Using Biotic Taphonomy Signature Analysis and Neoichnology Profiling to determine the identity of the carnivore taxa responsible for the deposition and mechanical mastication of three independent prey bone assemblages in the Mount St. Helen's ecosystem of the Cascade mountain range

by

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The discovery of three independent prey bone assemblages and track evidence within a 17 mile radius of Mount St. Helen's presented a unique opportunity to establish baseline Taphonomic and Neoichnologic profiles of a currently unclassified carnivore taxa. Mount St. Helen's is located within the Cascade Mountain range ecosystem of central Washington State. This mountain range extends from Southern British Columbia to Northern California. The methodologies for this scholarly essay will focus upon chronologically presenting facts, measurements, and analysis based upon the discovery, collection, and synthesis of physical post mortem forensic evidence within an integrated Taphonomic and Ichnologic research framework. These individual and categorical conclusions will then be cross compared in the process of illuminating potential commonalities and evidence based linkages to geographically separated site and evidence profiles. The careful elimination of all of currently classified biological possibilities that may have been responsible for the deposition of this physical evidence required the expansion of methodology and scope of inquiry to include all possibilities both geographical and theoretical in the search for truth as required by the foundations of scientific inquiry. Furthermore, the conclusions drawn from this multi-year research effort should help to enable the collection and comparison of further regionalized prey assemblages against the baseline results of this study as well as encourage additional scholarly attention from anthropologists, forensics scientists, and wildlife biologists in a renewed effort to bring further understanding and clarity to the conclusions illuminated within this treatise. This effort is organized into the following main categories: taphonology and ichnology, discovery and collection narrative, taphonomic and neoichnologic research frameworks, evidence examination, evidence analysis, evidence conclusions, and a call for expanded cross disciplinary examination and discussion.

Taphonomy

Taphonomy is the examination and study of processes that organisms both floral and faunal are subjected to as they eventually become part of the fossil record (Hirst, 2015, para. 1). Taphonomy is further subdivided into two main categories (Lyman, 2010, p. 3). The first one describes the process deposition assemblages are subjected to from death through burial. The second stage is defined from recovery to examination or diagenesis. It is further divided into Biotic and Non-Biotic designations, which categorizes Taphonomy into faunal and floral assemblages (Lyman, 2010, p. 95). Forensic Biotic Taphonomy, a further sub-division provides a structure and organizational format for examining the chronology of a variety of post mortem processes that have been imposed upon assemblages or subset assemblages of human or animal remains (Beisaw, 1994; Pokines & Symes, 2013). Traces of predator activity both modern and in the fossil record can be identifiable in a variety of manners to include residual tooth impressions, disarticulation sequences, behaviors, predatory taxa, functional morphology, and surviving assemblage evidence identification and designation (Pobiner, 2007; Bright, 2010). Forensic Taphonomy was chosen in this essay as a scientific examination framework based upon the evidence profile collected from three different geographically separated prey bone assemblage deposition sites. The majority of the post mortem evidence collected at all three sites were morphologically similar ungulate (*Cervidae)* bone assemblages exhibiting consistent and measureable dentition morpho-physiology and dental load impression avulsion attributed injuries with distinctive accompanying bone stacking behaviors. In cooperation with Taphonomy, Neoichnology was also chosen as an additional complimentary scientific discipline which when integrated enabled the examination and analysis of the total portfolio of evidence collected.

Ichnology

Ichnology is a cross disciplinary branch of Paleontology and involves the scientific study of contemporary plant and animal traces to determine correlation or applicability to the fossil record (Bressan, 2011). It is commonly thought to have originated with Leonardo di Vinci in the 1500's and was constructed as a theoretical examination and explanatory framework which he created to support his theory of trace marine body fossils and sedimentary geology ("Tracemaker," 2015, para. 1). Ichnology can be further divided into the two main categories of Paleoichnology (study of ancient traces) and Neoichnology (study of modern traces). Neoichnology is the study of trace evidence and materials from modern animals in the process of trying to understand evidence illuminated in the fossil record ("Neoichnology and trace fossils," 2014, para. 1). Wildlife biologists and ecologists who study tracks and tracking are practicing Neoichnology ("Ichnology," 2015). Bone stacking behavior, foot prints, and track line evidence required an additional research framework which would complement and further illuminate trace evidence that may be correlated to the taxa potentially responsible for the forensic dental mastication evidence collected from three geographically separated ungulate prey assemblage deposition sites. The selection and integration of both Forensic Biotic-Taphonomy and Neoichnology provide the closest possible examination and analytical framework which would most effectively address the multi-spectrum cross disciplinary evidence collected in the most applicable manner. Together they form an approach that provides the structure needed in order to effectively integrate all evidence collected within both a singular and categorical cross comparative matrix.

Discovery and Collection Narrative

The following accounts from Mitchel N. Townsend and Mr. Gerald Mills are preserved here in our own words. We have decided to include these unedited accounts in keeping with our

stated belief in the open and free exchange of scientific information and discovery. These accounts accurately reflect the chain of events that led up to the discovery of three different geographically separated ungulate prey bone assemblage deposition sites. The exact locations of these sites are not included in this essay to preserve the research value and integrity of each micro habitat. These locations will be freely given to properly credentialed scientists who wish to conduct follow up research within guidelines that preserve this critical and sensitive research environment.

Mitchel N. Townsend Evidence Discovery Narrative*: "Every important discovery begins with a story, this case is no different. On a cold day on the 25th of May 2013 I began my annual trek to a small lake where I had planned get in some hiking and camping after the snow had receded far enough to permit recreational activities around the foothills of Mount St. Helen's.*

On this particular day I strayed about 100 yards to the right as I ascended the funnel route up the hill towards my destination which was situated 200 yards from the crest. As is my custom I was visually scanning the forest when my eyes were drawn to some bones assemblages that shown bright white on the green and brown forest floor. After a very brief examination I was struck by the fact that they were positioned in a manner that seemed inexplicable. Additionally, the bones did not seem to have been visited by local scavengers or strewn over any significant distance. At that time I marked the boundaries of the site with some blue survey tape and continued to my destination. After giving the discovery some additional thought I decided to investigate further when I returned through the area on my way back down from the lake.

Upon arriving back at the bone assemblage site I was struck by a very odd feeling. The forest seemed to be very quiet and I felt the hair on my neck standing up. After taking some initial pictures (Canon Power Shot A542 6.0 Mega Pixels) and video (Sony DCR-SR85 1MP

60GB Hard Drive Handycam Camcorder with 25x Optical Zoom) I did a physical examination of the site contents and discovered at least two sets of deer remains based upon the deer skulls found in direct proximity to the main assemblage of bones. The skulls had their noses/snouts crushed by what looked like blunt force trauma and had been placed in the same general nose downhill orientation. This seemed odd at first glance. What really caught my eye was a pile of bones next to a small log. My first impression was that something or someone had sat down and consumed these animals and just dropped the bones between their legs as they finished them. I further confirmed this by looking closely at the stack and noted some very interesting observations.

The bones seemed to be mostly rib bones that showed evidence of teeth marks and mechanical manipulation to varying degrees. Some areas had seemingly been bitten out and discernable dental impressions left behind. These dental impressions looked measurably different from the other known species that inhabit this ecosystem. After a few more photographs and sustained reflection I decided to collect the best samples of the deer bones from the "Bone Stack". I made an exact location determination with my GPS enabled navigation compass (Garmin eTrex 12 Channel GPS) and further identified the site with more blue survey tape so that I would be able to easily locate it again. I secured the samples in an unused black plastic trash bag and finished the rest of the route back to my transportation at another trail head.

After a couple of weeks of preliminary research towards trying to identify what types of currently classified resident animal species might be responsible for this assemblage site mystery I came to the very difficult conclusion that there was no explanation or identification possible under currently accepted scientific canon and that I would need to expand my research

paradigm to include non-traditional possibilities. With this realization in mind I set about looking for all possibilities that might help to explain the evidence as discovered.

Part of this effort was to contact a "non-traditional" species expert. I contacted Mr. Geoff Robinson of Portland, Oregon who represented a similarly situated national organization who then agreed to meet me, examine the collected specimens and visit the actual site. I met Mr. Robinson the day of our agreed upon appointment and led him to the site that I had now termed the "Bonestacker". Mr. Robinson was immediately intrigued regarding the pictures that I had taken and the bone specimens I had collected. We discussed the deposition of the bones and the potential cause of death as we hiked up the hill.

The site itself was undisturbed after several weeks. The blue survey tape that I had previously placed marked the exact location. Mr. Robinson set about critically examining the site and the narrative that I had provided. He examined the skulls and the remaining ribs and shoulder assembly in the "bone stack". We took more pictures and made some additional measurements.

At the bottom of the deer bone stack were bones from what looked to be the partial paw of a bear. Two other bone fragments looked to be the matching yet seemingly absent digits. These fragments indeed looked to be chewed up and spit out right in the pile next to the other bone remains. This new twist in the "bone stack" was indeed quite mysterious. What resident animal species would kill deer with blunt force trauma on the head, position them in the same directional orientation, eat the animals and drop the bones in a pile? How come scavengers were avoiding this site even though some of the bones still had flesh attached? These were just some of the questions now rushing through my thoughts.

Mr. Robinson and I discussed these additional findings and came to a similar conclusion. This site did not conform to currently accepted behaviors or morphology of known animals in the ecosystem where the site was located. Furthermore, that no other animal species currently classified in North America would engage in the behaviors required to explain the site. With this understanding in mind I returned to researching other potential explanations initially by confirming his observations and then by drafting a research strategy that I felt was needed in order to produce additional applicable information.

The first element of this new comprehensive information generation strategy was to examine what other potential animals from around the world could be responsible for the evidence collected at the "bone stack" site at Mount St. Helen's. The second part of this new strategy was to propose and instruct the first ever college level "Non-Traditional" Species courses at Centralia ("CC," 2014, p. 44, Brewer, 2014) and Lower Columbia Colleges ("LCC," 2014, p. 6) in Washington State that addressed the questions and evidence discovered at the site. This would enable me to engage the public and create a network of eyes and ears that would be searching for additional examples of similar evidence or other possible explanatory interpretations. These college courses were offered in the spring and summer of 2014.

In August of 2014 I returned to the "bone stack" site while I was retrieving some trail cameras in the vicinity I had emplaced several weeks before. I was hoping to catch on film what was responsible for the site. The site was undisturbed and the bones and skulls that I had left were in the same places. Again this was rather disconcerting in that scavengers were still avoiding the location almost 15 months later. Of the three trail cameras (Wild Game Innovations digital game scouting camera Model# s1.3x with SD card) that I had discreetly camouflaged, 2 were placed to record the site. The memory chips when examined displayed

several photographs of completely black pictures from the PM hours. The interesting part is that no discernable tree or bush images were present. How can an infrared enabled day or night trail camera take a picture with a bush or tree within range and not record its position? The last trail camera did not contain any images, and the counter was not tripped.

In September of 2014 one of my former students Mr. Gerald Mills contacted me with exciting news. He had found two other "bone stack" sites on the other side of Mount St. Helen's. He was referring to the Lewis River side. The first site was located on the Green River side. He sent me pictures of several elk rib evidence samples that exhibited very similar dental impressions to the ones on the deer bones that I had discovered. These samples were very clear and measurable. These ribs were also seemingly "stacked" in a pile in front of a stump. It looked like whatever had been chewing on these ribs had sat down and dropped the finished ribs in a pile. In addition, several measurable footprints were visible in the forest floor within the immediate vicinity. The best example was casted in plaster. Careful measurements were taken of track length, width, heel width, step length, and stride lengths. These track prints and the subsequent measurements did not match known examples of any currently classified animal species that inhabits this specific Pacific Northwest ecosystem.

A preliminary analysis of all three sites illuminated many of the same characteristics, over three different locations within relatively close geographical proximity. One of the elk skulls exhibited similar blunt force trauma, the bones were "stacked" in a pile located in front of a stump or log that one could interpret as a potential seat. The dental impressions were very similar and showed evidence of potentially three different sized impressions. The remaining bones and deposition sites were also undisturbed by scavengers.

I met Mr. Gerald Mills and his son Mr. Aaron Mills, both former students of mine from Lower Columbia College on 31OCT2014 and we journeyed to what we had now termed "Bone Stack #2" up above the Lewis River. After arriving we suited up and made our way towards the site through the forest. Mills had recorded the location on his iPad and he led me in a circuitous route through a series of small clearings and old growth timber. We began to discover vertebrae from elk. Mills led the least few feet to the site and we both noted that the bones that he had left were still in place and undisturbed. I took pictures (Canon Power Shot A542 6.0 Mega Pixels) and video (Sony DCR-SR85 1MP 60GB Hard Drive Handycam Camcorder with 25x Optical Zoom) of the site and additional samples of potential evidence. After confirming his observations and recollections we fanned out to search the immediate vicinity for more potential evidence. This search turned up more bone evidence in the form of another rib with flat incisors exhibited which was definitively linked to "EK#1/Bone Stack #2".

Once again the process to identify and classify the animal or animals responsible for the activities associated with what was now three independent sites had reached a seemingly insurmountable obstacle given current scientific understanding and accepted theory. While this would seem the end of this inquiry in reality it has further enabled the expansion of the possibilities and illuminated a requirement to research further into what if any currently classified species would be attributable to the evidence collected. After listing potential evidence from each different evidence collection site and doing some additional preliminary research, a series of commonalities began to emerge. This expanded research paradigm and the subsequent analysis involved lead to a series of startling initial conclusions. These initial conclusions form the foundational basis for the following analytical essay titled "Using Biotic Taphonomy Signature Analysis and Neoichnology profiling to determine the identity of the carnivore taxa

responsible for the deposition and mechanical mastication of three independent prey bone assemblages in the Mount St. Helen's ecosystem of the Cascade mountain range".

Gerald Mills Evidence Discovery Narrative: *"Now I will take up the story about my part in this discovery with some excerpts from my field journal. But, first I'll tell you how I met Mr. Townsend".*

"Mr. Townsend was an instructor of a class I took this summer at Lower Columbia College ("LCC," 2014, p. 6). One day he brought in some deer bones which he had found north of Mt. St. Helens. They had some interesting tooth impressions on them and had been found in a bone pile. I proceeded to file this in my mind as a useful piece of information.

Now to the excerpts from my field journal: On 8-23-14 my son Aaron and I were camped near boundary trail #1 on the east side of Mt. St. Helens. That morning we crossed the trail and headed in a southerly direction from our camp. We followed an old skidder road through the big timber, then along the edge of a 20+ year old clear cut. We ended up on a landing with a great view of the mountain to the west, where we could partially see into the crater.

As we sat there on a big stump enjoying the view we heard something tearing a log or stump apart below and to the south of us. I hit some sticks together to see what would happen, probably shouldn't have, because this spooked whatever it was into the timber across the clear cut from us. We lined up with where we had heard the sound originally and went down the hill until we found where a log had been freshly torn apart. We figured it was probably a bear looking for termites.

We decided to head back up the hill through a small clearing. On the other side of the clearing we found the end of the old road we had originally started on. Shortly we found an adult cow elk skull, with the nose area broken out. Then we started seeing other bones here and there.

I walked around behind a bush and found a bone stack of ribs and vertebrae. The elk had probably been killed earlier in the spring, as they looked fairly fresh with some flesh still present. The odd thing was we found no leg bones in the area, as if they had been carried off later. It looked as if whatever killed the elk, had sat on the mound of earth beside a stump to eat and dropped the bones in a pile as it finished each one. I found two rib bones with flat incisor marks on them. This reminded me of Mr. Townsend's bones. These were not teeth marks that other known predators would make with their teeth without leaving canine marks. The impressions were more like a person would leave biting into something, except they were much larger. I collected two bones and brought them back with us. (This was EK#1 or bone stack #2.)

We then retraced our steps back toward camp which was about ¾ mile away. The plan was to hit trail #1 and walk east on it for a mile or so. Before we got there Aaron found a track impression in the road we had previously walked up. We had missed it the first time by. Aaron was waiting for me and was standing almost on top of it when he noticed it. It was in one track of the skidder road pressed into the hemlock cones and fir needles on the road. The substrate was very hard. It looked like it had been made when the area was damper. Probably after a thunder storm which had occurred a week before. We found three full tracks of which only one was really cast able. The track was 16" long x 7" across ball x 4.5" across heel and ¾" deep. We measured a 72" step with a 144" stride, heel to heel. We first tried following the tracks in the direction they were headed but once we got up over the bank the forest floor was to springy to leave any track impressions. Using a measuring stick, which Mitch Townsend had suggested to us in class, we were able to back track it about 100 yards over a couple of logs, where it appeared to have double stepped before stepping onto the logs. We found that it had come from an area across the creek from boundary trail #1. Both areas were visible from either side

because the forest was old growth and wide open. There were a lot of blue huckleberries in this area. We surmised that it heard something coming down the trail, a hiker or motorcycle, and ran up the hill away from the trail; hence the long stride. It crossed the road and continued up the hill. After casting and back tracking the tracks we crossed over to trail #1 and hiked up it about a half a mile. Except for motorcycle tracks no other tracks were found. We then headed back to camp for the night.

After returning home I noticed that there were actually two different size incisor impressions on one of the rib bones I had collected, possibly a mother and offspring; very interesting.

On 9-8-14, while hunting with my hunting partner, we found another elk kill in an old clear cut about 10 miles SE of the previous kill. We found it in a small hollow under a fir tree. The lower spine, some ribs and one rear leg were located there. Above and on the other side of the hollow we found more ribs stacked on top of a clump of bear grass, the upper spine, and the skull. This skull was intact but the spine was in two pieces. I couldn't determine if this had happened at the time of the kill or after. Some of the bones appeared to have been scattered around by other small animals. Some of the ribs showed the same flat incisor impressions as the previous kill we had found. I collected three of these and brought them back with us. (This was EK#2 or bone stack #3.)

This same hunting season we were able to get an elk. We left the intact rib cage, vertebrae, and pelvis in the area where we had gotten the elk as a sort of control to see what would happen to these bones over a period of time. Two days after the kill we returned to the area and something had dragged the bones away from the kill site. From the evidence, it appeared to be a cougar.

On 10-31-14, Mr. Townsend went with Aaron and I back to the first elk kill site (EK#1). The bone stack had not been disturbed since the last time we were in the area. We proceeded to search the area for further evidence. We found a second hunter killed elk about 40 yards behind the original kill. There were saw impressions on the pelvis and the leg bones of this kill. It appeared to be a couple years old, more weathered with algae growing on them, so it had occurred sometime before the first one we found. The bones of this kill had been scattered all around the area by small animals. We weren't able to find the original kill site of the first elk, but we did find another rib with the flat incisor impressions which I collected and returned with us. While there, we also found a spring in the area, which would make it a good area to hunt animals frequenting the spring.

We then proceeded to the control site of our hunter killed elk. The carcass was still intact except for a few of the ribs that had been broken loose from being dragged around. The flesh was stripped from the bones, but I could find no apparent tooth impressions on the bones. The bones had again been dragged from the original drag site about 40 yards to the other side of the kill site. So whatever had feed on this kill did not disarticulate the skeleton except for knocking a few ribs loose.

Because of the location of the second kill we had found (EK#2), and time constraints, we were unable to return to that location. We then returned to town.

I was very curious as to what we had found, so I decided to take a more in depth look into this. After doing some research on elk predators, I found that forensically the type of predator which has killed and/or fed on an animal can be determined by the tooth impressions left by said predator. Finding that the impressions on the collected bones did not match any of the known predators I decided to compile our findings into a report. I also found from this research that

very few predators will tackle an adult elk because of the hazards that can occur to the predator. Adult male cougars are usually the only predator in Western Washington that will attack an adult elk and the percentage of these kills is low. Elk calves are usually the prey of choice for both cougars and black bear". (Pictures were taken with a Nikon Coolpix S9500 and video recorded with an ASUS Nexus 7 Android)

This concludes the discovery and collection narrative. The inventory of post mortem evidence collected from each individual evidence deposition location has been carefully inventoried and preserved. Perishable Neoichnologic evidence in the form of tracks and track line measurement data was preserved as well. One of the tracks was casted in plaster and the track line was carefully reconstructed, examined, measured, and recorded. The totality of the evidence collected necessitated an integrated cross disciplinary examination framework. For the purposes of this examination we chose to integrate Forensic Biotic Taphonomy and Neoichnology into a format that enabled us to examine all of the evidence collected both singularly and comprehensively in the process of successfully establishing a base line profile of the carnivore taxa responsible.

Taphonomic Research Framework

Forensic Biotic Taphonomy provides an analytical framework which enables the organization of applicable evidence and data collected into a format that illuminates comparative results related to post mortem bone assemblage disarticulation sequencing and residual scavenger tooth pattern artifacts (Haglund, et al, 1989; Haglund & Sorg, 2002). Disarticulation sequencing provides additional clues as to what types of predator or scavenger may be responsible (Bright, 2010; Pickering et al., 2013, p. 1303). This forensic re-construction process illuminates the fact that predator and scavenger taxa target different areas of a cadaver for

quantifiable reasons that can be attributed or generally assigned to specific species (Plummer & Stanford, 2000, p. 360; Bright, 2010; Cantu, 2014, Garcia-Putnam, 201; "Alberta Fish and Wildlife," 2015, p. 3; "Center for Wildlife," 2015). Disarticulation sequencing is dependent upon a large degree of variables which must be examined and considered for potential applicability within individual research strategies (Haglund et al., 1989; Cantu, 2014; Garcia-Putnam, 2014). Disarticulation Sequencing provides the first boundary edge of our Biotic Taphonomic research framework.

The body of scientific evidence related to understanding taphonomic dentition morpho-physiological signatures of contemporary large body predators currently available is limited however, there is sufficient data available to make comparative analysis possible (Bright, 2010). Careful examination and analysis of dentition morpho-physiology may help identify the source of the carnivore or scavenger responsible (Carson, et al, 2000; Foust, 2007; Bright, 2010, Fonseca & Palacios, 2011; Tedesci-Oliveira, et al, 2011). The identification of resident carnivore and scavenger taxa present within a specific ecosystem and charting the dentition morpho-physiology of each enables a process of exclusion or inclusion. The amount of resources available for examining the measurements and shape of contemporary predator teeth are widely available (Lyman, 1994; Foust, 2007; Smits & Evans, 2012; Christensen, 2014; "Skulls and Teeth," 2015). The examination and analysis of all prey bone assemblage dental load injury patterns would help to establish a baseline profile of tooth measurements and shape data which can then be assigned to or eliminate specific predators or scavengers responsible for the “Bonestack” sites at Mount St. Helens. Forensic dental load injury analysis provides the second boundary edge of our Biotic Taphonomic research framework.

Neoichnologic Research Framework

Neoichnology provides a scientific research framework for examining the behavior and biogenic structures produced by contemporary organisms to provide potential insights and information in order to further understand similar evidence generated from throughout geologic history (Gingras, et al, 2008; Bressan, 2011;"Neoichnology and trace fossils," 2014). Any organism can produce several different types of trace evidence based upon specific behaviors ("KU Ichno," 2015). Some examples of this type of behavior based evidence would include tracks, nests, burrows, borings, scat, feeding activity, or any other traces that could be correlated to a specific organism (Bromley, 1996; Bowen & Hembree, 2014). Trace fossils or "Ichnofossils" are preserved in place and records of behavior which are rarely transported out of the immediate deposition environment (Catena & Hembree, 2014). This gives researchers the ability to situate the trace maker within a specific geographical location. The Neoichnologic evidence profiles collected from all three prey bone assemblages are very similar in content and disposition. Behavioral trace ichnofossils include bone stacking behavior, choice of prey, dearth of scavenger activity, and disarticulation chronology and methodology. This evidence category provides the first boundary edge of our Neoichnology research framework. Physical trace ichnofossils including footprints and track line evidence integrated for comparative examination and analysis provides the second boundary edge of our Neoichnologic research framework (Meldrum, 2007).

Integrated Research Framework

The Integration of Taphonomy and Neoichnology enabled a multi-spectrum cross-disciplinary research approach that was specifically tailored to the examination and analysis of the "Bonestack" evidence profiles collected. This cross disciplinary framework enabled us to examine each individual piece of evidence singularly and within potentially related contexts and

expository scenarios. We will methodically document, measure, record, chart, and explain within context every item collected. After this process we shall search for potential patterns that may emerge definitively linking or preventing the linkage of individual pieces of evidence into an integrated explanatory narrative. Individual and consolidated conclusions will be carefully cross-compared against current scientific research and theory to further narrow the identification possibilities regarding potentially responsible carnivore taxa. Finally, integrated analysis and conclusions will submitted for public examination and critique in the form of a multi-level peer review process before submission for formal publication consideration.

Evidence Examination

Mount St. Helen's is geographically located in the north central area of the Cascades Mountain range. The Cascades Range stretches over 700 miles from Southern British Columbia to Northern California and parallels the Pacific Ocean about 100-150 miles inland ("Cascades," 2015).

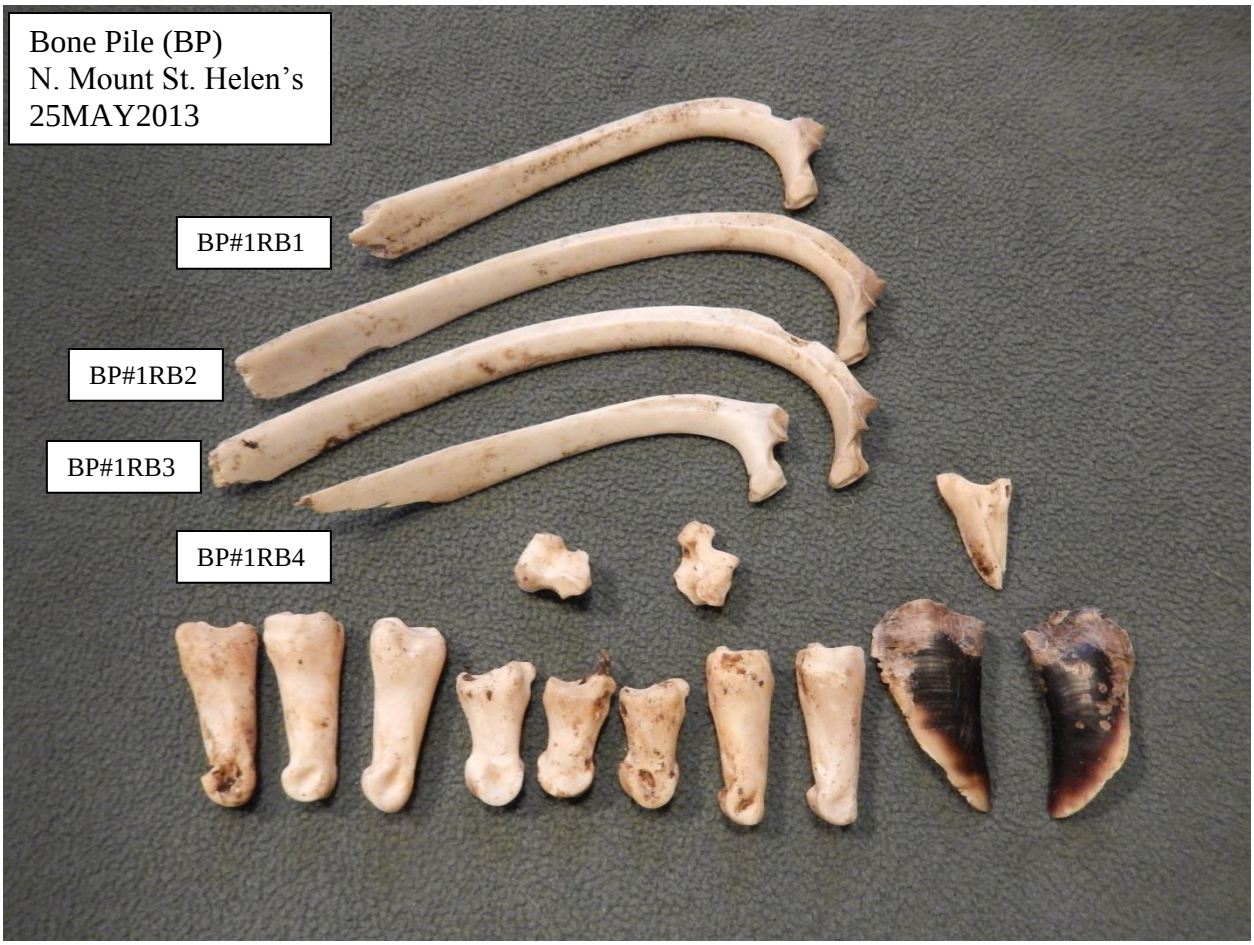
http://upload.wikimedia.org/wikipedia/commons/c/cc/Cascaderangemap.jpg	http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0CAcQjRw&url=http%3A%2F%2Fwww.hdwallpaperup.com%2F2015%2F01%2Fmount-st-helens-sunset%2F&ei=mQlmVbjPAsTYsAXO1oH4Bw&bvm=bv.93990622,d.b2w&psig=AFQjCNH_wbsqCMbwSvcfV8

The geographical location directly around Mount St. Helen's is a region that has seen regular volcanic activity and is currently recovering from its most recent eruption on May 18, 1980 ("Science Update," 2010; "Eruption," 2015). Flora and fauna present before the latest eruption have also begun to make significant levels of resurgence. Large mammals common to the region include elk (*Cervus canadensis*), black tail deer (*Odocoileus hemionus columbianus*), mountain goat (*Oreamnos americanus*), black bear (*Ursus americanus*), cougar (*Puma concolor*), lynx (*Lynx canadensis*), *and* wolverine (*Gulo gulo*), (Thompson, 2010). The resident species listed above illuminate the both the prey animals and the potential predator taxa responsible for the

evidence recovered from three geographically separated deposition sites discovered within this ecosystem.

The first prey assemblage deposition site titled “BP” was located on the north side of Mount St. Helen’s approximately 12.5 miles from the crater in the Ryan Lake Interpretive Site area. The elevation at the exact deposition site is approximately 2900 feet above sea level. The terrain consists of a narrow mountain valley ascending upward and outward at approximately a 45 degree angle with a cliff on the downward sloping side and a steep hillside on the upslope side which combine to form a natural funnel. The prey bone assemblage was located in the lower elevation and narrower throat of the funnel. This specific funnel mouth location is approximately 150 feet from slope to cliff. Blue huckleberries (*Vaccinium deliciosum*) and red huckleberry (*Vaccinium parvfolium*) bushes are quite numerous. In addition, the remaining flora generally consists of very large first and second growth coniferous trees with little undergrowth and a under canopy visibility range of approximately 20-300 feet.

The biotic taphonomic evidence collected included 17 specimens of bone including ribs(4) (BP/RB1, BP/RB2, BP/RB3, BP/RB4), lower foot bones (8), wrist or ankle bones (2), toe bone (1) and halves of one hoof (2) from the black tail deer (*Odocoileus hemionus columbianus*) species.



These specimens exhibited potential evidence of mechanical manipulation and were subjected to stacking behaviors. One partial shoulder assembly from the stack was not collected or catalogued into the specimen evidence profile. It was recorded but not collected based upon preliminary examination which did not reflect any potential mechanical manipulation. Photographic evidence has been retained for reference. The post-mortem remains of at least two animals were also recorded at the site based upon the skull evidence present. Skull evidence suggested blunt force trauma as the potential cause of death. Additional bones were also observed within a 30 feet conical shaped debris field. No hair or other separate flesh evidence was present at the site. Disarticulation sequencing and surviving bone examples were noted and recorded. Finally, a lateral post-mortem cone shaped prey assemblage debris field pattern was noted and recorded.

No specimen evidence was subjected to scavenging behavior. All of the bones present in the immediate deposition zone were observed to be relatively fresh. All evidence not physically collected was photographically preserved in the form of photographs and video.

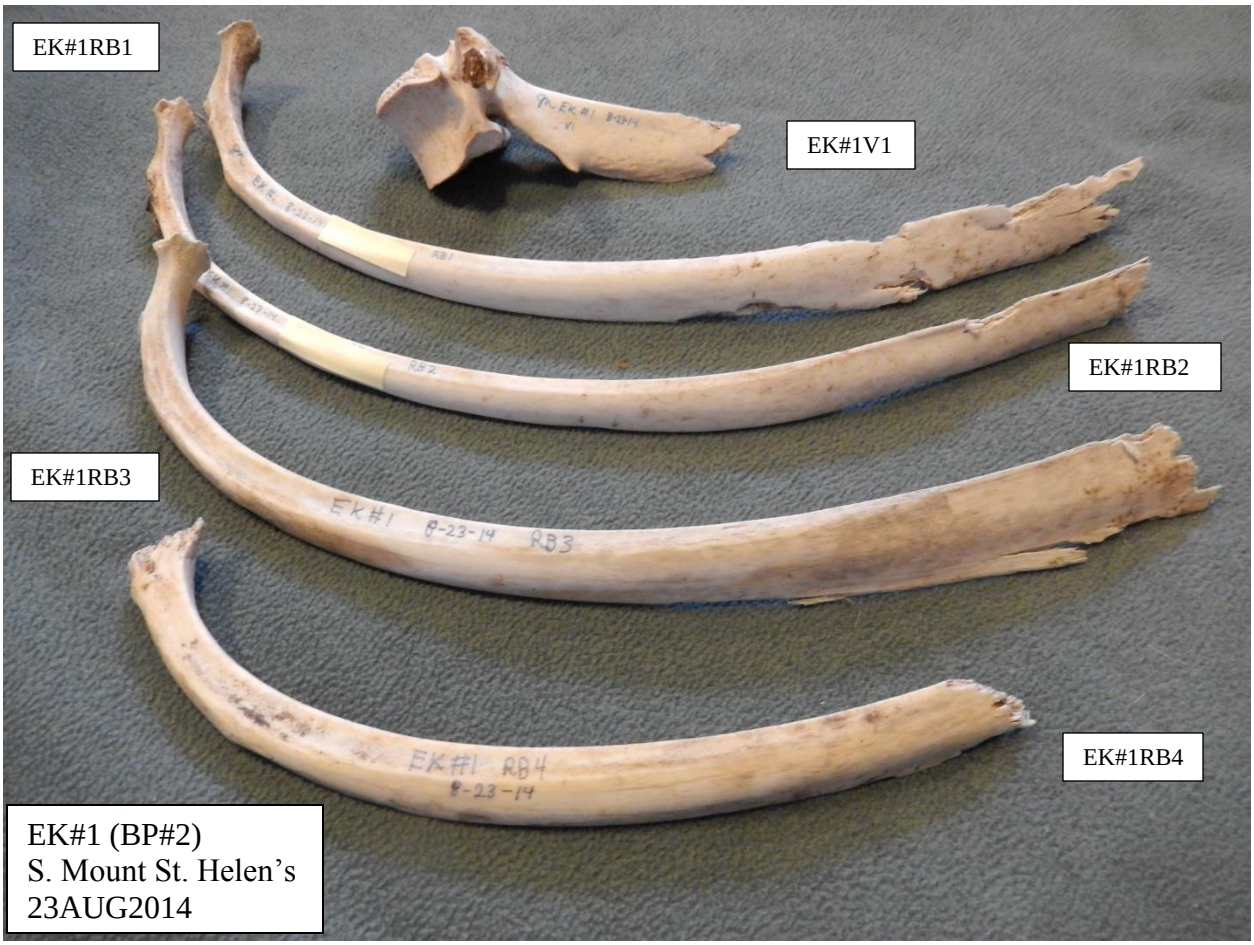
After closely examining all of the bone specimens collected only four ribs evidenced observable and measurable mechanical manipulation evidence. Dental load attributed avulsion injury measurements were taken with a Mitutoyo dial caliper in both millimeters and inches. Specimen BP/RB1's ventral end is broken. It has a possible molar cusp impression at the break on the inside. It also shows one flat incisor impression on the side of the rib near its dorsal end .50" (12.7mm) wide. Specimen BP/RB2 exhibited one flat incisor impression on the side of the rib near the ventral end .50" (12.7mm) wide. Specimen BP/RB3 Exhibited one flat incisor impression on the side of the rib near the dorsal end .54" (13.72mm) wide. Specimen BP/RB4 was broken diagonally at the ventral end showing slightly jagged on the inside edge. It also showed surface texture disturbance on the dorsal end which may have occurred during the disarticulation process. No other visual evidence was observed or recorded for the rib evidence specimens. The rest of the specimens showed no visually obvious mechanical modification or scoring by teeth. Small amounts of flesh remained attached to one of the lower foot bones. All of the additional specimens were disarticulated but none were cracked or chewed with enough force to leave discernable impressions.

The Neoichnologic evidence collected is behavioral in disposition. Bone collection and stacking behavioral evidence was observed, examined, and recorded for further analysis.

Prey selection was recorded. The stack of bones was positioned in front of a small log where one could reasonably theorize that it may have been utilized as a potential seat. Rib disarticulation processes from spinal column vertebrae evidence was also noted and recorded. Consumption sequence behavior as evidenced by surviving specimens within the bone pile suggests specific deliberate processes and preference choices. Potential evidence of skull blunt force trauma suggests predatory behavior patterns rather than accidents or disease. Lack of scavenging behavior or evidence potentially suggests territorial marking, predatory site identification, or continued proximity presence of the predator responsible. Site location and topographic funneling also suggests the possibility of pinch point hunting or predatory ambush behaviors.

The second deposition site titled EK#1 was located on the south side of Mount St. Helen's near Boundary Trail #1. The exact location remains classified to protect the integrity of this critically sensitive research environment. The elevation was at the exact deposition site was recorded at 3900 feet above sea level. The site is located on a small flat plateau at the base of a slope that leads to a ridge between the Cispus and Lewis Rivers watersheds. This location is commonly referred to as the "Dark Divide". The exact site was located within a twenty year old clear cut which contained scattered small clearings. The surrounding terrain exhibited large old growth and second growth coniferous trees with significant intermediate mid-level vegetation ground cover. The existing ground vegetation is intermittent with small clearings opening up at regular intervals. Visibility ranges from less than 50 feet to over 300 feet. There is at least one active surface water spring within approximately 300 feet of the bone pile which provides water to the immediate area. Blue huckleberries (*Vaccinium deliciosum*) are very prevalent in this area. The ungulate bone sample evidence recovered from this deposition location was fresh.

The biotic taphonomic evidence collected included rib bones (4) (EK#1/RB1, EK#1/RB2, EK#1/ RB3, EK1#/RB4) and one vertebrae EK#1/V1 and lower legs bones (4) from an elk (*Cervus Canadensis*).



Dental load attributed avulsion injury measurements were taken with a Mitutoyo dial caliper in both millimeters and inches. These specimens exhibited potential evidence of mechanical manipulation and were subjected to stacking behavior. Skull evidence present suggested blunt force trauma as cause of death verses accident or disease. Additional bones were also observed within a large prey assembly debris field possibly suggesting more than one decedent. No hair or other separate flesh evidence was present at the site. Disarticulation sequencing and surviving bone examples were noted and recorded. Scavenger activity was almost non-existent and when re-visited on October 31st 2014 was unchanged. A very small amount of specimen evidence was subjected to identifiable scavenging behavior. All evidence not physically collected was photographically preserved in the form of pictures and video.

After closely examining the bone specimens collected all showed evidence of varying degrees of mechanical manipulation. The vertebrae designated EK#1/V1 had one dorsal tip impression of approximately .11” (2.79mm). This round impression appears to be the canine of a small scavenger. Specimen EK#1/RB1’s ventral is broken and appears to have been chewed off with no identifiable teeth impressions evident. EK#1/RB1 has five different distinctive and one inconclusive bite mark locations. EK#1/RB1-1 marks appear to have been made by three large flat incisors. Mark #1 measures .75” (19.05mm) wide. Mark #2 measures .61” (15.49mm) wide. Mark #3 measures approximately .62” (15.75mm) wide because the bone in split off at this location. The bite radius for EK#1/RB1-1 is 1.650” (41.91mm). EK#1/RB1-2 shows one incisor impression on the outside and two impressions on the inside of the rib. The predator bit through but did not break the piece off. One tooth which perforated the bone measured .55” (13.97mm) wide and .15” (3.81mm) thick. The bone may have flexed around this tooth and then returned to shape thus making an exact measurement problematic. This further suggests that the bone’s age at the time of predator consumption and mastication as contemporary to death or within a relatively short approximate time frame. EK#1/RB1-3 evidences the same flat tooth impression shape with smaller sizes. Mark#1 grazed the bone and measures .21” (5.33mm) wide. Mark #2 measures .3125” (7.94mm) wide. Mark#3 measures .40” (10.16mm) wide. EK#1/RB1-3 bite radius measures 1.197” (30.48mm). EK#1/RB1-4 is chipped but with no discernable tooth impressions. EK#1/RB1-5 evidences a missing section of bone material that measures 1” (25.4mm). EK#1/RB1-6 shows undiscernible marks that appear to have been made by rounded molar cusps in the form of shallow dents.

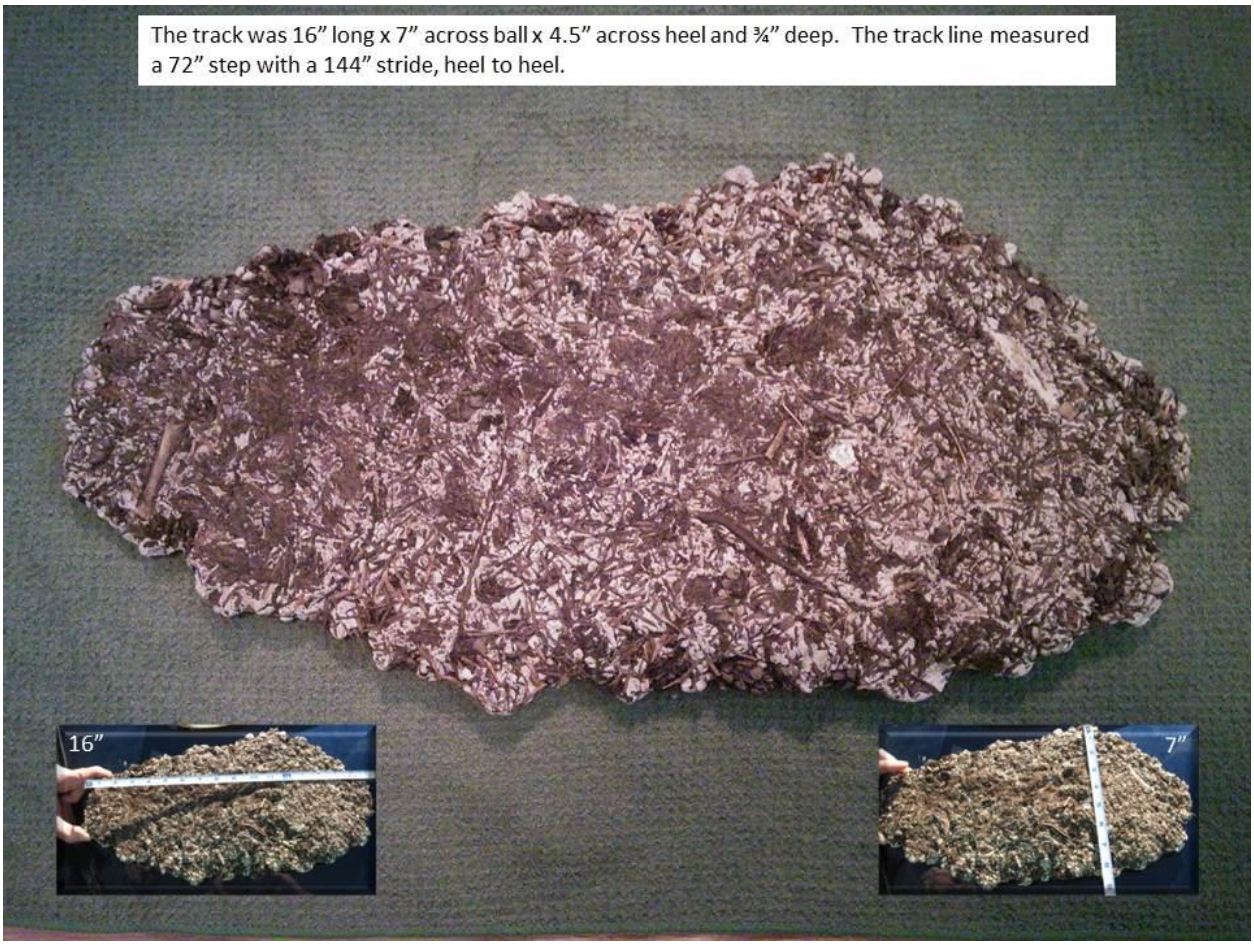
Evidence specimen EK#1/RB2 seems to be chewed or broken off in a similar manner to EK#1/RB1. A gouge is evident on one side without identifiable impressions. On the opposite of

this mark is a long thin chip missing which measures .55” (13.97mm) long. EK#1/RB3 has been masticated on at the ventral end. EK#1/RB3-1 exhibits two flat incisor impressions. Mark#1 measures .38” (9.65mm) wide. Mark#2 measures .40” (10.16mm) wide. EK#1/RB3-2 has missing material that measures 1.75” (44.45mm) with a possible flat tooth impression visible. EK#1/RB3-3 has a long edge piece missing which measures 1.8” (45.72mm) long. The inside of this specimen has two flat impressions which match and measure at .28” (7.11mm) long. Specimen EK#1/RB4 is missing both the dorsal and ventral ends as they have been masticated off. EK#1/RB4-1 shows one flat incisor mark that measures .37 (9.4mm) wide. EK#1/RB4-2 exhibits two flat incisor impressions. Mark#1 measures .27” (6.56mm) wide. Mark #2 measures .29” (7.37mm) wide. These impressions compare very closely to the previously detailed smaller incisor evidence. The flat end of the incisors is quite clear. EK#1/RB4-3 has two round canine impressions on at the dorsal end that measure .125 (3.18mm) and .325 (8.26mm) on center.

The Neoichnologic evidence collected from the exact location of this prey assemblage deposit is behavioral in disposition. Bone collection and stacking behavioral evidence were observed, examined, and recorded for further analysis.

Prey selection was recorded. Rib disarticulation process from spinal column vertebrae evidence was also noted. Consumption sequence behavior as evidenced by surviving specimens within the bone pile suggests process or preference choices. Potential evidence of skull blunt force trauma suggests predatory behavioral patterns. Lack of scavenging behavior or evidence suggests territorial marking, predatory site identification, and or continued proximity presence of the predator taxa responsible. Comprehensive terrain analysis and the large amount of peripheral bone evidence strongly suggest repeated ambush behavior manifestation.

Within half of a mile of this site several recognizable tracks were found pressed into firmly packed Hemlock cones which were then further compressed into the hard packed dirt substrate surface of a major trail. One of the tracks was casted using plaster.

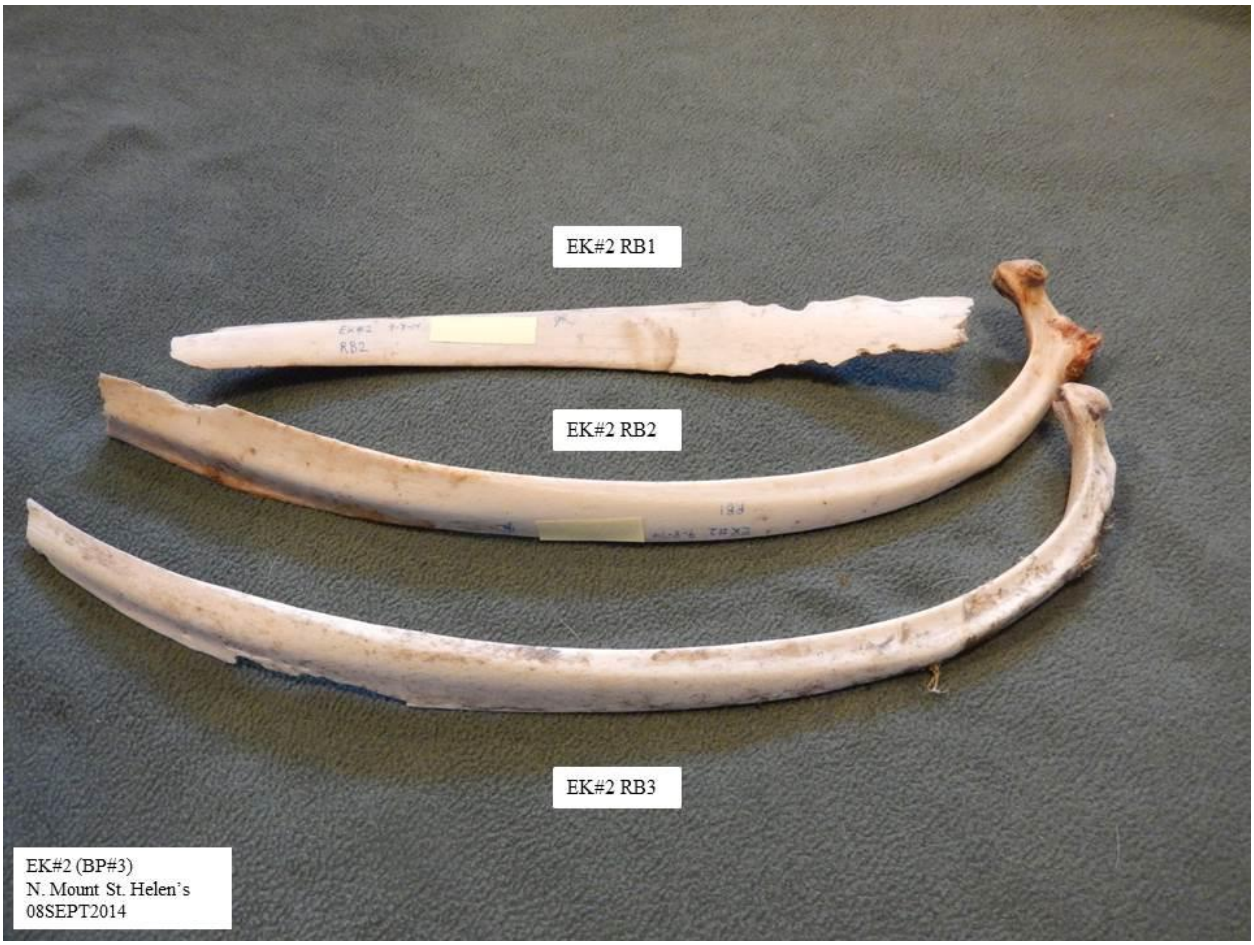


The tracks were “Hominoid” tracks of approximately 16”in length, 7” width across the ball of the foot, and 4.5”width across the heel. The step measured 72” with a stride of 144” from heel to heel. Several other faint track impressions were noted as this track line was carefully reconstructed to a distance of over 300 feet (91.44 m) where it eventually disappeared due increasingly unfavorable substrate conditions on the forest floor. No other similar tracks were located in proximity to this area or in this chronological time frame.

The third and final deposition site titled EK#2 was also located on the south side of Mount St. Helen’s about 10 miles South East of EK#1. Dental load avulsion attributed injury measurements were taken with a Mitutoyo dial caliper in both millimeters and inches. The elevation at the exact deposition site was recorded at 3200 feet above sea level. The immediate

terrain around the site topographically descends down from the “Dark Divide”. Blue huckleberries (*Vaccinium deliciosum*) and Oregon grape (*Mahonia aquifolium*) are very prevalent. The main prey assemblage was located in a small hollow under a fir tree near a small spring fed creek. The lower spinal column, some ribs, and one rear leg were located in this location among elk hair tufts. Some of the remaining bones looked like they had been scattered about on a flat area above the hollow. The actual kill may have occurred on an elk trail leading into this area from the ridge above where more tufts of elk hair were located and identified. Above and on the opposite side of this hollow the rest of the spine was located along with the skull and a stack of rib bones set on a clump of bear grass that appeared to have been masticated. The exact cause of death is hard to definitively determine, however catastrophic spinal separation at the mid-level would account for death. Dental load avulsion attributed injuries and the surviving bone depositions looked very similar to the previous site specific examples found at BP and EK#1. The skull at this site was intact with no evidence of blunt force trauma. The specimen bones collected from this deposition location are very similar to the other two collection locations in type (*Cervidae*) and selection (Ribs) again suggesting deliberate processing and selection.

The biotic taphonomic evidence collected consisted of rib bones (3) EK#2/RB1, EK#2/RB2, and EK#2/RB3 from an elk (*Cervus Canadensis*).



These specimens exhibited potential evidence of mechanical manipulation and were subjected to stacking behavior. Specimen EK#2/RB1 The dorsal end exhibits no visually apparent modification. The edge of the rib bone has a shallow flat channel positioned longitudinally that suggests a tooth scrapping flesh from the surface of the bone. The ventral end exhibits modification by small predators and or scavengers. EK#2/RB1-1 has three flat incisor shaped impressions. Mark#1 measures .42" (10.67mm) wide. Mark#2 measures .47" (11.94mm) wide. Mark #3 measures .48" (12.19mm) wide. EK#2/RB1-2 has small round predator and or scavenger marks upon the dorsal end. It has also been bitten from the inside with maxillary incisors. The Maxillary Canine width measures .125" (6.34mm) with a spread distance of .525" (13.34mm). The Mandibular Canine width measures .125" (3.18mm) with a spread distance of

.35 (8.89mm). EK#2/RB1-3 exhibits two barely discernable impressions which match the distance between the maxillary incisors of EK2/RB2-2 which measures .525” (13.34mm) and are visible at about 4.5” (114.3mm) from the end of the bone on the external side. EK#2/RB1-4 has a long score on the internal side of the bone opposite EK#2/RB1-1 which measures 1.25” (31.75mm) in length. It appears to be impressed into the bone verses scored out of it. There are slight tooth impressions on the opposite side of the bone corresponding with biting down rather than scoring or sliding along the rib surface longitudinally.

Specimen EK#2/RB2 Shows evidence of modification by at least two different predators. The dorsal end is gone and the ventral end exhibits tooth scoring. EK#2/RB2-1 shows three distinctly flat tooth impressions. Mark#1 measures .62” (15.75mm) wide. Mark#2 measures .49” (12.45mm) wide and exhibits a very distinctive “twist or snag feature” that may be an individual intra-species identification characteristic. Mark #3 measures .46” (11.68mm) wide. EK#2/RB2-1 has an approximate bite radius of 1.459” (37.08mm), the shape of the impressions make ascertaining the bite radius measurement problematic. RB2-2 Shows a straight impression toward the bone median before the tooth moved back and then bit a piece out of the bone. Mark #1 measures .4” (10.16mm) long. Mark #2 measures .73” (18.54mm) wide space that was missing from the bone edge. EK#2/RB2-3 exhibits the same type of impressions as EK#2/RB2-2, as it again bit down then moved back. It seems that a potential second bite missed the bone. Mark #1 measures .4” (10.16mm) in length. EK#2/RB2-4&5 have both the ventral and dorsal ends exhibiting mastication activity. They also showed sharp small impressions that suggested those of a small predator and or scavenger’s molars.

Specimen EK#2/RB2-6 exhibits round canine dental impressions. Maxillary canine width measures .17” (4.32mm) with a spread distance of .475” (12.06mm). Mandibular canine

width is .17” (4.32mm) with a spread distance of .35” (10.61mm). EK#2/RB2-7 exhibits the same type of impression profile as EK#2/RB2-6 with additional scores from the median to the outer edge of the bone. Finally, EK#2/RB2-8 shows three shallow scoring marks in the center of the bone and parallel to its axis. They measure approximately 1.1” (27.94mm), 2.6” (66.04mm) and .21” (5.33mm) with an equal distance in separation.

Specimen EK#2/RB3 is the final piece of biotic Taphonomy evidence collected and measured from EK#2. This bone exhibited multiple impressions along one edge and suggested a small predator and or scavenger was gnawing upon the bone. The cusp impressions are triangular in shape and measure .1” (2.54mm) wide. A section of the bone is missing in this location and measures 2.5” (63.5mm) long. Impressions seem to match EK#2/RB2-2 marks #2 and #3 suggesting more evidence of a potential distinctive intra-species identification characteristic. Finally, this area has some additional small impressions of an indiscernible disposition.

The Neoichnologic evidence collected from the exact location of this prey assemblage deposit is behavioral in disposition. Bone collection and stacking behavioral evidence was observed, examined, and recorded for further analysis.

Prey selection was recorded. Rib disarticulation process from spinal column vertebrae evidence was also noted and recorded. Consumption behavior as evidenced by surviving specimens within the bone pile suggests processing and or preference choices

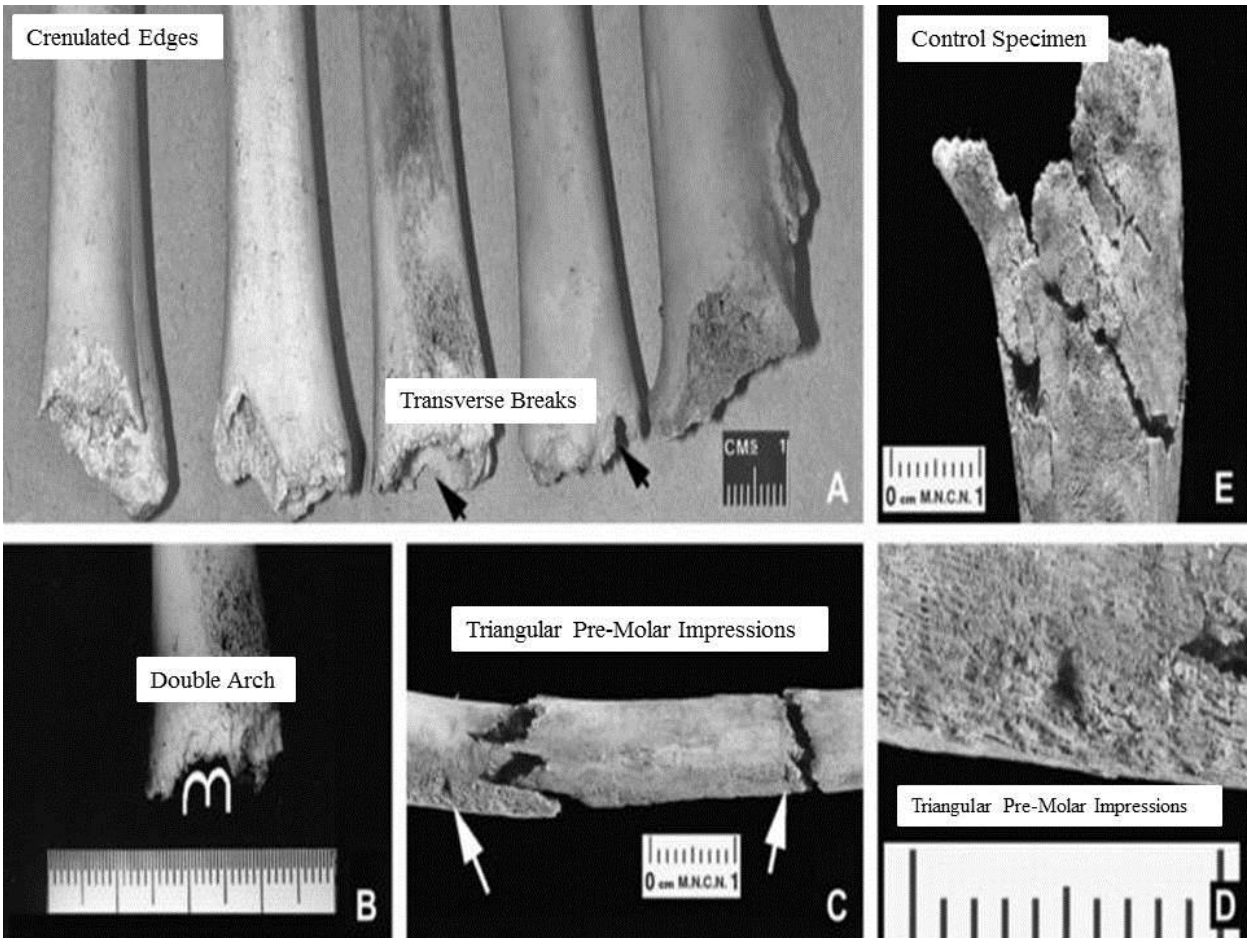
Evidence Analysis

The taphonomic and neoichnologic conclusions for BP1, EK#1 (BP#2), and EK#2 (BP#2) are very similar in disposition. The conclusions drawn from these commonalities and will be listed and examined together to provide direct comparison and contrast. The evidence for the taphonomic research category focuses upon post mortem dental load attributed avulsion injury evidence analysis. This evidence is sub-divided into the following categories: mastication evidence, bite radius/arch, upper inter-canine measurements, tooth shapes and sizes, and hominoid dentition morpho-physiology cross comparison. Conclusions are drawn from the cross comparison analysis of the taphonomic data drawn from all three deposition sites.

The post-mortem forensic dental impression analysis of the surviving ungulate bones specimens from collection sited BP, EK#1, and EK#2 all exhibited very similar mastication processes that resulted clear and conclusive evidence. None of the bone specimens exhibited heat processing or tool damage evidence of any kind. All of the specimens were deposited within one year of recovery based upon their physical condition which included residual flesh attachments and a clear lack of intermediate to advanced diagenesis evidence. No algae or mold was present and the rib bones still maintained a small amount residual ability to flex and twist without fracture. The Journal of Forensic Taphonomy describes the weather process in terms of six weathering stages designated (WS 0 through WS 5) based upon progressive linear cracking and flaking of the cortical surface, followed by formations of rough fibrous texturing, and loss of structural integrity (Pokines & Symes, 2013, p. 292). The evidence samples collected and analyzed clearly qualified for the WS-0 designation and exhibited very little weathering. All of the surviving specimens were in excellent condition with clear and quantifiable evidence of signature hominoid molar based mastication rib bone peeling with measureable hominoid dental avulsion attributed injuries.

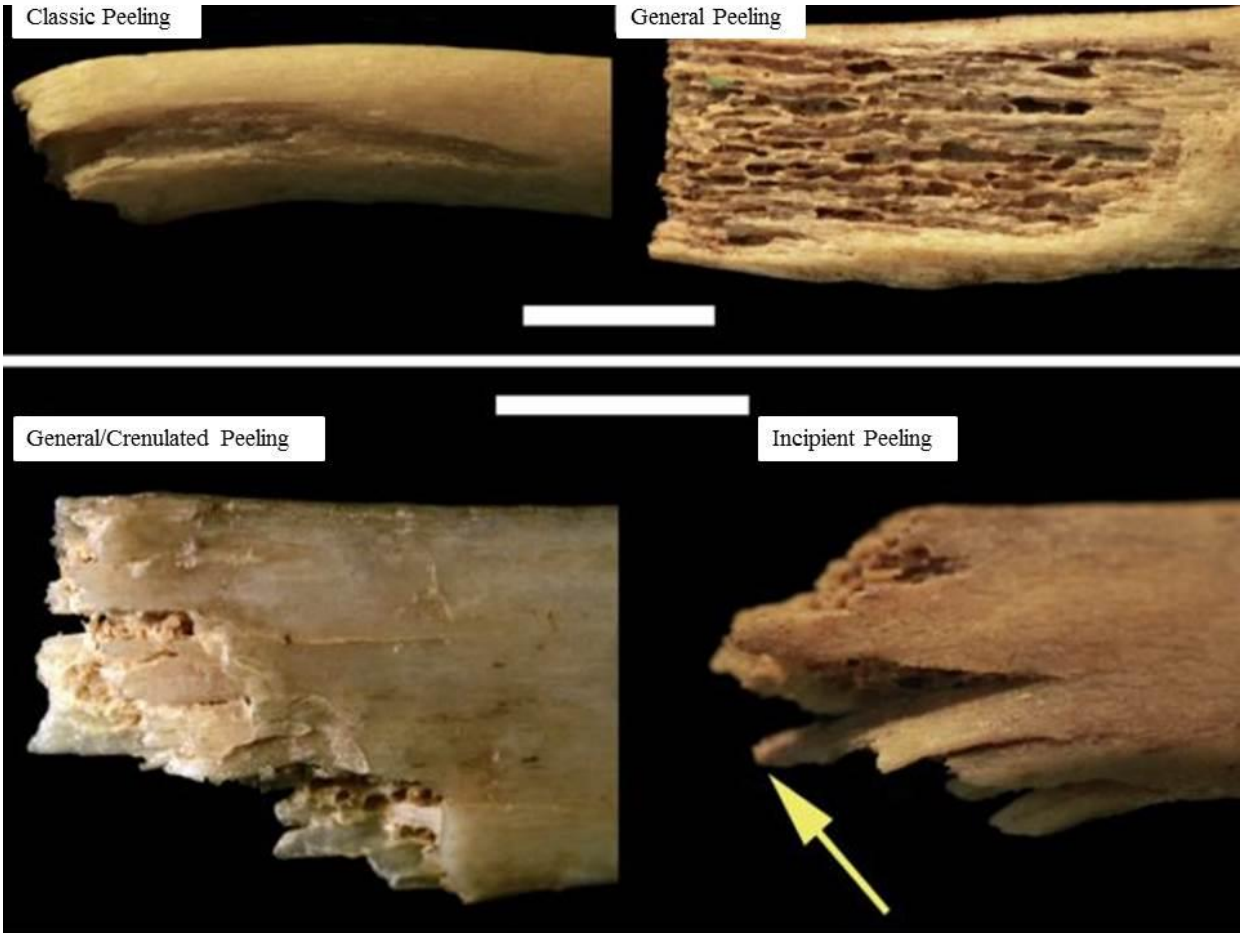
The identification of suspected primate generated marks on animal bones has been previously investigated primarily to determine the differences between hunter-scavengers and passive scavengers among pre-technology early hominoids (Pickering and Wallis, 1997; Plummer and Stanford, 2000; Pobiner et al., 2007). Contemporary human chewing studies (Elkin & Mondini, 2001), contemporary chimpanzee mastication strategies, and ethno-archaeological studies (Brain, 1981; Lupo & O'Connell, 2002) have all been done to help illuminate information that could possibly be extrapolated into the evolution of early hominoids. Some of the main traits that identify human chewed bones are bent bone ends or masticated ends,

crenulated edges, bone peeling, double arch molar punctures on the chewed edges, triangular shaped pre-molar impressions, and puncture or linear mark evidence upon the bones surfaces as cited in Fernandez-Jalvo & Andrews, (2010, p. 119); Viegas, (2012, para. 3).



Fernandez-Jalvo & Andrews, (2010, p. 1119), Fig, 2.

The mastication process termed *Rib Peeling* is highly diagnostic of ancient and some contemporary hominoids and more specifically hominin faunal activity as cited in Pickering et al., (2013 p. 1301).



Pickering et al., (2013 Pg. 1301) Fig. 3.

Contemporary chimpanzees also exhibit very similar mastication generated evidence as cited in and Fernandez-Jalvo & Andrews (2010, p. 121). There are three main types of rib cortical peeling. The first is named *Classic Peeling* and is described by Pickering et al., (2013) as like bending a fresh twig from a tree, the two sides even while snapping are connected with fibrous cortical tissue until further separated or peeled apart. The second is called *General Peeling* and is described by Pickering et al., (2013) as an area of the whole dorsal or ventral cortex of a rib peeled back at some length exposing the internal trabeculae. The final category as described by Pickering et al., (2013) is called *Incipient Peeling* and is characterized by peeling a strip of lamella away from the bone, but not fully separating it from the structure.

All of the ribs from BP1 exhibit classic peeling and general peeling evidence.

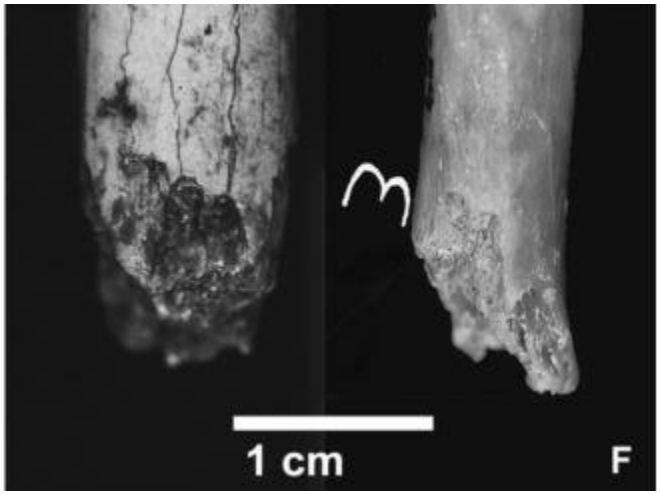
The ribs 1-4 and vertebrae (V-1) from EK#1 all clearly exhibit classic peeling and general peeling mastication processes.

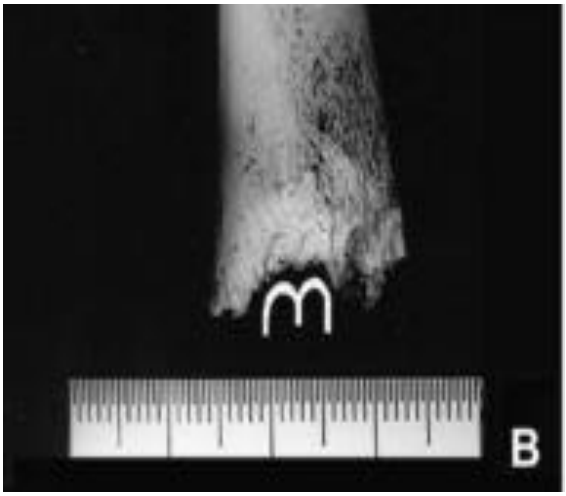
EK#1 (BP#2)
E. Mount St. Helen's
23AUG2014

Incipient peeling is clearly evident on EK#1 ribs 1-3. The rib specimens collected from EK#2 also clearly exhibit classic peeling.

This type of hominoid mastication signature evidence is a critical component of the very earliest zoological record and is present in various archaeological sites located in Kenya, South Africa, and Ethiopia. In addition, Pickering et al., (2013) goes further to state that the association of classic and general rib peeling stand as the strongest candidates in the earliest known Pleistocene hominoid/hominin tooth marks on bones and also may account for the large maxillary incisors common to early Homo. Classic and general rib peeling are diagnostic of hominoid behavior and can be effectively utilized in the search for the earliest signs of hominoid meat eating behaviors as well as used to describe the feeding behaviors of an extremely small number of primitive contemporary human cultures like the Khoikhoi tribe located in Namibia.

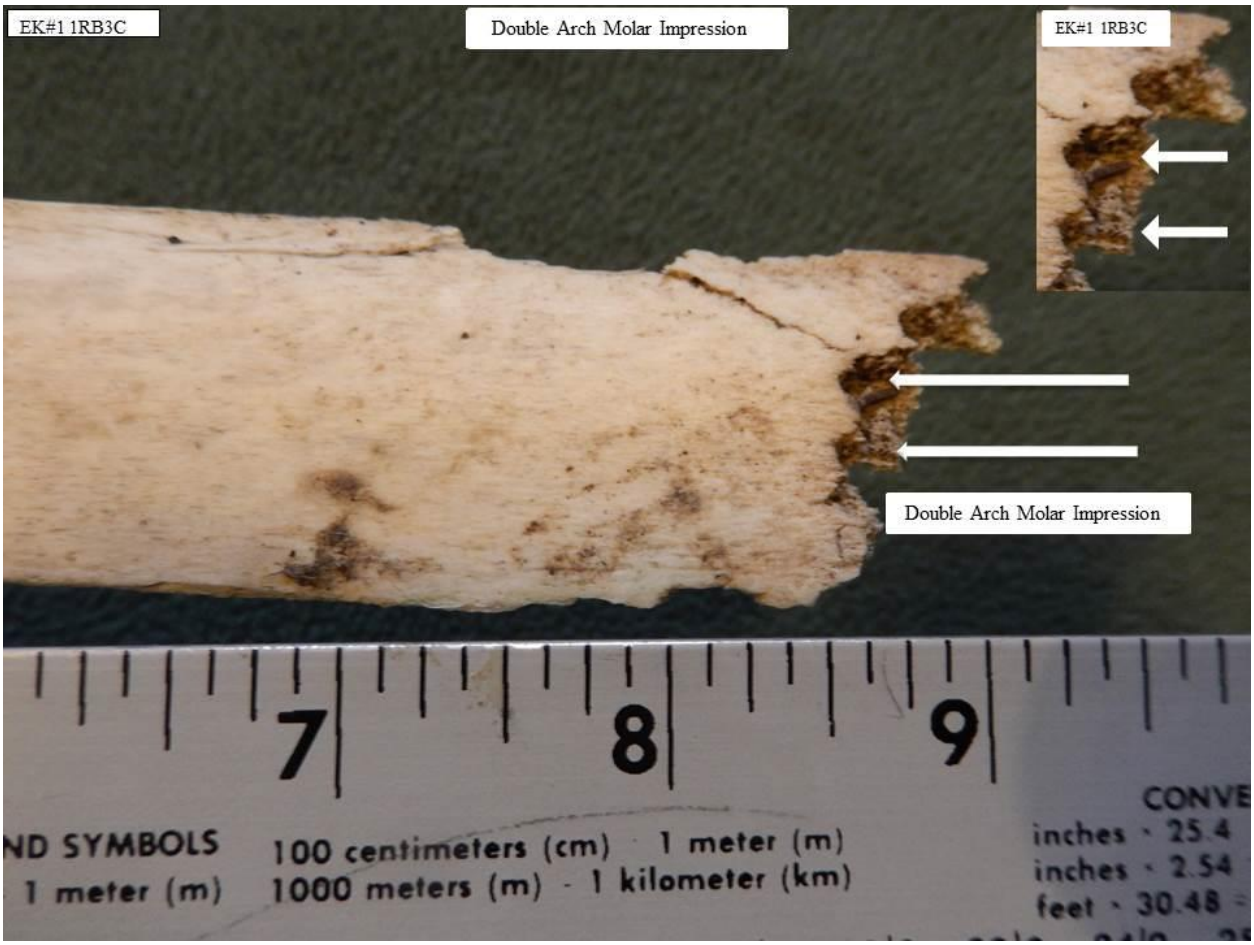
A double arch molar impression signature is another identifiable characteristic of hominoid mastication activity as described in Fernandez-Jalvo & Andrews (2010, figure 2).





Fernandez-Jalvo & Andrews, (2010, p. 122) Fig. 4. (F)	Fernandez-Jalvo & Andrews, (2010, p. 119) Fig. 2. (B)

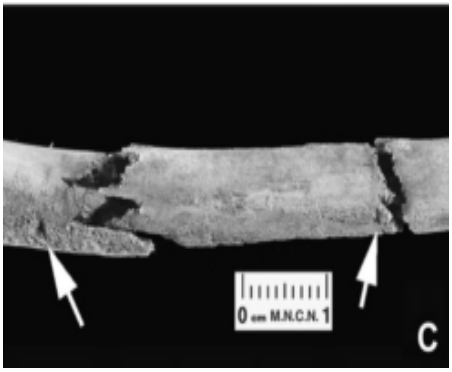
Different primate taxa generate molar tooth load impression evidence that is individually diagnostic. Chimpanzee puncture impressions have been examined in different contexts producing similar results, yet diagnostically different than humans (Plummer and Stanford, 2000; Pickering and Wallis, 2007; Fernandez-Jalvo & Andrews, 2010, p. 121). Human molar mastication activity in the process of bone peeling produces distinctive double arch punctures that are clearly diagnostic of early and a very small number of contemporary humans. The evidence collected from all three prey bone assemblage sites was carefully examined and found to exhibit four clearly identifiable double arch pre-molar impressions. Samples designated BP-1RB3, EK#1-1RB3C, EK#2-2RB2A, and EK#2-2RB1A all show clear double arch molar impression loading evidence. The sample designated EK#1-1RB3C exhibits a very clear and convincing double arch pre-molar bite impression that is characteristic of human molar loading (Fernandez-Jalvo & Andrews, 2010, figure 2).



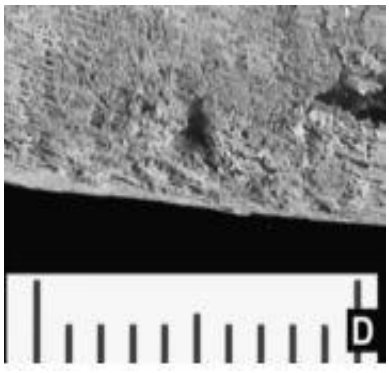
All four samples exhibit double arch bite impression evidence in varying degrees of clarity and condition. They are all located on the crenulated ends of each rib bone specimen.

Triangular shaped pre-molar load impression evidence observed on bone samples is also a distinctive identification characteristic of hominoid mastication activity and have been made by bending the ends of the bones while chewing on them (Fernandez-Jalvo & Andrews, 2010, p. 121).

Fernandez-Jalvo & Andrews, (2010, p. 119) Fig 3. (F)

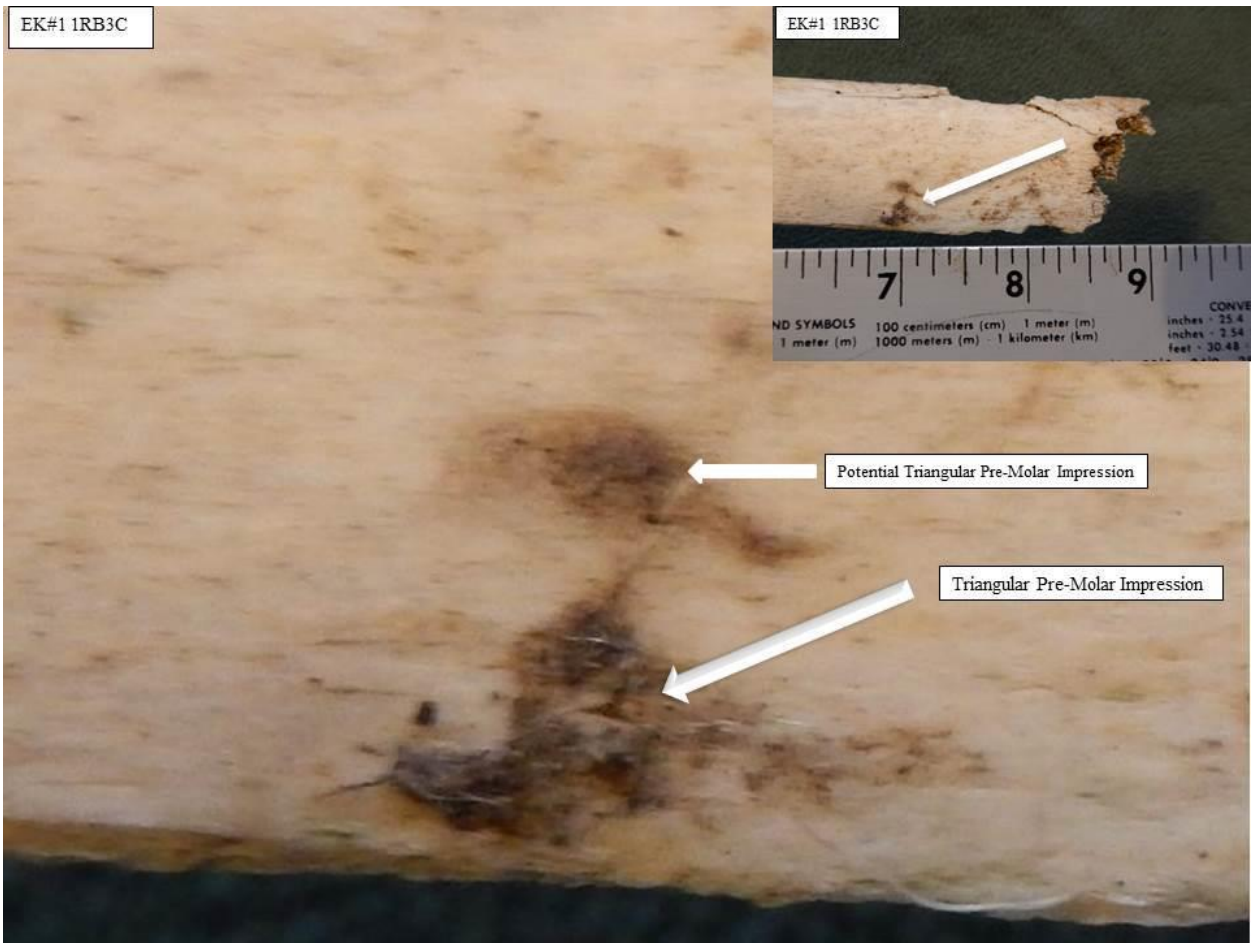


Fernandez-Jalvo & Andrews, (2010, p. 119) Fig. 2. (C)

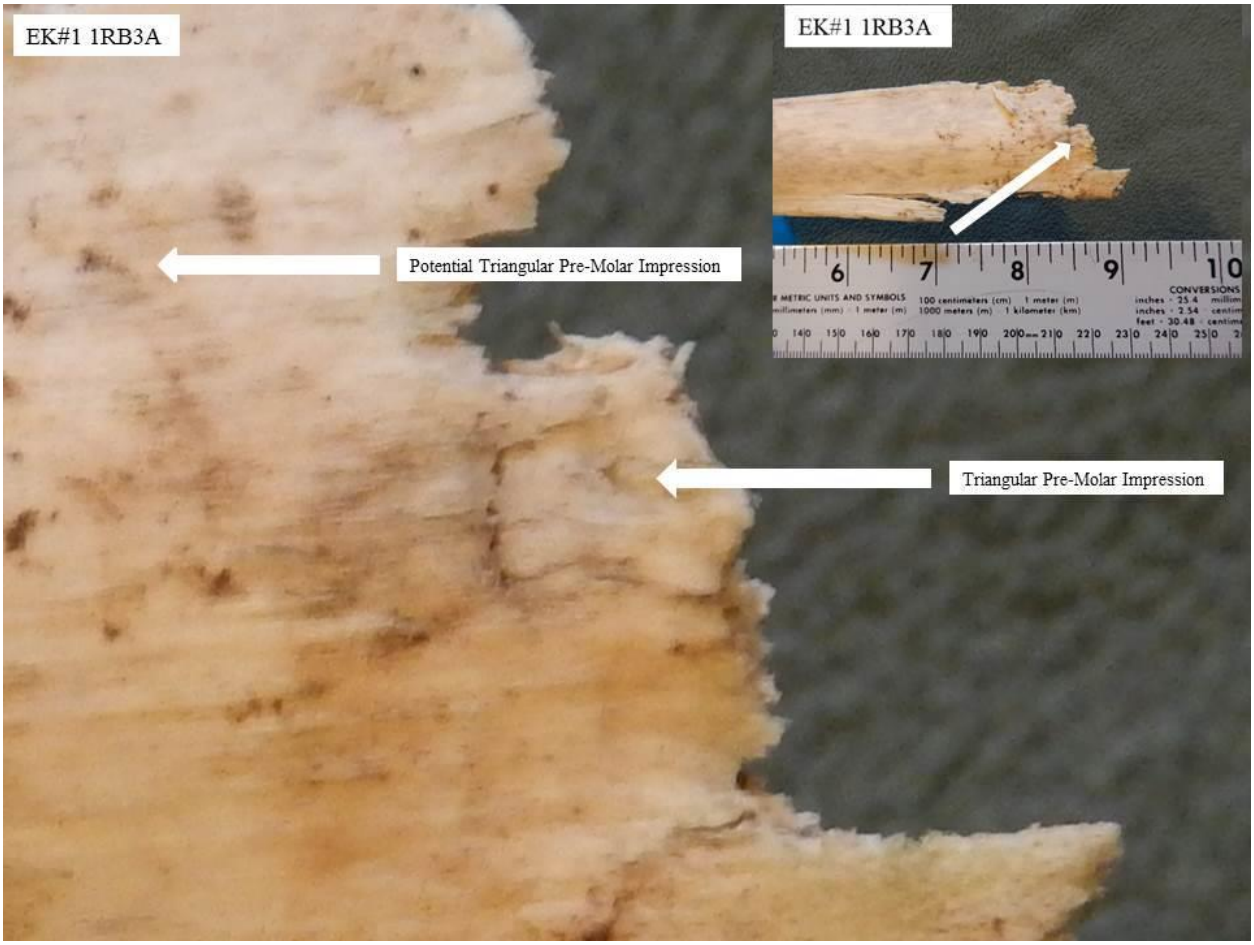


Fernandez-Jalvo & Andrews, (2010, p. 119) Fig. 2. (D)

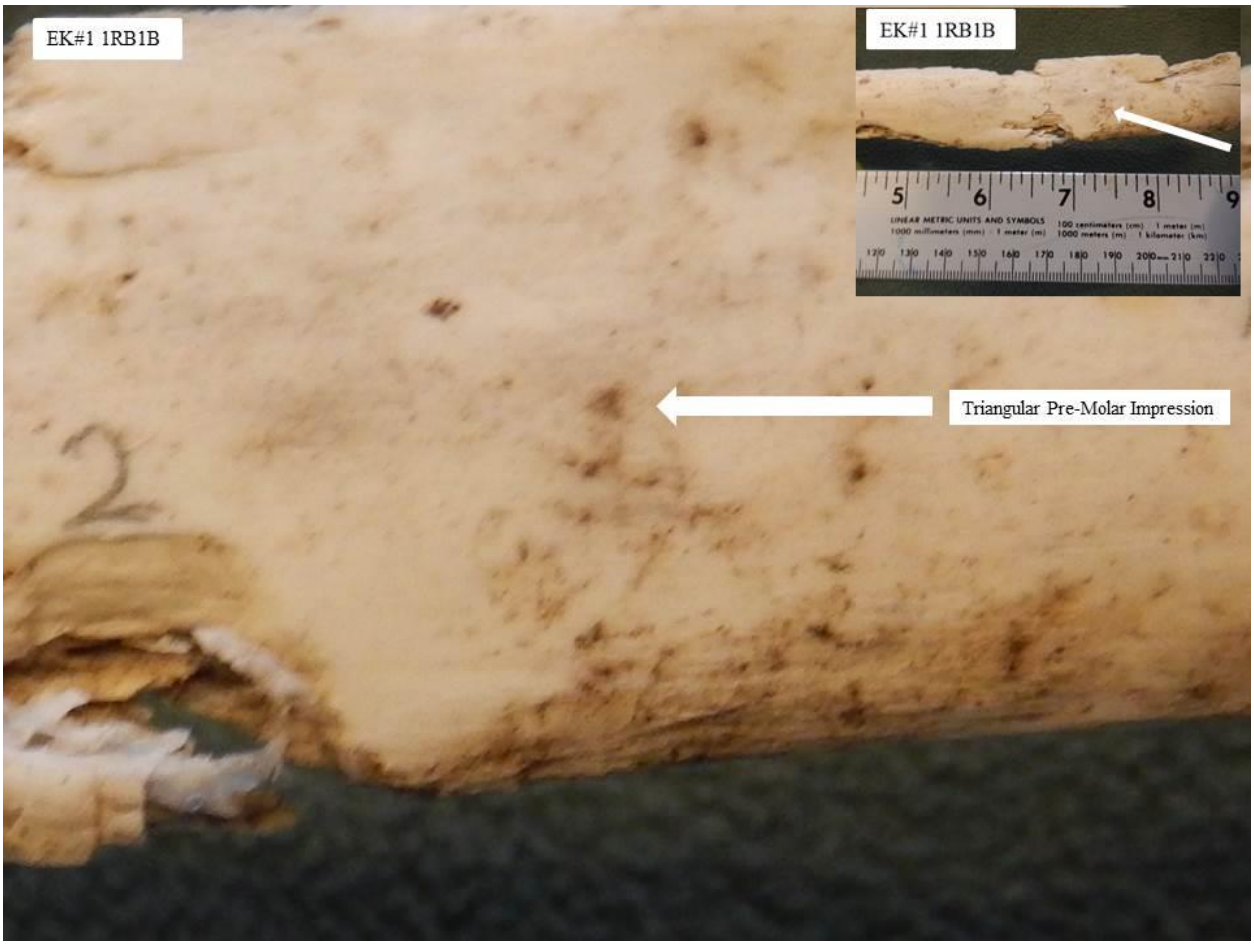
Puncture marks made on bones by chimpanzees have been identified and are generally larger and their shape is described as circular rather than triangular (Pickering and Wallis, 1997; Plummer and Stanford, 2000). Evidence specimen EK#1RB3C exhibits two distinctive triangular pre-molar bite mark impressions.



Evidence specimen EK#1 1RB3A also exhibits one clear and distinctive triangular pre-molar bite mark impression which was located upon the crenulated end.

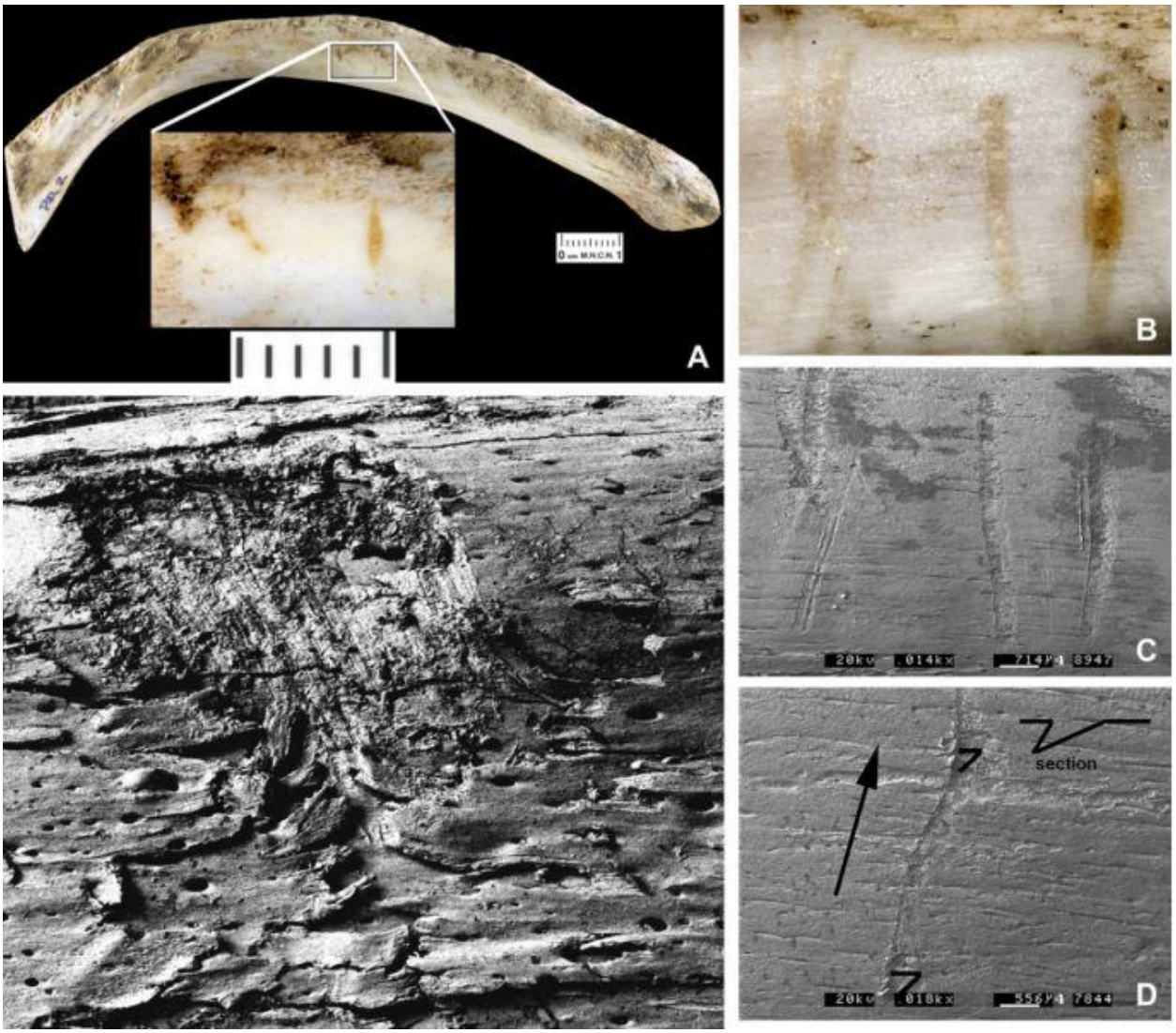


Evidence specimen EK#1 1RB1B also exhibits one clear and distinctive triangular pre-molar bite mark impression.

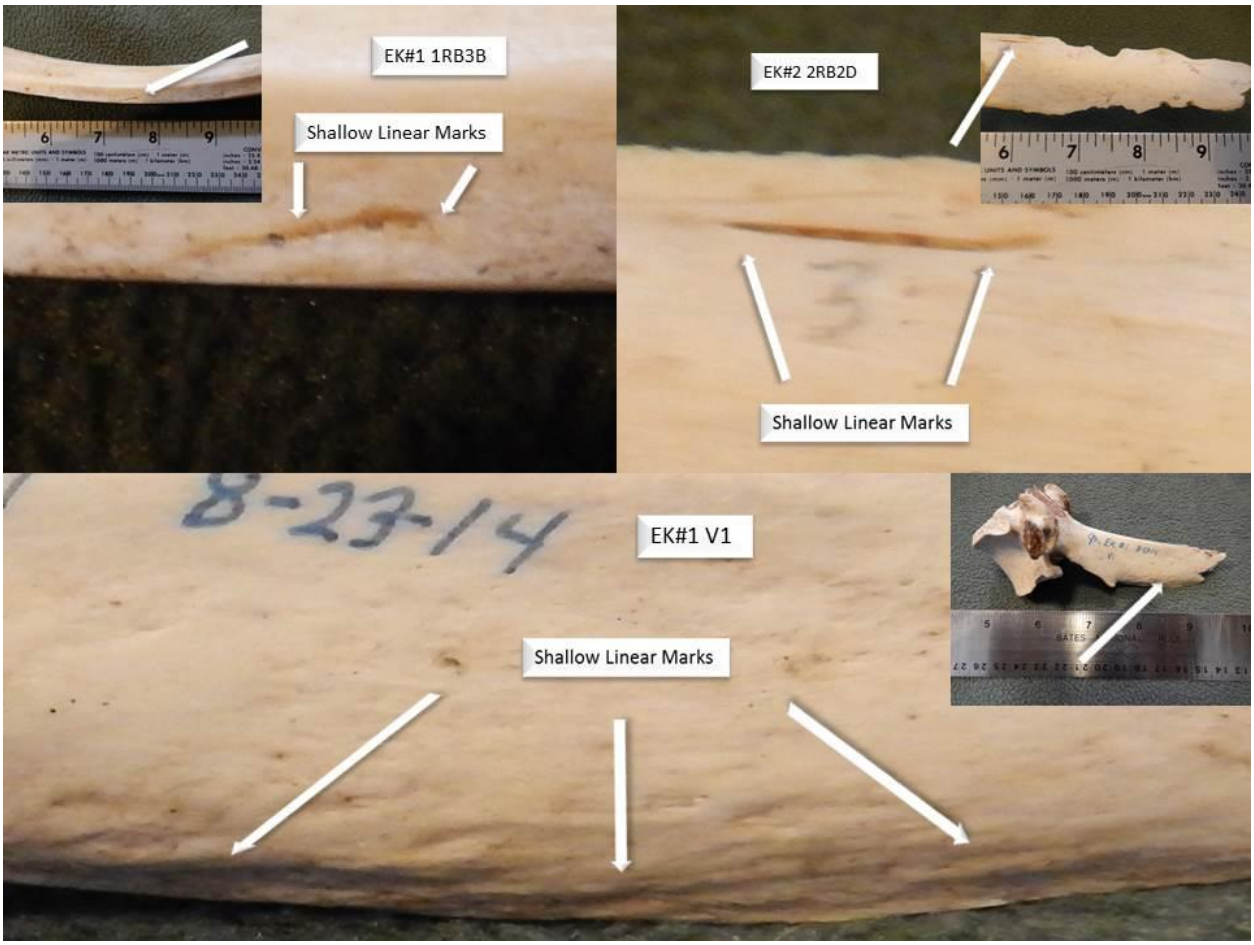


All three visual samples are very clear and demonstrate classic triangular human pre-molar impression dental physio-morphology. None of the evidence samples collected from any of the deposition sites exhibited any molar load impression evidence consistent with chimpanzee molar impressions as cited in the literature. Further analysis at the microscopic level may illuminate additional diagnostic molar impression evidence across all of the evidence sample profiles.

Shallow linear bone scoring marks are also a diagnostic characteristic of human mastication processing of prey bones as cited in Fernandez-Jalvo & Andrews (2010, p. 121.



These marks are not easily viewable without magnification and described as shallow linear scoring marks. These shallow groves usually have evidence of uneven incisor occlusal surfaces that can be identified under magnification. The lateral sides of the scoring marks may show Herztian fractures cones that indicated directionality of the scoring process (Bromage & Boyde, 1984; Bermudez da Castro et al., 1988). This type of hominoid diagnostic signature was preliminarily recorded on specimens designated EK#1 V1, EK#1 1RB, and EK#2 2RB.



There is a gouge on one side which shows no pointed tooth load impression marks. On the opposite side there is a thin long chip out of the rib which measures .55” (13.97mm) long. Specimen EK#1 RB3-2 also demonstrates this feature in the form of a 1.75” (44.45mm) long piece of bone missing with a possible impression of a flat tooth with no sharp cusp marks. Specimen EK#2 RB1 may also exhibit this diagnostic feature. The edge of the rib bone has shallow flat impressions when you run your finger longitudinally along the bone. As if a flat tooth was used along the bone to remove the flesh. Specimen EK#2 RB2-2 Mark #2 has a .73” (18.54mm) wide gouge taken out of the bone. Specimen EK#2 RB2-8 Three light scores are visible in the center of the bone parallel to the axis approximately 1.1” (27.94mm) to 2.6” (66.04mm) long, .21” (5.33mm) placed an equal distant apart. Theses preliminary observations

should be reinforced with additional microscopic analysis as described in Bromage & Boyde (1984) in the process of establishing individual and comprehensive definitive dental shape signature identification matrix's. Furthermore the recent development of non-destructive three-dimensional micro-CT techniques as cited in (Olejinczak et al., 2008, p. 409) would add additional microscope level analysis capability to a potential multi-layer investigative process. This category of hominin mastication analysis demonstrates consistency and evidence based support within the comprehensive assessment that a hominoid was responsible for the prey bone assemblage mastication evidence as previously described in the literature and as expressed in the site data.

Mamelons are rounded protuberances present along the incisial edge of newly erupted permanent human incisors (Chegini-Farahini, Fuss, & Townsend, 2000, para. 2; Gorea, Agnihottry, & Aggarwal, 2010, para. 1; Gulati, 2011, p. 28; Howe, 2013, p. 13). Permanent maxillary and mandibular incisors follow a predictable eruption chronology which begins at about 6 years of age and is finished at about 12-17 years (An, 2009, para. 3; Gulati, 2011, p. 14). The American Dental Association gives an average range of erupting permanent teeth beginning at 7-8 years old and generally finishing at age 13 when all 28 adult teeth are present ("ADA ," 2006, para. 4). They generally reveal a three elevation pattern along the mesial margin in a straight line while the distal margin is more rounded (Chegini-Farahini et al., 2000, p. 1; Gulati, 2011, p. 28; Howe, 2013 p. 14). Fitzgerald and Associates (1983) created a classification system as cited in Chegini-Farahini et al., (2000, p. 1) that featured a 12 point visually descriptive score ranging from 1 or a straight incisial edge with no mamelons to a 12 which demonstrates a four mamelons dental morpho-physiology with an accessory lobe between the middle and mesial lobes.

Mamelon Classification System

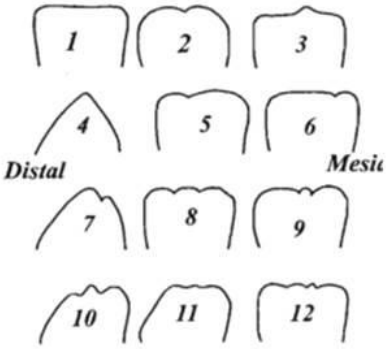
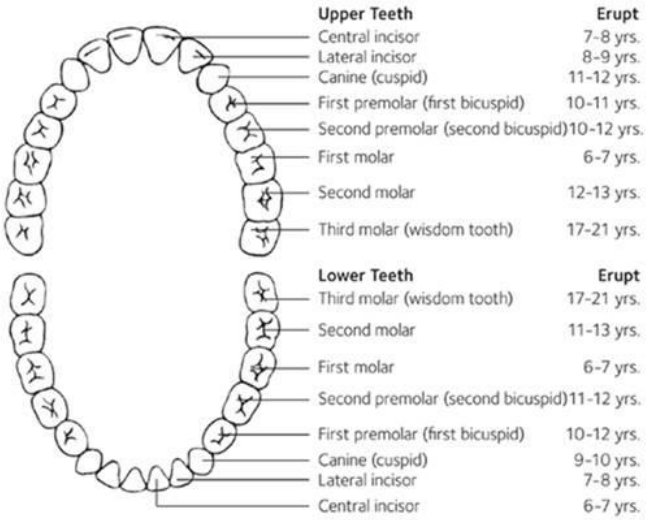


Fig. 1. Fitzgerald 12-grade for scoring mamelons. 1 = straight incisal edge with no evidence of mamelon formation; 2 = median notch; 3 = median dominance; 4 = median prominence with caniniform incisal edge with no lingual or labial grooves; 5 = distal notch; 6 = mesial notch; 7 = median prominence with caniniform incisal edge and mesial or distal notch; 8 = typical three-mamelon configuration with lobes of similar size; 9 = three-mamelon configuration with reduced middle lobe; 10 = three mamelon configuration with prominent middle lobe and tapering distal crown contour; 11. three-mamelon configuration with weak expression and taperong crown distal contour; 12 = four-mamelon configuration with accessory lobe generally between middle and mesial lobes.

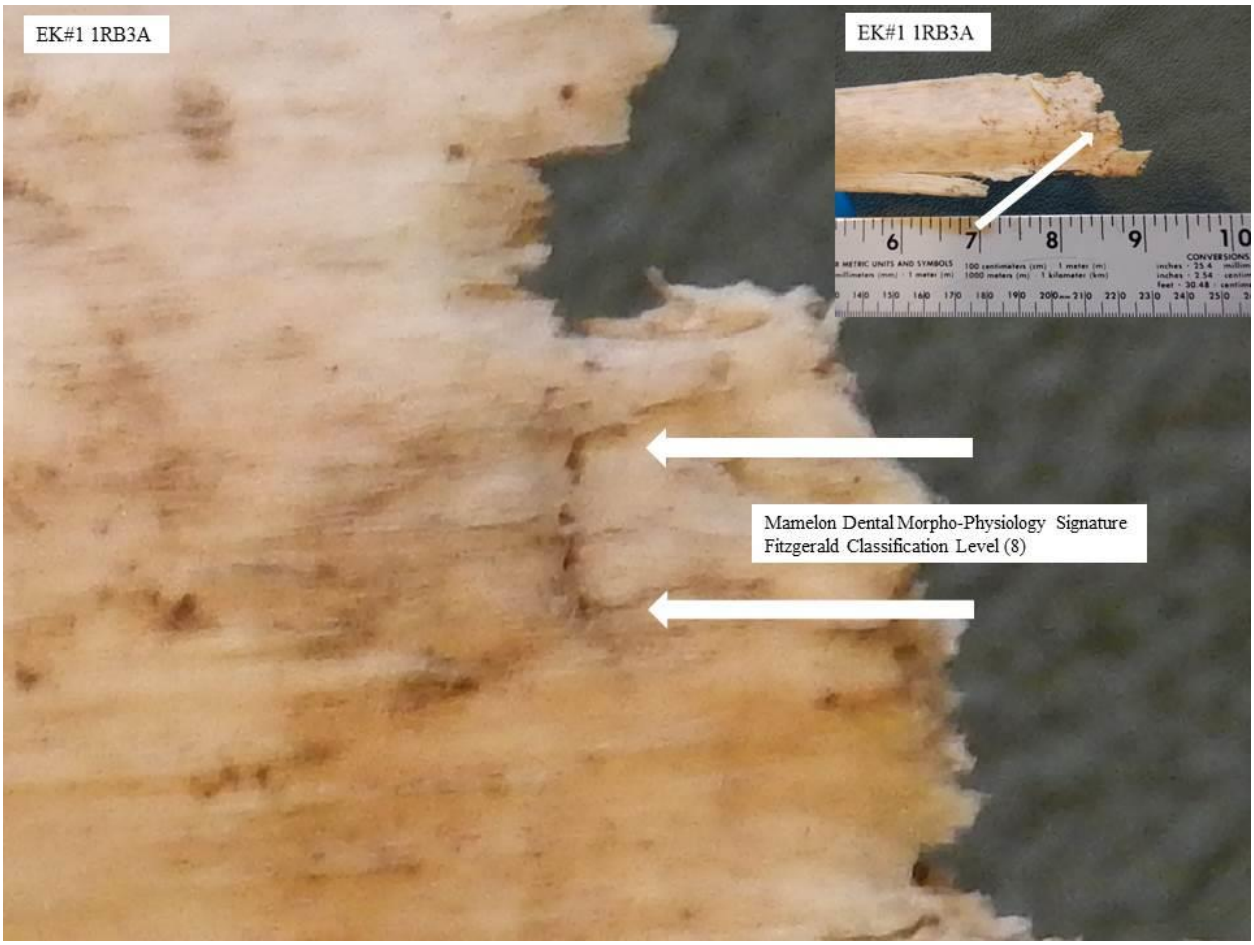
Source as Cited in Chegini-Farahini et al., (2000, p. 1)

Permanent Teeth Eruption Chart



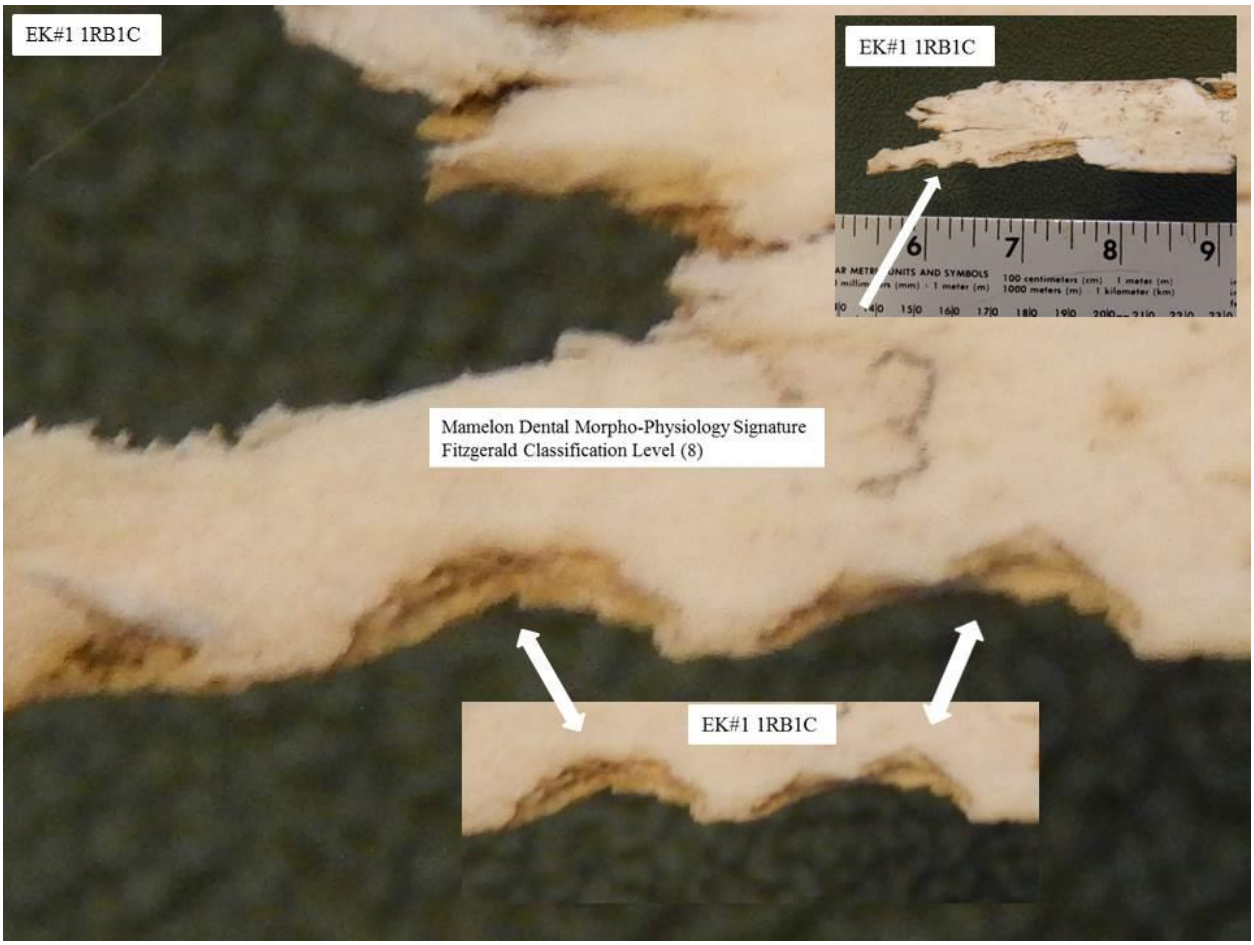
American Dental Association
Source http://www.mouthhealthy.org/en/az-topics/e/eruption-charts

Evidence specimen EK#1 1RB3A exhibited clear and recognizable mamelon dental morpho-physiology signature impression with a Fitzgerald Classification designation of level (8).



Evidence specimen EK#1 1RB3C exhibited clear and recognizable mamelon dental morpho-physiology signature impression with a Fitzgerald Classification designation of level (8).

Evidence specimen EK#1 1RB1C exhibited clear and recognizable mamelon dental morpho-physiology signature impression with a Fitzgerald Classification designation of level (8).

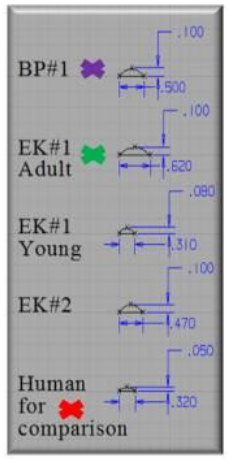


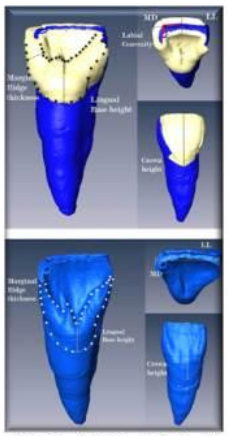
The mamelon Fitzgerald Classification System signature is also consistent across all three evidence samples additionally suggesting that the same predator was responsible. All of the samples clearly indicate the very strong suggestion that the predator taxa responsible for generating this specific dental avulsion attributed injury signature evidence was a different size (smaller) and age (younger) then the one responsible for generating the rest of the tooth, bite radius, and inter-canine distance data as well as the corresponding Neoichnologic data.

Pronounced large anterior tooth shoveling, acute labial convexity and prominent lingual tubercles are diagnostic incisor characteristics of early Pleistocene Homo Neanderthal (*Homo neanderthalensis*) and to a lesser extent some contemporary Asiatic and native North American populations (Scott, 1997, p. 183; Bailey, 2002, p. 16; Bailey, 2006, p. 257; Denton, 2011, p. 17;

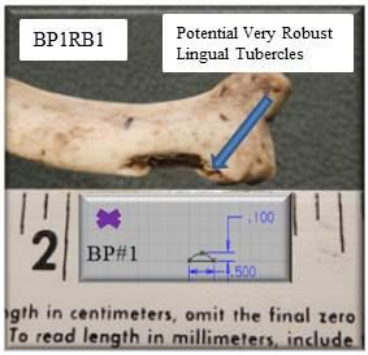
Clement, Hillson, & Aiello, 2012; Harvati et al., 2012). These diagnostic characteristics while similar in all three populations exhibit distinctive differences to include the chronology of dentition maturation, size of incisors, degree of shoveling convexity, degree of labial curvature, and robustness or foundational morpho-physiology of the lingual tubercles (Scott, 1997, p. 182; Bailey, 2002, p. 17; Bailey, 2006, p. 259; Smith et al., 2010; Denton, 2011). Neanderthal central and lateral incisor dentition morpho-physiology is measurably larger and exhibits individual diagnostic characteristics which when taken in totality present a definitive matrix for assessing applicability to modern Homo sapiens dentition morpho-physiology (Clement et al., 2012, p. 369).

Evidence specimen EK#1 1RB1A is the very best example of a potential shovel shaped incisor dental avulsion attributed injury signature with an additional potential double labial convexity. Evidence specimen BP1RB1 exhibits potential evidence of a shovel shaped incisor with a very robust lingual tubercles dental avulsion attributed injury signature. Evidence specimen BPRB3 is potential evidence of a shovel shaped incisor dental avulsion attributed injury signature with an additional potential double labial convexity.

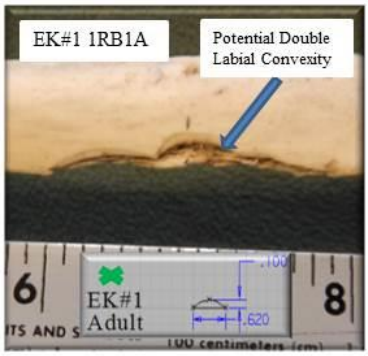




Source Denton, 2011, p. 38



"Potential" Shovel Shaped Incisor Dentition Morpho-Physiology



Arizona State University Dental Anthropology System

Source Denton, 2011, p. 21

All potential Shovel Shaped Incisor signatures need further examination and microscopic analysis to either confirm or rule out this or a possible hybridization of this additional "hominoid" dentition morpho-physiology characteristic. Micro-CT reconstructive digital technologies (SKYSCAN 1172: High Resolution Micro-CT) as cited in Olejinczak et al., (2008, figure 1) may provide a diagnostic technology aid that when combined with comparative mathematical analysis might either confirm or eliminate this preliminary determination by illuminating a microscopic dentition morpho-physiology profile signature of each dental load avulsion attributed injury signature that could then be matched to data based reconstructions of individual tooth signatures. While the visual evidence and preliminary comparative

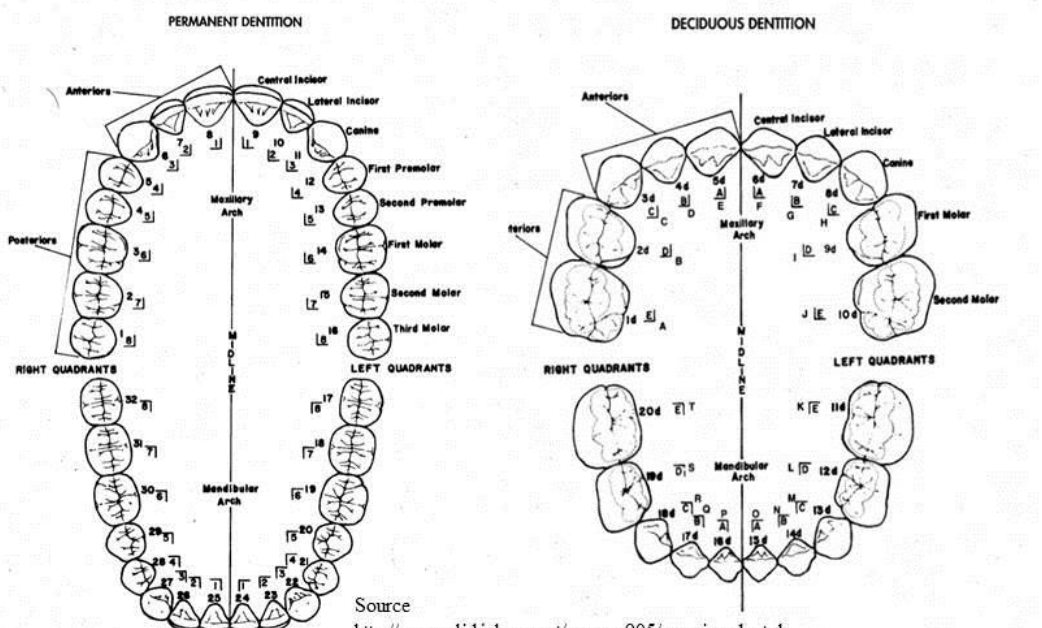
measurement analysis suggest shovel shaped incisors along with supporting structures, it does not conclusively prove Neanderthal (*Homo neanderthalensis*) dentition morpho-physiology.

The dental avulsion attributed injury measurements evidence taken from the consolidated rib bone samples demonstrated individual shapes that are very similar to contemporary Homo sapiens as cited in (Denton, 2011) yet the range of tooth size measurements, bite radiuses, and upper inter-canine measurements were primarily outside the upper range of contemporary human dentition morpho-physiology.

Modern Human (Homo Sapien) Dentition Formula

The deciduous dentition of man has the following dental formula: I - -2. . c - : M - 2 (r 2 = 20 total teeth) 2 1

The dental formula for mans permanent dentition is as follows: I - -2 . c - : p - 2: - M - 3 (X2 = 32

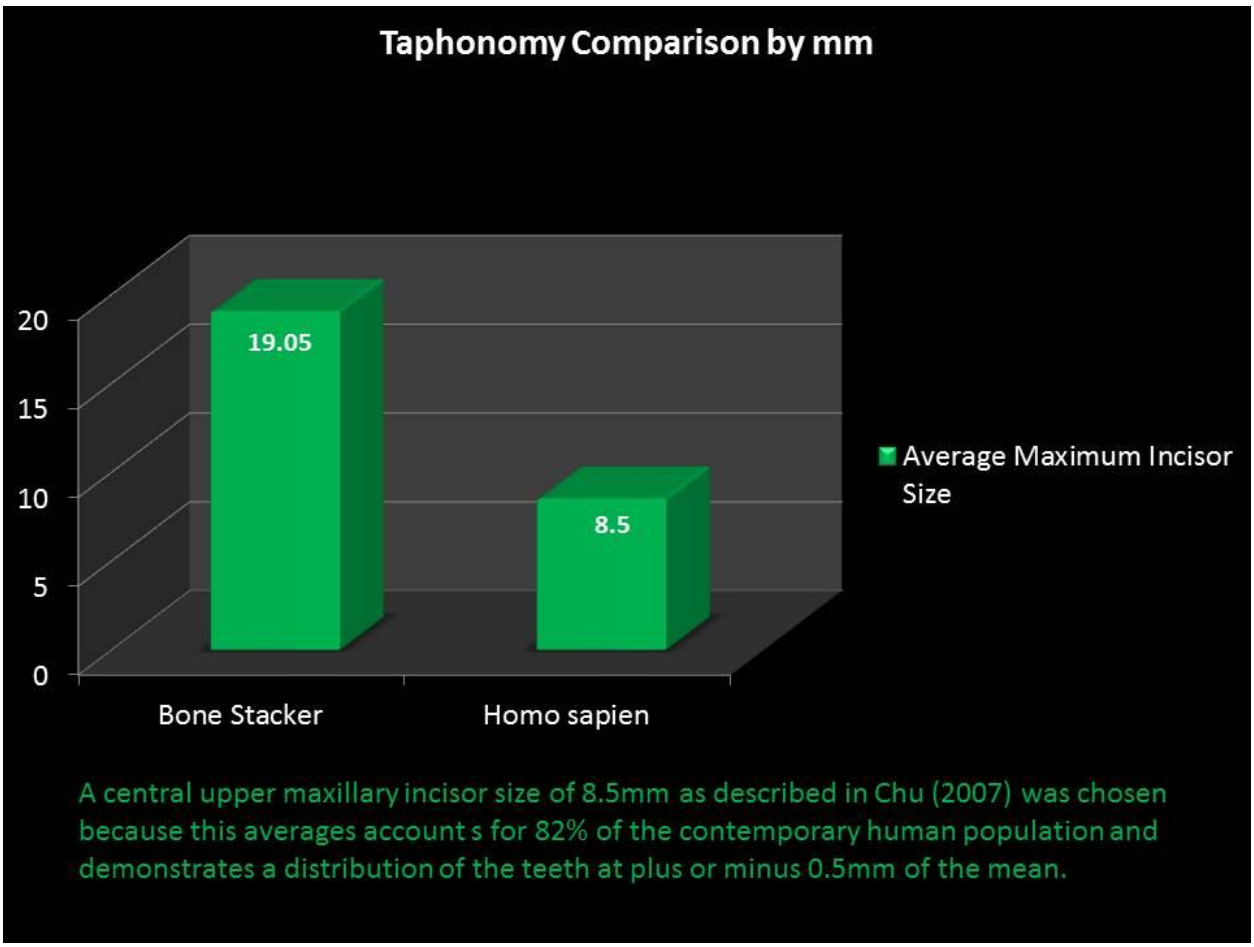


Source
http://www.slideshare.net/ammar905/concise-dental-anatomyandmorphology0874141257?related=1

Dentition morpho-physiological data from Magne et al., (2003) assigns a standard contemporary Homo sapien size range in width of upper central incisors from .334” (8.5mm) to .437” (11.1mm) and maxillary lateral incisor .216” (5.5mm) to .322”(8.2mm), while Chu (2007)

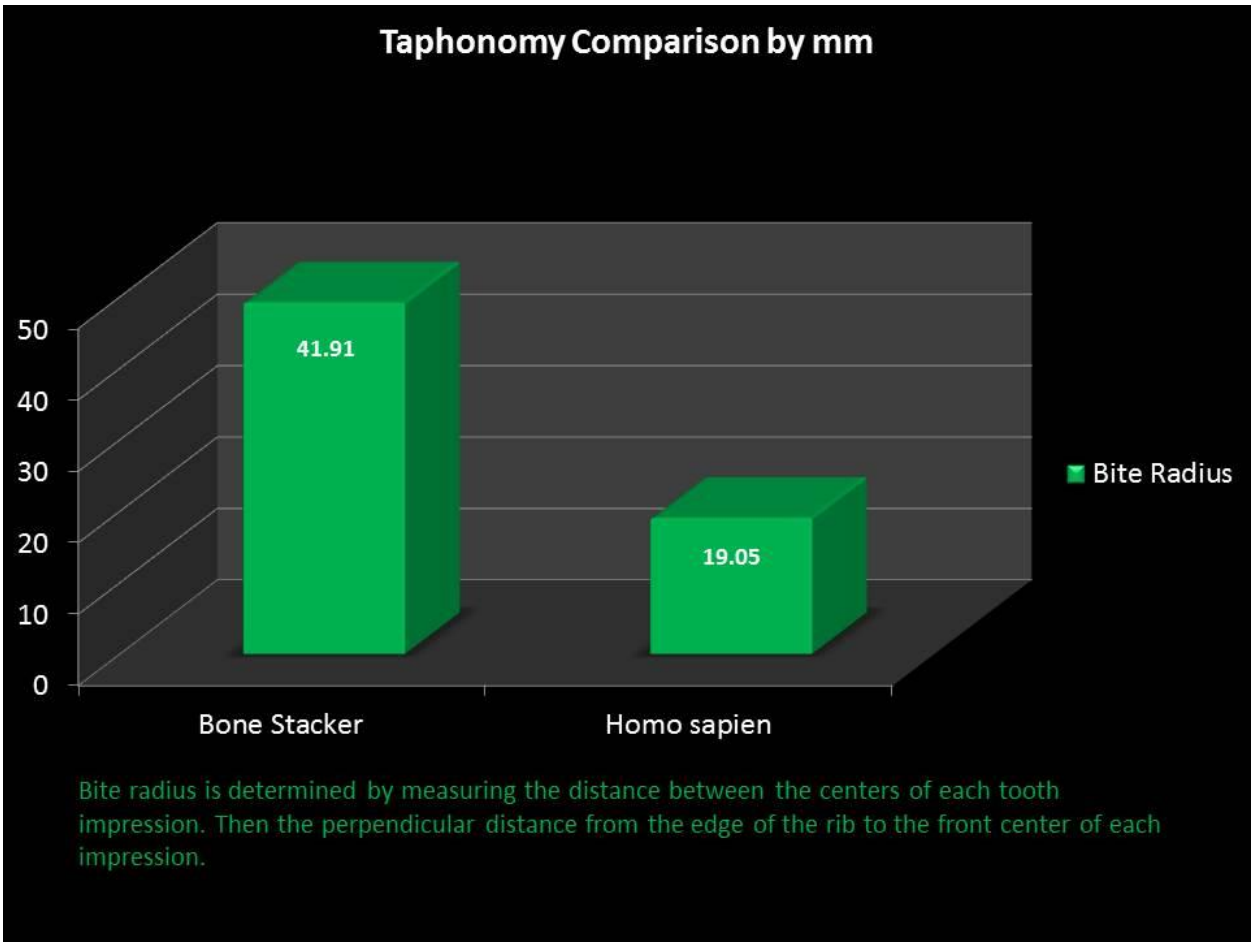
assigns a range of .0279” (7.1mm) to .397” (10.1mm) for upper central incisors and .236” (6.0mm) to .314” (8.0mm) and for maxillary lateral incisors. The average upper jaw central incisor measures a width of .332” (8.44mm) for the right side and left side .327” (8.35mm), while the average upper lateral incisor measures .259” (6.6mm) for the right side and .257” (6.54mm) as described in (Hashim & Al-Ghamdi, 2005, p. 5). For the purposes of following examination we shall contrast the range of upper maxillary central incisor width measurement range from .279” (7.1mm/Chu) to .437” (11.1mm/Mange), and the upper lateral maxillary incisors width measurement range from .216” (5.5mm/Mange) to .322” (8.2mm/Mange). The average upper lateral maxillary incisor size of 6.5mm and a central upper maxillary incisor size of 8.5mm as described in Chu (2007) were chosen because these averages account for 82% of the contemporary human population and demonstrate a distribution of the teeth at plus or minus 0.5mm of the mean.

The incisor measurements taken on the consolidated residual bone evidence from sites BP1, EK#1 and EK#2 ranged in size from .21’ (5.33mm) to .75” (19.05mm), with 25 combined incisor measurements recorded. The average incisor size measured .41” (10.41mm). Of the 25 total incisor measurements, 20 are outside the average central incisor range (.33”/8.5mm) and 23 (92%) are outside the average lateral incisor range (.25”/6.5mm) as described in Chu (2007). Of the total measurements taken 80% are outside the average incisor range of contemporary humans (.25”/6.5mm-.33”/8.5mm).



Of the four largest incisor measurements which ranged from .61” (15mm) -.75’ (19.05mm) one was over twice the size of the average human central incisor while the other three were almost double the size. The evidence specimens collected did not exhibit a clear and definable separation between the lateral and central incisors bite marks and thus individually classifying them is problematic without additional microscopic examination. Each tooth leaves specific measurements and energy transfer profiles as defined in Bromage & Boyde, (1984) and thus establishing a microscopic signature of each tooth bite impression which would enable the comprehensive mapping of individual tooth signatures into a very accurate diagnostic matrix.

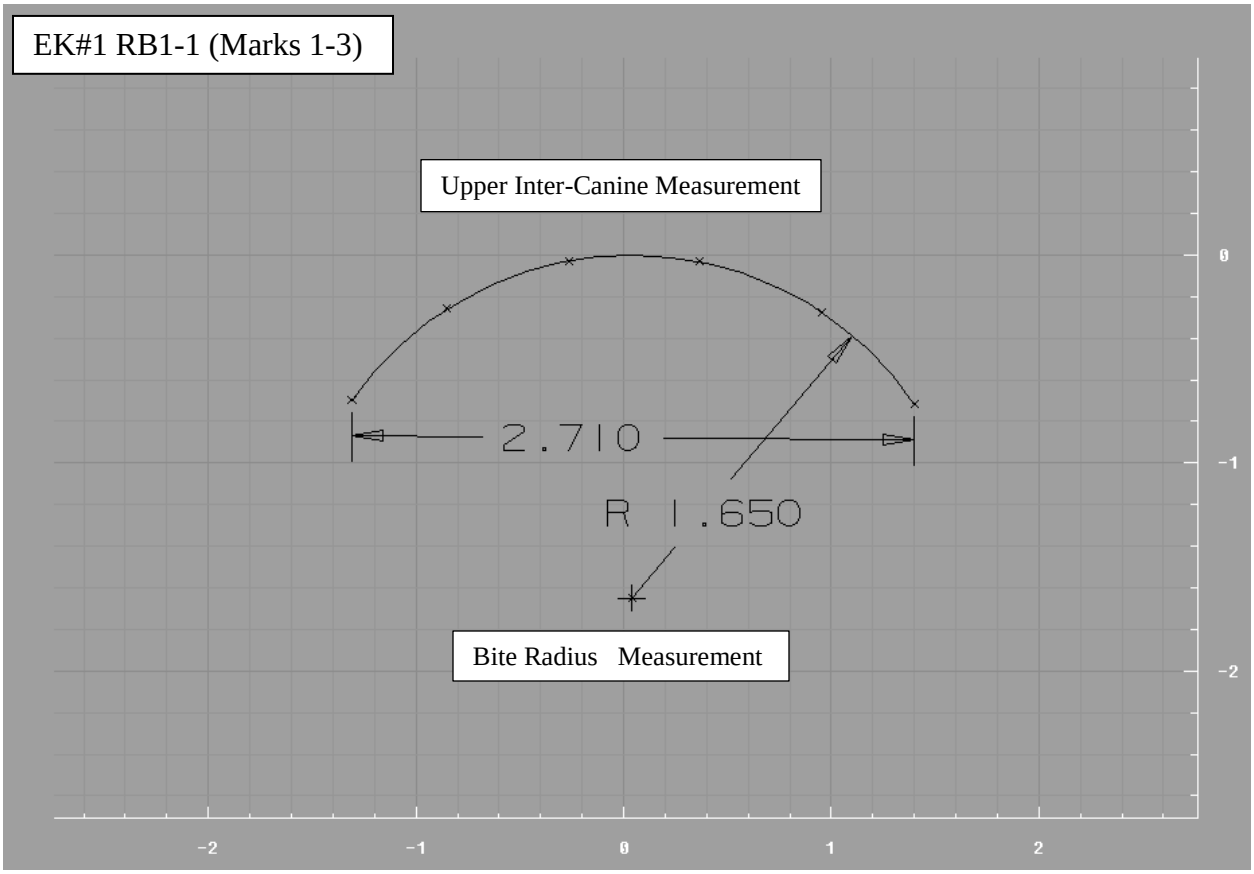
The final two elements of taphonological dental evidence illuminated are Bite Radius and Inter-Canine Width comparison analysis. Bite radius is determined by measuring the distance between the centers of each tooth impression. Then the perpendicular distance from the edge of the rib to the front center of each impression.



CAD X11 was then used by placing these measurements into this graphics program as points forming an arc from which the radius of the impressions was calculated. Inter-canine distance is determined by measuring the upper and lower permanent canine cusp tips from right to left (Hashim & Al-Ghamdi, 2005, p. 3; Tedesci-Oliveira et al., 2011, p. 30; Baheti, Gharat, & Toshniwal, 2014, p. 872). To calculate the inter-canine distance we then measured the angle between the center points of each impression on the calculated radius using the same graphics

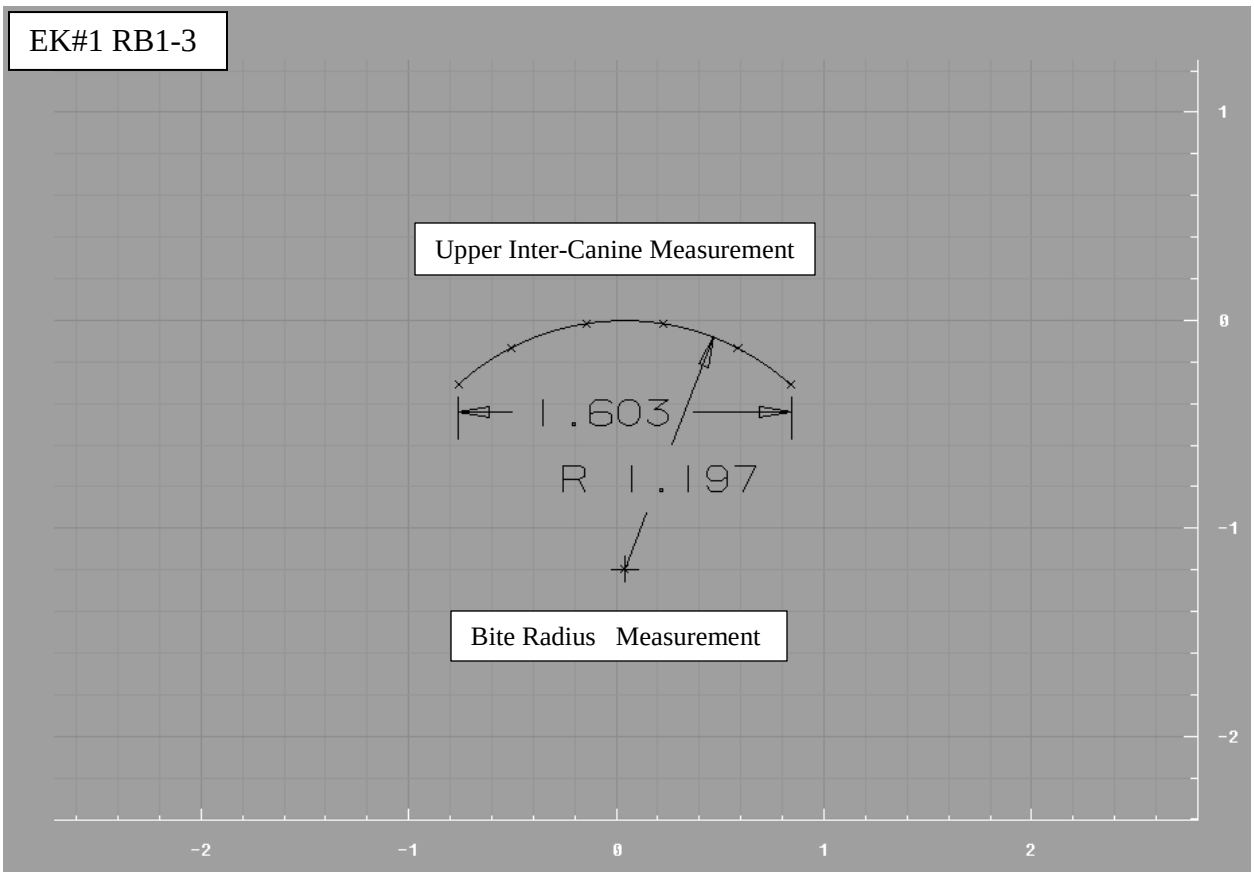
program. The average of this angle was then used to place three more points on the arc of the radius. Then the distance between points 1 and 6 was measured with the program to give the distance between the canines. This measurement was extrapolated from the original three impressions so it is an evidence based reconstruction estimate. However, we used the same technique on the reference/control bite. After using the graphics program to get this measurement, the actual distance between the canines was measured on the reference bite subject (one of the authors). This extrapolation came to within .050” (12.7mm) of the actual measurement reference bite. An inter-canine distance of less than .984” (25mm) would probably be produced by a child (Stavrianos et al., 2011, para. 8; Tedesci-Oliveira et al., 2011, p. 30). These measurements will be different an adult with the average for the upper at 1.216” (30.91mm) and the lower at 1.027” (26.10mm) as cited in (Hashim & Al-Ghamdi, 2005, p. 8).

After examining and measuring the three main bite marks upon EK#1 RB1-1 (Marks 1-3) a bite radius of 1.650” (41.91mm) was recorded with an estimated upper inter-canine distance of 2.710” (68.834mm).

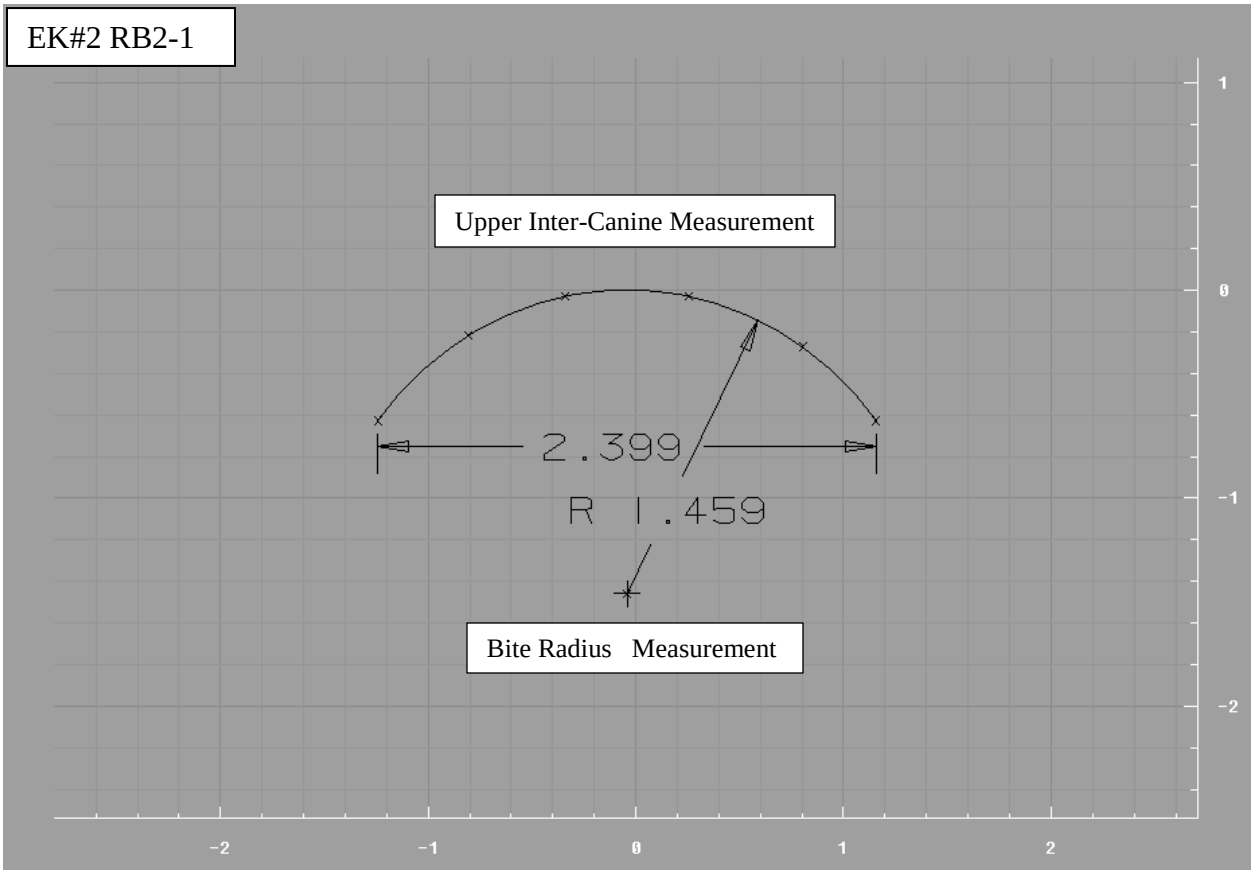


EK#1 RB1-3 exhibited a bite radius of 1.194” (30.32mm) with an estimated upper inter-canine

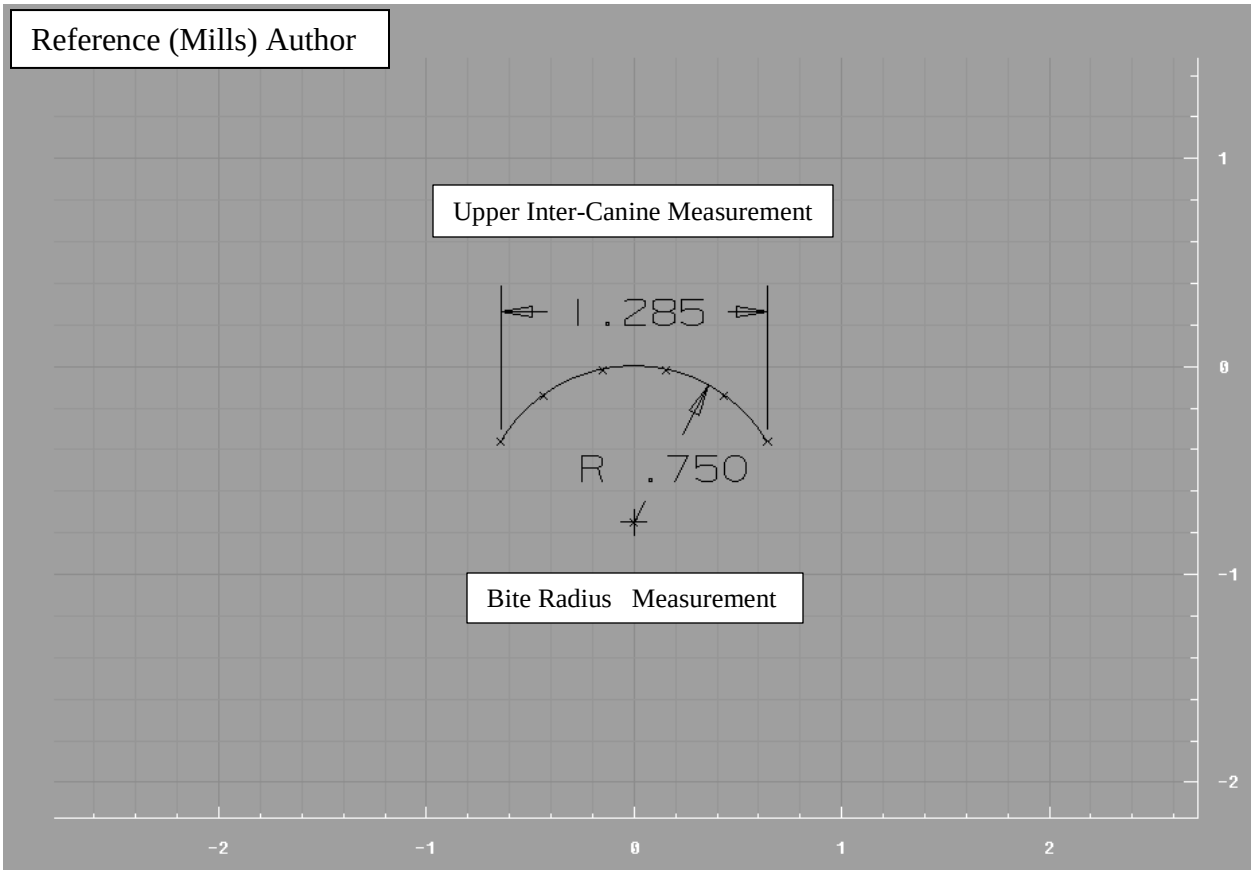
distance of 1.603” (40.71mm).



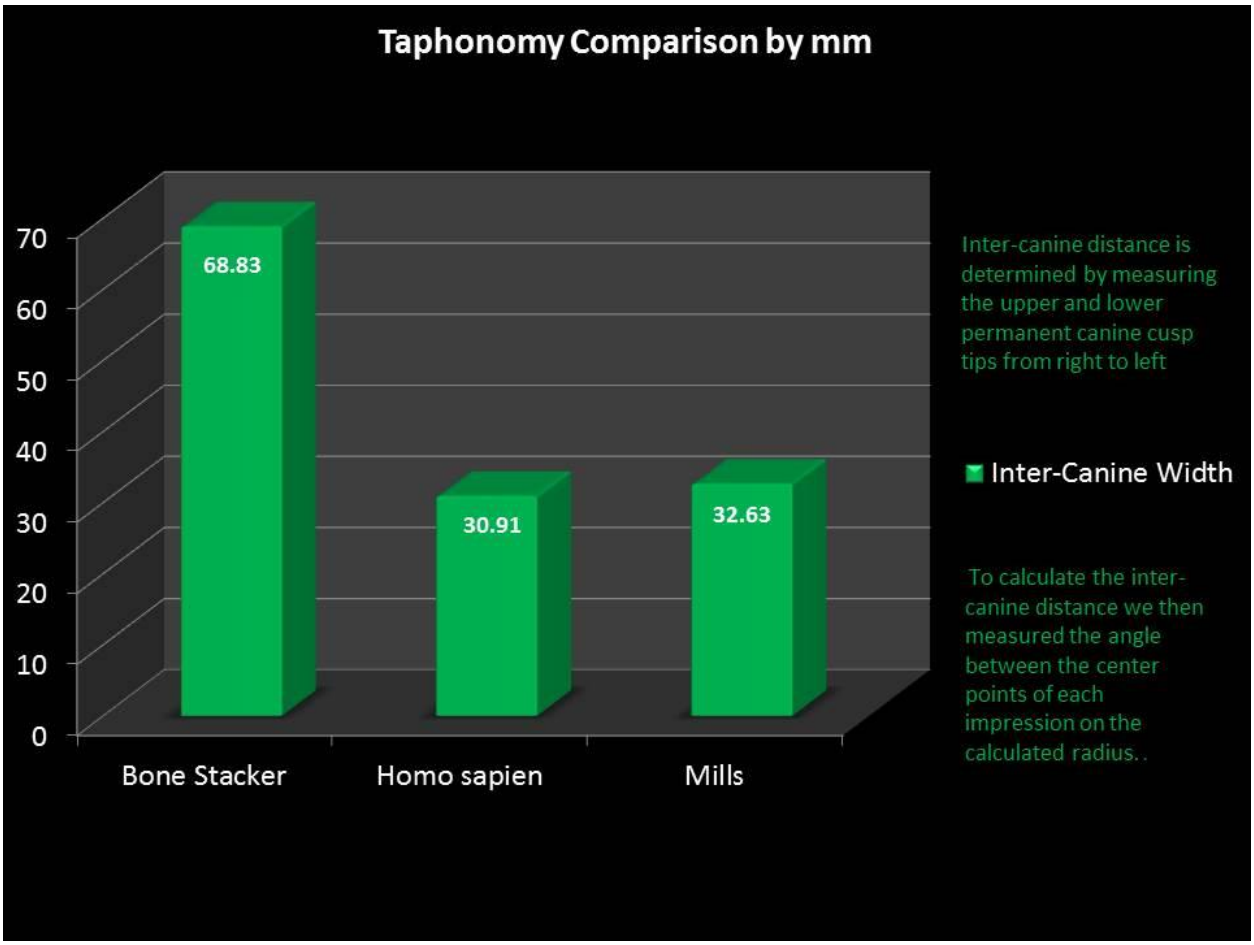
EK#2 RB2-1 demonstrated a bite radius of 1.459” (37.05mm) with an estimated upper inter-canine distance of 2.399” (60.93mm).



By way of comparison one of the authors (G. Mills) bite radius measured .75” (19.05mm) with an inter-canine distance of 1.285” (32.639mm).



The author's measurement of upper inter-canine distance 1.285" (32.639mm) is within the upper range of the average inter-canine distance measurements for a contemporary human adults as cited in Hashim & Al-Ghamdi (2005, p. 8) and provides a contemporary Homo sapien comparison. The inter-canine distance measurements evidence based estimations from the bite mark evidence collected ranges from 1.459" (37.05mm) to 2.710" (68.83mm) which are all outside the average range for contemporary humans.



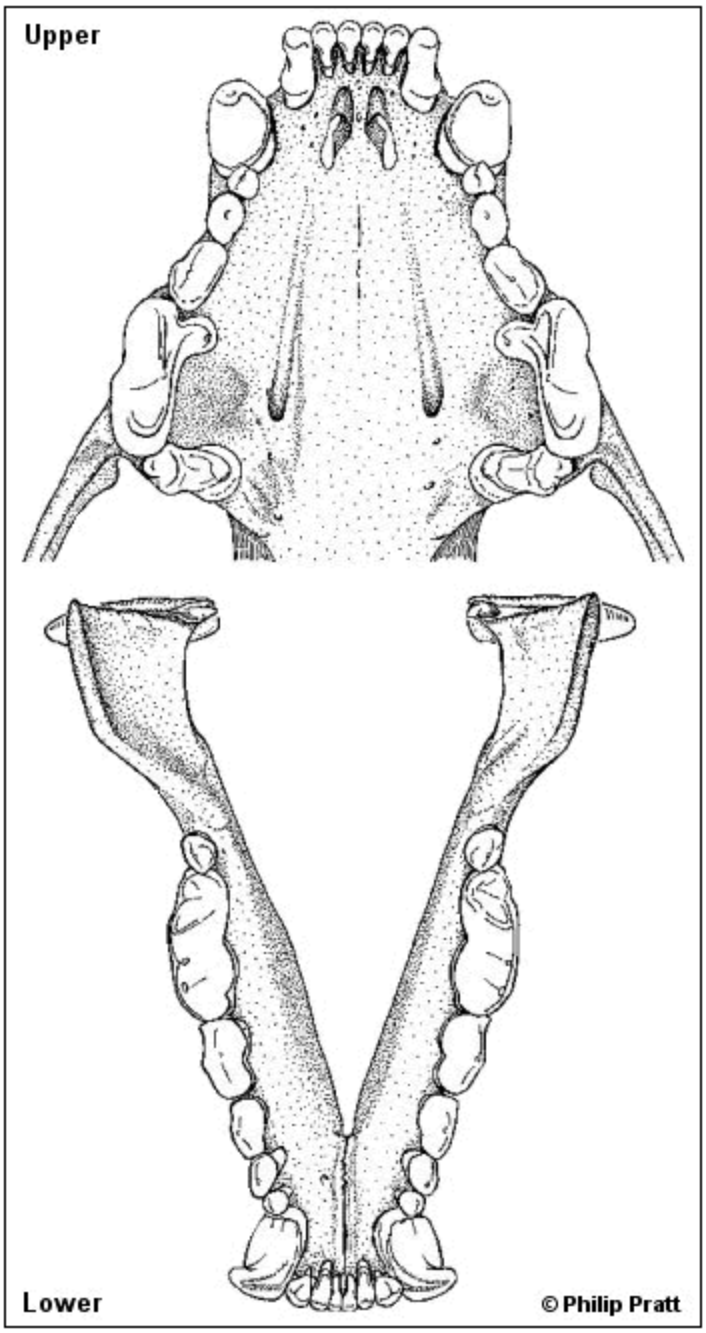
The largest measurement is over two times the average size of a contemporary human (*Homo sapien*).

The primary evidence for the neoichnologic research category focuses upon bone "Stacking/Assembly" behavior. The secondary analytical categories of prey selections cause of death, disarticulation observations, terrain examination, scavenger activity and the presence of "Hominid" tracks and track line within close proximity of EK#1 and EK#2 form the remainder of the neoichnologic evidence. Neoichnologic evidence analysis is drawn from a three site cross comparison analysis of the ichnofossils collected and recorded.

The primary neoichnologic evidence common to all three geographically separated locations is clear and definitive evidence of "Bone Stacking" or "Bone Assembly" behavior.

After looking at all of the other resident taxa possibilities to include black bear (*Ursus americanus*), cougar (*Puma concolor*), lynx (*Lynx canadensis*), and Wolverine (*Gulo gulo luscus*) it is clear that there are only two viable possibilities based upon the examination and analysis of the "Bone Stacking/Assembly" ichnofossil. This type of behavior has not been observed or recorded among any species resident to the Mount St. Helen's ecosystem with the exception of two, the North American Wolverine (*Gulo gulo luscus*), and Humans (*Homo sapiens*).

Wolverines are most accurately described as an opportunistic omnivore as referenced by Breen (2000); Beauvais & Johnson (2004, p. 22). Beauvais & Johnson (2004, p. 22); Luensmann (2008); Inman et al (2012, p. 638) describe wolverines caching ungulate remains which is their primary food source in secure locations or persistent snow drifts to provide a source of accessible protein for later consumption. They generally inhabit elevations of 6000 feet above sea level or higher in the Pacific Northwest during the summer and lower elevations during the winter, range large distances, and do not actively mark or defend home territories (Beauvais & Johnson, 2004, p. 22; Luensmann, 2008). Wolverines are described as having a dentition morpho-physiological profile of 38 teeth with a dental formula of incisor 3/3, canine1/1, premolar 4/4, and molar ½ Ewer (1973).



Wolverine Dental Formula:
Incisor 3/3, canine 1/1, premolar 4/4, molar 1/2 for a total of 38 teeth.

Note that the upper molars are rotated 90 degrees inward, which is the identifying dentition characteristic of the family Mustelidae (weasel family).

This is one of the structural features that have made the wolverine successful as a predator/scavenger, enabling it to crush bones and consume frozen tissue.

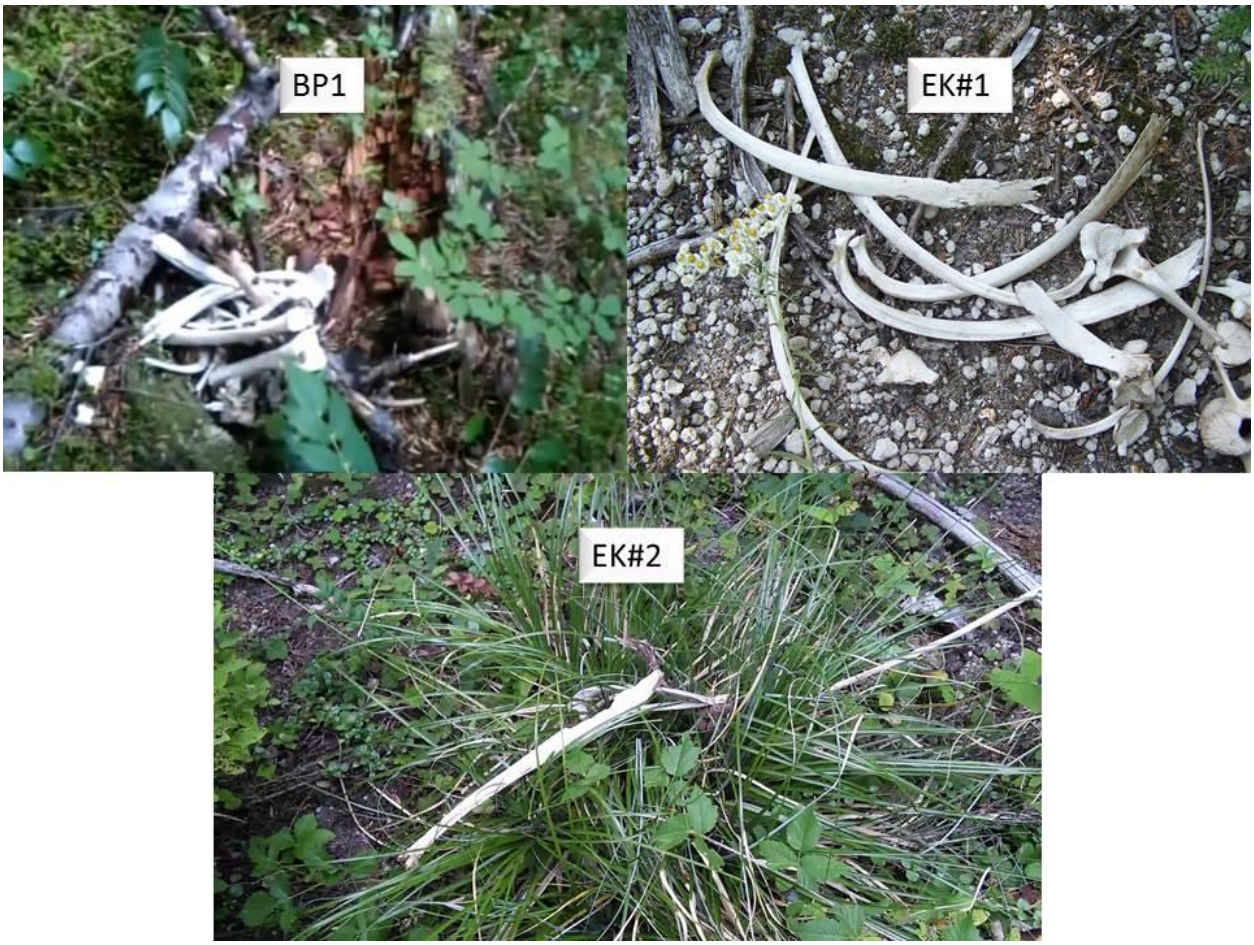
C. Breen 2000

Source: Wolverine Foundation http://wolverinefoundation.org/dentition-of-the-wolverine

A wolverine has very powerful jaws and teeth sharp enough to chew through bones and frozen carcasses. They are very aggressive and actively hunt animals many times their size, however they are primarily scavengers according to Beauvais & Johnson (2004) and Luensmann (2008).

Humans have a very long history of stacking bones and using them for many different purposes. Contemporary humans have used the bones of prey and scavenged animals for many

of the same purposes as ancient humans like food, fuel, decorations, building materials, medicinal ingredients, musical instruments, and religious or ceremonial artifacts (Adams, 2013; Hames, 2014; Holloway, 2014; Neiburger, 2014). These collections generally exhibit some identifiable human activity signature like tool marks, fire marks, teeth marks, and mechanical manipulation like marrow extraction and or modification into a different functional utility. Contemporary humans may have been responsible for this unique "Bone Stacking/Assembly" behavioral activity according the Washington State Department of Fish and Wildlife's Richard Beausoleil (2014), who is a bear and cougar specialist with the WSDFW's Karelian Bear Dog Program "To me, the bones look like they were placed there by a human (hunt site, illegal bait site). You looked at a lot of species to explain this, but in my experience with carnivores, this one is likely tied to Homo sapiens".



The next question that naturally arose was whether or not wolverines and humans hunt the same prey taxa in common locations.

All three evidence collection sites exclusively featured post mortem ungulate remains. Both EK#1 and EK#2 produced elk (*Cervus canadensis*) post mortem evidence. The site designated BP exhibited the remains of at least two black tail deer (*Odocoileus hemionus columbianus*) based upon the surviving skull evidence. The remainder of the individual specimens collected from each site further supports these identification conclusions. Wolverines primary food caching source is ungulate remains as cited in Beauvais & Johnson (2004, p. 22); Luensmann (2008); Inman et al (2012, p. 638). Contemporary humans also hunt these two prey taxa in the same locations.

The site designated BP is located within the Margaret #524 Game Management Area ("GMU," 2015, para. 1). Legal black tail deer (*Odocoileus hemionus columbianus*) harvesting is regulated by the Washington State Department of Fish and Wildlife to between October 11-31 (modern firearms), November 13-16 (late firearms), and November 26-December 15 (later archery) ("DFW Dates"). The condition of the bone evidence examined and collected from the site designated BP was very recent with moist flesh still attached to some of the specimens, with no scavenger activity observed or recorded. This may accurately suggest that the bone assemblage was deposited sometime in the winter of 2012 or spring of 2013 either by humans (*Homo sapiens*) or wolverines (*Gulo gulo*). With no canine tooth impressions observed or recorded, nor any mechanical crushing evidence, wolverines (*Gulo gulo*) would most likely not be responsible for this site. The taphonomic examination of the same evidence clearly supports the above assertion and conclusively eliminates wolverines (*Gulo gulo*) as the responsible predator taxa. The measurements taken from the dental load impression cut-outs strongly suggest human (*Homo sapien*) tooth structure and shape further supporting the conclusion that a “Hominid” was responsible for evidence collected and analyzed.

The two remaining sites designated EK#1 and EK#2 are located within the Lewis River # 560 Game Management Unit ("GMU LR," 2015, para. 1). Legal elk (*Cervus canadensis*) harvesting is regulated by the Washington State Department of Fish and Wildlife to between September 2-14 (archery) and November 1-12 (modern firearms) in the Lewis River GMU ("DFW Dates" p. 1). The condition of the bone specimen evidence from EK#1 and EK #2 were also in very recent condition with a very small amount of identifiable scavenger activity observed and recorded. This would suggest that the deposition of prey assemblages at these two sites occurred sometime between the spring of 2014 and the summer of 2014 based upon the

condition of the surviving specimens. The scavenger activity recorded upon a few of the specimens observed and documented at EK#2 could not be assigned to wolverines based upon the small size of the canine impressions, absence of tracks, and lack of mechanical predator dentition crushing manipulation signatures. The taphonomic examination of the same evidence clearly supports the above assertion and conclusively eliminates wolverines (*Gulo gulo*) as the responsible taxa. The measurements taken from the dental load avulsion attributed injuries strongly suggest human (*Homo sapien*) tooth structures and shapes further comprehensively supporting the conclusion that a "Hominid" was responsible for evidence collected and analyzed.

Analysis of the potential cause of death across all three sites suggests conscious behavioral expression or manifestation. The two surviving skulls at site BP exhibited conclusive evidence of blunt force trauma at the forehead and snout locations. The primary trauma displayed upon both skulls looked to be similar in shape and possibly made with the same shape of instrument. The shape was a concaved indentation in the form of a half circle. The shape suggests a large branch, rock, baseball bat or piece of metal with a rounded striking edge. Both skulls were discovered in a downhill facing orientation which was in directional coordination with the rest of the surviving secondary bone evidence debris field. The skull from EK#1 exhibited a visually similar type of blunt force trauma on the snout area. The skull from EK#2 was intact with no evidence of blunt force trauma to the skull. The cause of death in this case is most likely due to catastrophic spinal column separation, which signals blunt force and or twisting forces being applied in sufficient strength to break a large elk's spinal column in half with remaining tissue separation. No evidence of arrows, bullets, tool or cut makes were recorded on any specimens observed or collected from site's BP, EK#1, or EK#2. Humans (*Homo sapiens*) could have been responsible for the blunt force trauma skull evidence at

exhibited at sites BP and EK#1 but not EK#2. Wolverines as cited in the literature could not have produced the cause of death injuries as described at the three sites under any circumstances.

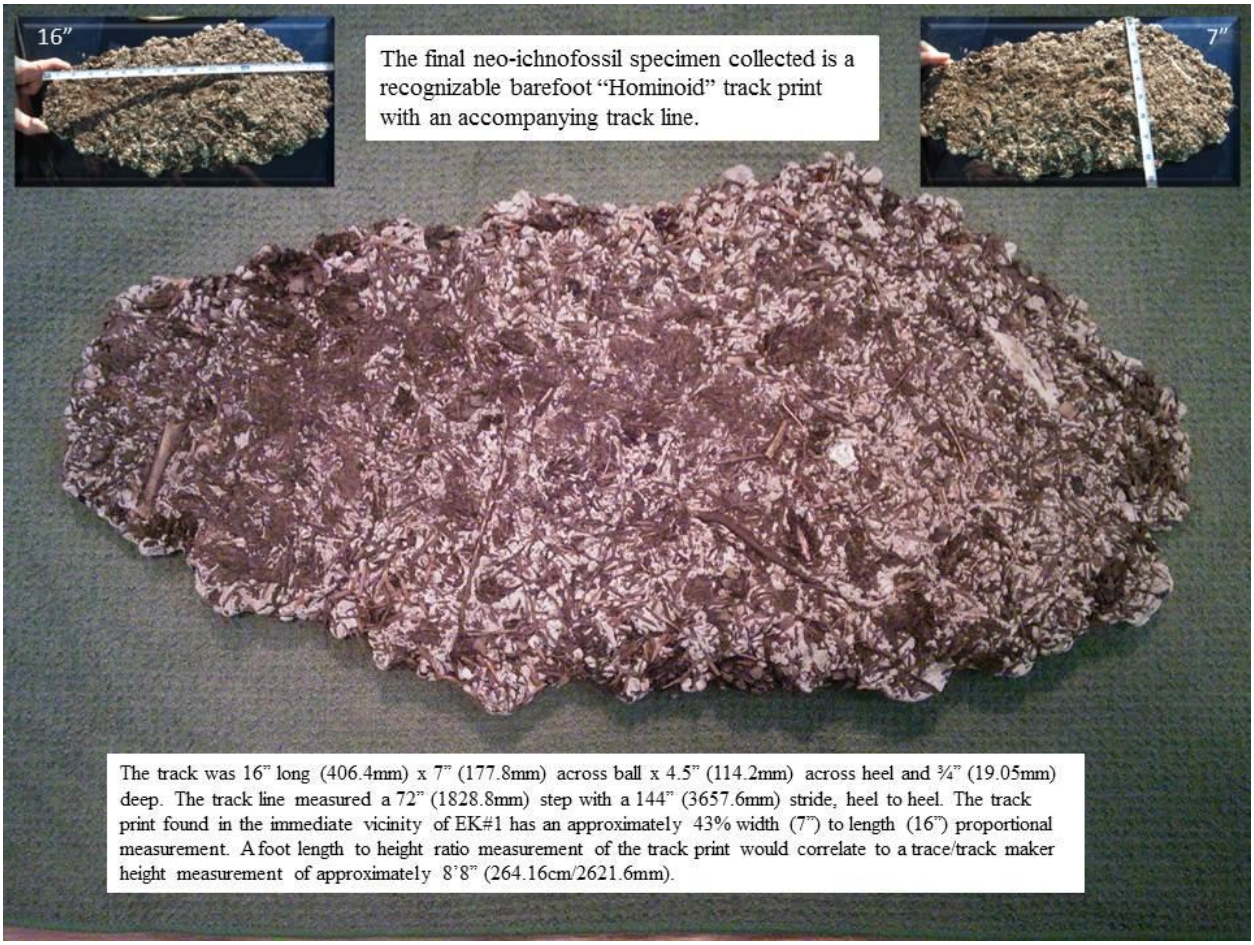
The disarticulation observations and surviving bone evidence specimens in all three cases are closely aligned. One of the initial observations recorded from all three sites was the manner in which the ribs were separated from the spinal columns. The rib bones had been broken away or disarticulated from the corresponding vertebrae sections with significant force yet the existing tooth load avulsion attributed evidence cannot reasonably account for this separation process. The lack of wolverine, bear or cougar teeth or track evidence of any kind very strongly suggests humans may have been responsible. This may potentially explain the separation processes and lack of explanatory claw or tooth marks. The very specific disarticulation process described above very strongly suggests hominoid/hominin or primate hands were used to hold the rib bones while masticating as cited in Plummer & Stanford, (2000, table 5) and Pickering et al., (2013, p. 1303). The amount of force it would take for a contemporary human to cleanly snap large elk ribs from the corresponding spinal vertebrae without leaving tools marks is a question which when answered may help to confirm or eliminate contemporary humans as the source of this site common disarticulation process.

Scavenger activity is an expected occurrence and yet in the case of BP was totally non-existent. Sites EK#1 and EK#2 exhibited trace amounts of small round canine tooth impression signatures. This dearth of scavenger activity is not consistent with generally accepted processes that a post mortem remains are subjected to in an unprotected natural environment. The lack of activity may suggest that the sites have been marked or designated in such a manner as to preclude or inhibit scavenger activity. Wolverines as cited by Ewer (1973); Beauvais & Johnson, (2004, p. 22); Luensmann, (2008) do not mark their territories. However, male

wolverines as cited in (Bradford, 2014, p.5; "Nat Geo," 2015, para. 4) scent mark their territory to warn other males and attract multiple females. Humans may mark territory with visual or physical markers. However, they generally do not mark a location with an olfactory substance like urine or feces which may be readily identifiable to scavenger population's resident to this specific geographical ecosystem. This brings up the question as to why scavengers would avoid these post mortem remains in conflict with their naturally occurring behaviors. One could accurately extrapolate from this dearth of activity that indeed something had marked these areas with a substance that the resident populations of scavengers can accurately detect, identify, and interpret. The resulting behavioral modifications very strongly suggest that the predator responsible is known to these scavenger species and also is a current and historical resident of the same geographical ecosystem. Finally, it has been observed that scavengers are not deterred by human hunter kills strongly suggesting that human scent is not responsible for the dearth of scavenger related activities at all three evidence collection sites.

The geographical position that each site occupied shared several commonalities. The elevation of the sites ranged from 2900 (BP) to 3900 (EK#1), with EK#2 occupying the middle at 3200 feet above sea level. The average elevation is 3333 feet. Visibility averages between 50-300 feet with intermittent old growth, second growth fir, and patchy undergrowth. Water sources in the form of creeks or springs are present and very close to each location. The presence of red and blue huckleberries along with Oregon grape in very large amounts is another characteristic that is common to all three sites. In the case of EK#1 there is a significant amount of post mortem bone assemblages of varying ages which suggests a historically active hunting or ambush location with very little ongoing scavenger activity. When taking the terrain observations in totality each location could easily be interpreted as predatory ambush locations.

The final neo-ichnofossil specimen collected is a recognizable barefoot “Hominoid” track print with an accompanying track line.



This evidence was found within one half mile from EK#1. The track was 16” long (406.4mm) x 7” (177.8mm) across ball x 4.5” (114.2mm) across heel and ¾” (19.05mm) deep. The track line measured a 72” (1828.8mm) step with a 144” (3657.6mm) stride, heel to heel. Several other faint partial track impressions were noted as this track line was reconstructed over 100 yards (91.44m) where it eventually disappeared due to the substrate conditions on the forest floor. No other similar tracks or wolverine prints were located in this immediate area or the vicinities around EK#2 or BP. Maximum foot length is measure from the posterior surface of the heel, pterion, to the most distal point of the longest toe as cited in Davis (1990, p. 13). The average

contemporary human foot as cited in Hawes (1994) measures approximately 10.35” or 26.3cm (263mm) for a 35.5 year old North American adult Caucasian male with a standard deviation of 1.2cm (12mm). NASA provides a range of figures that give an average foot length of 10.76” (27.33cm/273.3mm) and breadth of 3.6” (9.144cm/91.44mm) ("NASA Antro/Bio," 2015, para. 28).

Step Length is the distance between the heel strike of one foot and the heel strike of another, while Stride Length is the distance between the heel strikes of the same foot (Johnson, 2013, para. 1). The average Step Length for males is 31.10” (79cm/790mm) and 25.98 (66cm/660mm) for females, while the average Stride Length for males is 62.20” (158cm/1580mm) and 51.96” (132cm/1320mm) for females (Blanke & Hageman, 1989; "UOSA," 2015, para. 1). The “Hominoid” step length and stride length measure more than double the average of a contemporary human (*Homo sapien*) male and almost triple that of the average female as compared above. The track print found in the immediate vicinity of EK#1 has an approximately 43% width (7”) to length (16”) proportional measurement. The average human measures approximately 33% width (3.6”) to length (10.76”) proportional measurement. No discernable longitudinal foot arch was evident from a close examination of the track print cast or partial print impressions from the track print line. The heel is proportionally larger and broader then an average human heel. The proportional differences and lack of longitudinal arch very strongly suggests that the organism that made the track print was very heavy and had a foot that is quite different in functional morphology and shape then contemporary humans (Hawes, Nachbauer, Slovack, & Nigg, 1992, para. 1; Wang & Compton, 2004; Meldrum, 2007, p. 225). This observation is supported by the depth measurement (3/4”) of the track print pressed into Hemlock cones which were then further compressed into a hard packed dirt road substrate. The

Step Length and Stride Length are beyond the ability of the average human. Finally, the foot length to height ratio measurement for the average adult human is approximately 15% (Rich, Dean, & Powers, 2005, p. 404; Giles & Vallandigham, 1991; "AnthroMeas," 2015, para. 1). In the case of the average human foot which is approximately 10.76” (27.33cm/273.3mm) this would correlate to a height measurement of 5’9” (175.26cm/1752.6mm). Using this same foot length to height ratio measurement the track print which measured 16” (40.64cm/406.4mm) would correlate to a trace/track maker height measurement of approximately 8’8” (264.16cm/2621.6mm). The neo-ichnofossil track print analysis and subsequent comparison measurements clearly exclude the possibility that wolverines or contemporary humans (Homo sapien) were responsible for its deposition and that of the accompanying track line.

Evidence Conclusions

The Taphonomic evidence strongly suggests that the taxa responsible for the forensic dental avulsion attributed injury evidence are a currently unclassified form of Hominin. Some of the main characteristics that identify human chewed bones are bent bone ends or masticated ends, crenulated edges, bone peeling, double arch molar punctures on the chewed edges, triangular shaped pre-molar impressions, and puncture or linear marks evidence upon the bones surfaces as cited in Fernandez-Jalvo & Andrews, (2010, p. 119); Viegas, (2012, para. 3). Rib peeling, double arch molar impression signatures, triangular shaped pre-molar impression evidence, shallow linear bone scoring marks, human juvenile mamelon evidence and potential shovel shaped incisors were all clearly exhibited. Multiple examples of clearly illustrated hominid incisal mamelon evidence are further conclusive evidence of mastication activity by a juvenile in addition to the rest of the mastication evidence present. The presence of two distinctively different sets of hominid dentition morpho-physiology signatures was confirmed at

both sites EK#1 and EK#2. Evidence of potential shovel shaped incisors present at all three site locations is a hominid dentition morpho-physiological characteristic that is cited in the literature as one of the most commonly examined determinatives of Neanderthal dentition morpho-physiology. The evidence examined from sites BP and EK#1 preliminarily show a close resemblance in multiple areas. While this initial examination does not conclusively prove definitive shovel shaped incisor dentition signature is does strongly suggest it. Additional examination is needed in order to conclusively determine classic applicability or possible hybridized variation.

The consolidated dental load avulsion attributed injury measurement evidence taken from the rib bone samples demonstrated a range of tooth measurements primarily outside the upper range of contemporary Homo sapien dental morpho-physiology, yet very similar in shape. Of the 25 total incisor measurements taken (92%) are outside the average lateral incisor range as described in Chu (2007). Of the total measurements taken 80% are outside the average central incisor range of contemporary humans. Evidence based reconstructions of the bite radiuses and inter-canine distance's exhibited a distribution of measurements completely outside the upper range of contemporary humans (*Homo sapiens*). Individually and comprehensively this multiple number of mutually supporting Hominid diagnostic characteristics as expressed in the evidence are very compelling proof of consistency and reliability across three geographically separated locations.

The Neoichnology evidence very clearly supports the conclusions drawn from the Taphonomic evidence analysis. The combination of contextual analysis cross referenced with a configurational process for assessing bone damage may effectively enable the investigation of hominoid hunting (Plummer & Stanford, 2000, p. 359). The primary neoichnologic evidence

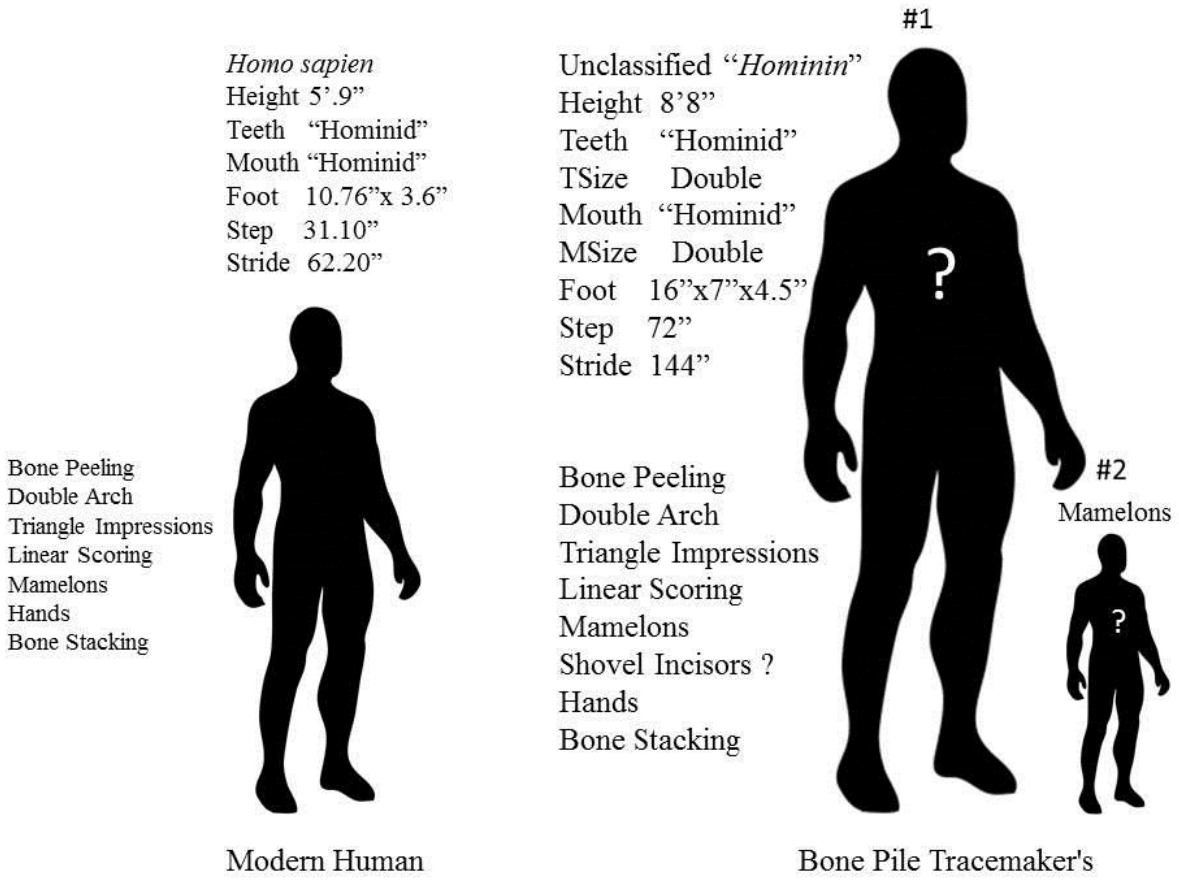
common to all three geographically separated locations is clear and definitive evidence of "Bone Stacking" or "Bone Assembly" behavior. Prey selection, spinal column disarticulation processes, and surviving bone evidence were also consistent across all three locations. The cause of death in two cases was most likely blunt force trauma to the skull while the third very strongly suggested catastrophic spinal column separation. One of the three sites recorded no scavenger activity while the other two exhibited very little strongly suggesting the continued residence of the predator responsible with coordinated scent marking identification strategies. The evidence analysis clearly and definitively eliminated wolverines or any other currently classified resident species of the Mount St. Helens ecosystem as the depositor of these ichnofossils.

The geographical location and elevation of all three sites may suggest ambush behavior. Site locations and topographic funneling suggest the possibility of pinch point or predatory ambush behaviors. There are water sources very close to all three evidence collection locations. Blue and red huckleberries are very prevalent in these areas. Comprehensive terrain analysis and a significant amount of peripheral bone evidence in the areas of EK#1 and EK#2strongly suggest repeated predatory ambush behavior. The elevations recorded fall within a consistent range of 2900-3900 feet above sea level. Finally, the causes of deaths do not indicate natural causes or accidents further supporting predatory ambush behavior as a behavioral ichnofossil.

The final neo-ichnofossil specimen collected is a recognizable barefoot "Hominoid" track print with an accompanying measurable track line. The "Hominoid" step length and stride length measure more than double the average of a contemporary human (*Homo sapien*) male and almost triple that of the average female. The track print has an approximately 43% width (7") to length (16") proportional measurement. The average human measure approximately 33% width (3.6") to length (10.76") proportional measurement. No discernable longitudinal foot arch was

evident from the examination of the track print cast or partial prints from the track print line. The heel is proportionally larger and broader then an average human heel. In the case of the average human foot which is approximately 10.76” (27.33cm) this would correlate to a height measurement of 5’9” (175.26cm). Using this same foot length to height ratio measurement the track print which measured 16” (40.64cm) would correlate to a trace maker height measurement of approximately 8’8” (264.16cm). The neo-ichnofossil track print analysis and subsequent comparison measurements exclude the possibility that wolverines, contemporary humans, or any other currently classified resident species were responsible for its deposition and that of the accompanying track line.

The consolidation of both the Taphonomic and Neoichnology data clearly record a baseline profile of a currently unclassified contemporary “Hominin” predator taxa resident to the Mount St. Helen’s ecosystem.



The evidence clearly and accurately illustrates and constructs a baseline profile of both physical and behavioral diagnostic characteristics assignable to this new species. The totality of the evidence analysis very conclusively proves that a new "Hominin" species with an estimated height of over 8'8", a 16" foot print and physically capable of striding over two times the distance of contemporary humans is currently living and feeding upon various ungulate (*Cervidae*) species in the immediate vicinity of Mount St. Helen's. Furthermore, a cursory examination of the applicable literature related specifically to the ichnofossil track print strongly suggests that there is large amount of additional historical and contemporary geographically situated data and analysis consistent with the assertions, declarations, and conclusions contained within this essay. When taken in totality the information and analysis presented in this paper

accurately establishes baseline Forensic Taphonomic and Neoichnologic evidence profiles that are measureable, verifiable, and comparable in the process of definitively identifying and eventually classifying a new "Hominin" species resident to the Mount St. Helen's ecosystem.

Expanded Inquiry

The evidence and analysis presented in this essay provides a unique opportunity for a variety of scientific discipline's to further augment their individual and cross-disciplinary bodies of scientific knowledge. Wildlife biologists, anthropologists, forensic dentists, and primatologists might find some value in further examining the findings and evidence contained within this essay. A database of pictures, measurements, analysis and original documentation are all available in conjunction with the actual surviving prey bone assemblages to those academics and scientists interested in furthering this line of inquiry. The authors of this essay welcome the opportunity to provide all of the evidence collected for further scientific examination and analysis in the process of adding to the collective scientific body of knowledge.

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