L Ribs	1	110	0.0002	Y
R Ulnae	2	31	R Ribs	1	103	0.0000	Y
R Ulnae	2	31	Vertebrae C	2	87	0.0011	Y
R Ulnae	2	31	Vertebrae T	1	186	0.0000	Y
R Ulnae	2	31	L Metacarpals	2	29	0.0083	Y
R Ulnae	2	31	R Metacarpals	1	35	0.0000	Y
R Ulnae	2	31	L Metatarsals	2	39	0.0085	Y
R Ulnae	2	31	R Metatarsals	1	50	0.0009	Y
R Ulnae	2	31	L Carpals	1	24	0.0000	Y
R Ulnae	2	31	R Carpals	1	21	0.0001	Y
R Ulnae	2	31	L Tarsals	2	33	0.0274	Y
R Ulnae	2	31	R Tarsals	1	27	0.0001	Y
R Ulnae	2	31	Sacra	2	15	0.0351	Y
R Ulnae	2	31	Mandibles	1	32	0.0018	Y
R Ulnae	2	31	Maxillae	1	25	0.0003	Y
L Radii	2	24	L Ribs	1	110	0.0003	Y
L Radii	2	24	R Ribs	1	103	0.0000	Y
L Radii	2	24	Vertebrae C	2	87	0.0014	Y
L Radii	2	24	Vertebrae T	1	186	0.0000	Y
L Radii	2	24	L Metacarpals	2	29	0.0074	Y
L Radii	2	24	R Metacarpals	1	35	0.0000	Y

L Radii	2	24	L Metatarsals	2	39	0.0076	Y
L Radii	2	24	R Metatarsals	1	50	0.0008	Y
L Radii	2	24	L Carpals	1	24	0.0000	Y
L Radii	2	24	R Carpals	1	21	0.0000	Y
L Radii	2	24	L Tarsals	2	33	0.0303	Y
L Radii	2	24	R Tarsals	1	27	0.0000	Y
L Radii	2	24	R Tali	2	17	0.0000	Y
L Radii	2	24	Sacra	2	15	0.0302	Y
L Radii	2	24	Mandibles	1	32	0.0016	Y
L Radii	2	24	Maxillae	1	25	0.0002	Y
R Radii	3	31	L Scapulae	2	36	0.0357	Y
R Radii	3	31	R Scapulae	2	29	0.0061	Y
R Radii	3	31	L Ribs	1	110	0.0000	Y
R Radii	3	31	R Ribs	1	103	0.0000	Y
R Radii	3	31	Vertebrae C	2	87	0.0000	Y
R Radii	3	31	Vertebrae T	1	186	0.0000	Y
R Radii	3	31	Vertebrae L	2	133	0.0006	Y
R Radii	3	31	L Metacarpals	2	29	0.0001	Y
R Radii	3	31	R Metacarpals	1	35	0.0000	Y
R Radii	3	31	R Metatarsals	1	50	0.0000	Y
R Radii	3	31	L Carpals	1	24	0.0000	Y
R Radii	3	31	R Carpals	1	21	0.0000	Y
R Radii	3	31	L Tarsals	2	33	0.0003	Y
R Radii	3	31	R Tarsals	1	27	0.0000	Y
R Radii	3	31	R Tali	2	17	0.0227	Y
R Radii	3	31	L Calcanei	2	19	0.0077	Y
R Radii	3	31	R Calcanei	2	15	0.0394	Y
R Radii	3	31	Sacra	2	15	0.0018	Y
R Radii	3	31	L Patellae	2	12	0.0327	Y
R Radii	3	31	Mandibles	1	32	0.0000	Y
R Radii	3	31	Maxillae	1	25	0.0000	Y
R Radii	3	31	Cranial Frags	2	163	0.0003	Y
L Scapulae	2	36	L Ribs	1	110	0.0006	Y
L Scapulae	2	36	R Ribs	1	103	0.0000	Y
L Scapulae	2	36	Vertebrae C	2	87	0.0040	Y
L Scapulae	2	36	Vertebrae T	1	186	0.0000	Y
L Scapulae	2	36	L Metacarpals	2	29	0.0189	Y
L Scapulae	2	36	R Metacarpals	1	35	0.0000	Y

L Scapulae	2	36	L Metatarsals	2	39	0.0204	Y
L Scapulae	2	36	R Metatarsals	1	50	0.0016	Y
L Scapulae	2	36	L Carpals	1	24	0.0000	Y
L Scapulae	2	36	R Carpals	1	21	0.0000	Y
L Scapulae	2	36	R Tarsals	1	27	0.0000	Y
L Scapulae	2	36	Mandibles	1	32	0.0037	Y
L Scapulae	2	36	Maxillae	1	25	0.0003	Y
R Scapulae	2	29	L Ribs	1	110	0.0427	Y
R Scapulae	2	29	R Ribs	1	103	0.0078	Y
R Scapulae	2	29	Vertebrae T	1	186	0.0116	Y
R Scapulae	2	29	R Metacarpals	1	35	0.0000	Y
R Scapulae	2	29	R Metatarsals	1	50	0.0451	Y
R Scapulae	2	29	L Carpals	1	24	0.0001	Y
R Scapulae	2	29	R Carpals	1	21	0.0009	Y
R Scapulae	2	29	R Tarsals	1	27	0.0015	Y
R Scapulae	2	29	R Innominates	2	44	0.0056	Y
R Scapulae	2	29	Maxillae	1	25	0.0065	Y
L Ribs	1	110	Vertebrae L	2	133	0.0000	Y
L Ribs	1	110	R Metacarpals	1	35	0.0006	Y
L Ribs	1	110	L Carpals	1	24	0.0013	Y
L Ribs	1	110	R Carpals	1	21	0.0123	Y
L Ribs	1	110	R Tarsals	1	27	0.0295	Y
L Ribs	1	110	R Tali	2	17	0.0012	Y
L Ribs	1	110	L Calcanei	2	19	0.0402	Y
L Ribs	1	110	R Calcanei	2	15	0.0332	Y
L Ribs	1	110	Sternums	2.5	6	0.0116	Y
L Ribs	1	110	L Innominates	2	48	0.0000	Y
L Ribs	1	110	R Innominates	2	44	0.0000	Y
L Ribs	1	110	L Patellae	2	12	0.0381	Y
L Ribs	1	110	R Patellae	2	13	0.0005	Y
L Ribs	1	110	Cranial Frags	2	163	0.0002	Y
R Ribs	1	103	Vertebrae L	2	133	0.0000	Y
R Ribs	1	103	R Metacarpals	1	35	0.0059	Y
R Ribs	1	103	L Carpals	1	24	0.0087	Y
R Ribs	1	103	L Tarsals	2	33	0.0141	Y
R Ribs	1	103	R Tali	2	17	0.0001	Y
R Ribs	1	103	L Calcanei	2	19	0.0085	Y
R Ribs	1	103	R Calcanei	2	15	0.0086	Y

R Ribs	1	103	Sternums	2.5	6	0.0053	Y
R Ribs	1	103	L Innominates	2	48	0.0000	Y
R Ribs	1	103	R Innominates	2	44	0.0000	Y
R Ribs	1	103	L Patellae	2	12	0.0071	Y
R Ribs	1	103	R Patellae	2	13	0.0001	Y
R Ribs	1	103	Cranial Frags	2	163	0.0000	Y
Vertebrae C	2	87	Vertebrae L	2	133	0.0008	Y
Vertebrae C	2	87	R Metacarpals	1	35	0.0001	Y
Vertebrae C	2	87	L Carpals	1	24	0.0002	Y
Vertebrae C	2	87	R Carpals	1	21	0.0029	Y
Vertebrae C	2	87	R Tarsals	1	27	0.0068	Y
Vertebrae C	2	87	R Tali	2	17	0.0050	Y
Vertebrae C	2	87	Sternums	2.5	6	0.0182	Y
Vertebrae C	2	87	L Innominates	2	48	0.0001	Y
Vertebrae C	2	87	R Innominates	2	44	0.0000	Y
Vertebrae C	2	87	R Patellae	2	13	0.0014	Y
Vertebrae C	2	87	Maxillae	1	25	0.0337	Y
Vertebrae C	2	87	Cranial Frags	2	163	0.0066	Y
Vertebrae T	1	186	Vertebrae L	2	133	0.0000	Y
Vertebrae T	1	186	R Metacarpals	1	35	0.0010	Y
Vertebrae T	1	186	L Carpals	1	24	0.0022	Y
Vertebrae T	1	186	R Carpals	1	21	0.0202	Y
Vertebrae T	1	186	L Tarsals	2	33	0.0241	Y
Vertebrae T	1	186	R Tali	2	17	0.0002	Y
Vertebrae T	1	186	Sternums	2.5	6	0.0060	Y
Vertebrae T	1	186	L Innominates	2	48	0.0000	Y
Vertebrae T	1	186	R Innominates	2	44	0.0000	Y
Vertebrae T	1	186	L Patellae	2	12	0.0106	Y
Vertebrae T	1	186	R Patellae	2	13	0.0001	Y
Vertebrae T	1	186	Cranial Frags	2	163	0.0000	Y
Vertebrae L	2	133	L Metacarpals	2	29	0.0159	Y
Vertebrae L	2	133	R Metacarpals	1	35	0.0000	Y
Vertebrae L	2	133	L Metatarsals	2	39	0.0155	Y
Vertebrae L	2	133	R Metatarsals	1	50	0.0003	Y
Vertebrae L	2	133	L Carpals	1	24	0.0000	Y
Vertebrae L	2	133	R Carpals	1	21	0.0000	Y
Vertebrae L	2	133	R Tarsals	1	27	0.0000	Y
Vertebrae L	2	133	R Innominates	2	44	0.0009	Y

Vertebrae L	2	133	Mandibles	1	32	0.0016	Y
Vertebrae L	2	133	Maxillae	1	25	0.0000	Y
L Metacarpals	2	29	R Metacarpals	1	35	0.0023	Y
L Metacarpals	2	29	L Carpals	1	24	0.0027	Y
L Metacarpals	2	29	R Carpals	1	21	0.0172	Y
L Metacarpals	2	29	R Tarsals	1	27	0.0392	Y
L Metacarpals	2	29	R Tali	2	17	0.0115	Y
L Metacarpals	2	29	Sternums	2.5	6	0.0300	Y
L Metacarpals	2	29	L Innominates	2	48	0.0016	Y
L Metacarpals	2	29	R Innominates	2	44	0.0000	Y
L Metacarpals	2	29	R Patellae	2	13	0.0049	Y
R Metacarpals	1	35	L Metatarsals	2	39	0.0007	Y
R Metacarpals	1	35	R Metatarsals	1	50	0.0090	Y
R Metacarpals	1	35	L Tarsals	2	33	0.0000	Y
R Metacarpals	1	35	R Tali	2	17	0.0000	Y
R Metacarpals	1	35	L Calcanei	2	19	0.0000	Y
R Metacarpals	1	35	R Calcanei	2	15	0.0001	Y
R Metacarpals	1	35	Sternums	2.5	6	0.0003	Y
R Metacarpals	1	35	L Innominates	2	48	0.0000	Y
R Metacarpals	1	35	R Innominates	2	44	0.0000	Y
R Metacarpals	1	35	Sacra	2	15	0.0075	Y
R Metacarpals	1	35	L Patellae	2	12	0.0000	Y
R Metacarpals	1	35	R Patellae	2	13	0.0000	Y
R Metacarpals	1	35	Mandibles	1	32	0.0065	Y
R Metacarpals	1	35	Cranial Frags	2	163	0.0000	Y
L Metatarsals	2	39	L Carpals	1	24	0.0010	Y
L Metatarsals	2	39	R Carpals	1	21	0.0082	Y
L Metatarsals	2	39	R Tarsals	1	27	0.0184	Y
L Metatarsals	2	39	R Tali	2	17	0.0148	Y
L Metatarsals	2	39	Sternums	2.5	6	0.0327	Y
L Metatarsals	2	39	L Innominates	2	48	0.0014	Y
L Metatarsals	2	39	R Innominates	2	44	0.0000	Y
L Metatarsals	2	39	R Patellae	2	13	0.0056	Y
R Metatarsals	1	50	L Carpals	1	24	0.0113	Y
R Metatarsals	1	50	R Tali	2	17	0.0021	Y
R Metatarsals	1	50	L Calcanei	2	19	0.0418	Y
R Metatarsals	1	50	R Calcanei	2	15	0.0359	Y
R Metatarsals	1	50	Sternums	2.5	6	0.0145	Y

R Metatarsals	1	50	L Innominates	2	48	0.0000	Y
R Metatarsals	1	50	R Innominates	2	44	0.0000	Y
R Metatarsals	1	50	L Patellae	2	12	0.0307	Y
R Metatarsals	1	50	R Patellae	2	13	0.0010	Y
R Metatarsals	1	50	Cranial Frags	2	163	0.0018	Y
L Carpals	1	24	L Tarsals	1	21	0.0001	Y
L Carpals	1	24	R Tali	2	17	0.0000	Y
L Carpals	1	24	L Calcanei	2	19	0.0001	Y
L Carpals	1	24	R Calcanei	2	15	0.0001	Y
L Carpals	1	24	Sternums	2.5	6	0.0002	Y
L Carpals	1	24	L Innominates	2	48	0.0000	Y
L Carpals	1	24	R Innominates	2	44	0.0000	Y
L Carpals	1	24	Sacra	2	15	0.0060	Y
L Carpals	1	24	L Patellae	2	12	0.0000	Y
L Carpals	1	24	R Patellae	2	13	0.0000	Y
L Carpals	1	24	Mandibles	1	32	0.0067	Y
R Carpals	1	21	R Tali	2	17	0.0000	Y
R Carpals	1	21	L Calcanei	2	19	0.0005	Y
R Carpals	1	21	R Calcanei	2	15	0.0008	Y
R Carpals	1	21	Sternums	2.5	6	0.0013	Y
R Carpals	1	21	L Innominates	2	48	0.0000	Y
R Carpals	1	21	R Innominates	2	44	0.0000	Y
R Carpals	1	21	Sacra	2	15	0.0303	Y
R Carpals	1	21	L Patellae	2	12	0.0004	Y
R Carpals	1	21	R Patellae	2	13	0.0000	Y
R Carpals	1	21	Mandibles	1	32	0.0385	Y
R Carpals	1	21	Cranial Frags	2	163	0.0000	Y
L Tarsals	1	21	R Tarsals	1	21	0.0015	Y
L Tarsals	1	21	Sternums	2.5	6	0.0489	Y
L Tarsals	1	21	L Innominates	2	48	0.0135	Y
L Tarsals	1	21	R Innominates	2	44	0.0001	Y
L Tarsals	1	21	R Patellae	2	13	0.0151	Y
L Tarsals	1	21	Maxillae	1	25	0.0073	Y
R Tarsals	1	21	R Tali	2	17	0.0000	Y
R Tarsals	1	21	L Calcanei	2	19	0.0010	Y
R Tarsals	1	21	R Calcanei	2	15	0.0015	Y
R Tarsals	1	21	Sternums	2.5	6	0.0019	Y
R Tarsals	1	21	L Innominates	2	48	0.0000	Y

R Tarsals	1	21	R Innominates	2	44	0.0000	Y
R Tarsals	1	21	L Patellae	2	12	0.0008	Y
R Tarsals	1	21	R Patellae	2	13	0.0000	Y
R Tarsals	1	21	Cranial Frags	2	163	0.0000	Y
R Tali	2	17	Sacra	2	15	0.0272	Y
R Tali	2	17	Mandibles	1	32	0.0019	Y
R Tali	2	17	Maxillae	1	25	0.0001	Y
L Calcanei	2	17	R Innominates	2	44	0.0086	Y
L Calcanei	2	17	Maxillae	1	25	0.0043	Y
R Calcanei	2	15	Mandibles	1	32	0.0422	Y
R Calcanei	2	15	Maxillae	1	25	0.0052	Y
Sternums	2.5	6	Mandibles	1	32	0.0150	Y
Sternums	2.5	6	Maxillae	1	25	0.0044	Y
L Innominates	2	48	Sacra	2	15	0.0141	Y
L Innominates	2	48	Mandibles	1	32	0.0001	Y
L Innominates	2	48	Maxillae	1	25	0.0000	Y
L Innominates	2	48	Cranial Frags	2	163	0.0424	Y
R Innominates	2	44	Sacra	2	15	0.0005	Y
R Innominates	2	44	L Patellae	2	12	0.0495	Y
R Innominates	2	44	Mandibles	1	32	0.0000	Y
R Innominates	2	44	Maxillae	1	25	0.0000	Y
R Innominates	2	44	Cranial Frags	2	163	0.0003	Y
Sacra	2	15	R Patellae	2	13	0.0156	Y
L Patellae	2	12	Mandibles	1	32	0.0314	Y
L Patellae	2	12	Maxillae	1	25	0.0029	Y
R Patellae	2	13	Mandibles	1	32	0.0011	Y
R Patellae	2	13	Maxillae	1	25	0.0001	Y
Mandibles	1	32	Cranial Frags	2	163	0.0084	Y
Maxillae	1	25	Cranial Frags	2	163	0.0003	Y