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2017-2019 historical, geological, and photographic perspectives on some old cairns atop Cushetunk Mountain in Hunterdon County, New Jersey,

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Introduction

In late 2016 I began donating time to the Hunterdon County Historical Society by photographing and helping document their collection of American Indian artifacts amassed by Hiram E. Deats and John C. Thatcher in the late 1800s[1]. This research of native peoples in Hunterdon County led soon after to the rediscovery of some ancient man-made stone mounds, or *cairns* of suspected Indian origin located atop Cushetunk Mountain (fig. 1). The site is off the beaten path and described in James Snell's *The History of Hunterdon and Somerset Counties, New Jersey* (Snell, 1881). A 1984 article in the N.Y. Times titled *Searchers Seek Indian Crypt* refers to Snell's work and recent efforts on locating them. This report chronicles the rediscovery of these cairns in a setting that is congruent with legendary colonial accounts and sets the stage for subsequent archeological work. A brief accounting of how I read about and acted upon finding the cairns is summarized together with the results of repeated excursions to the site to characterize their occurrence and evaluate this site with respect to a reported mountaintop fortress of the Raritan Tribe of American Indians in the 17th century.

Figure 1. Two of the larger stone heaps are cairns 005 on the left and 003 on the right. Cairn 005 has been partially excavated in an apparent attempt to uncover buried contents, whereas 003 is apparently undisturbed. The base of the excavation is above ground level so it remains uncertain as to what lies beneath.

Historical documentation

The first recorded English contact with American natives in the Hunterdon region was from 1640 to 1647 when 'Sir Edmund Ployden, a British citizen of Irish heritage, ventured into the province with 500 men to 'plant' and claim the region between the Delaware and Hudson rivers, then mapped as Noua (New) Albion (figs. 2 and 3). A journal account of this expedition was kept by Beauchamp Plantagenet who accompanied Sir Edmund and his 'knights' into lands along and northeast of the Delaware River that likely included northern reaches of Hunterdon County. As chronicled, 23 'Kings or Chief Commanders' of the region included two Raritan 'Kings' in the north next to 'Hudson's river'. One held a fortress on Mt. Ployden located '20 miles from the Sandhay sea and 90 miles from the ocean, next to Amara Hill, the retired paradise of the children of the Ethiopian emperor'. Mt. Ployden was described as a 'square rock, two miles compass, 150 foot high, a wall like precipice, a straight entrance

[1]https://hunterdonhistory.org/the-deats-thatcher-collection-an-introduction/deats-thatcher-archeological-collection-database/

easily made invincible, where he keeps 200 for his guard, and under it a flat valley, all plain to sow and plant.' The mountain fortress is depicted on the 5th edition of an early colonial map of the Virginia colony (fig. 3) that includes Noua Albion (NJ), but lacks details bearing on its location. Ployden's claim to

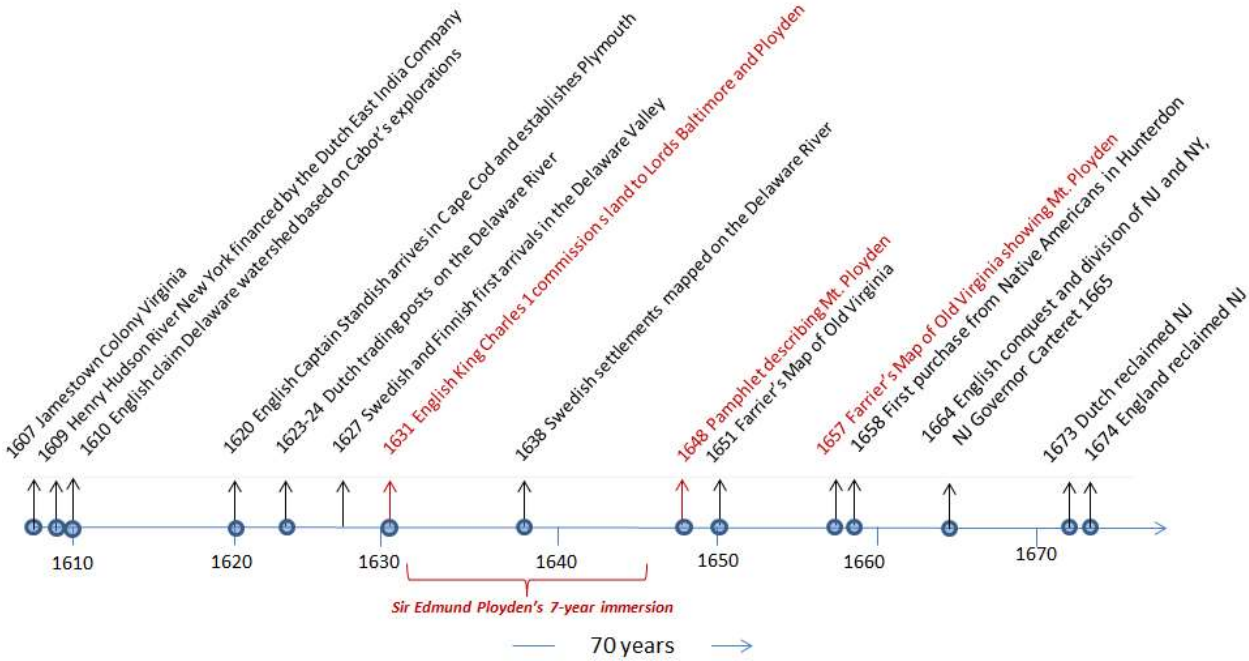


Figure 2. Timeline of some aspects of 17th century colonialism of the Mid-Atlantic region of North America.

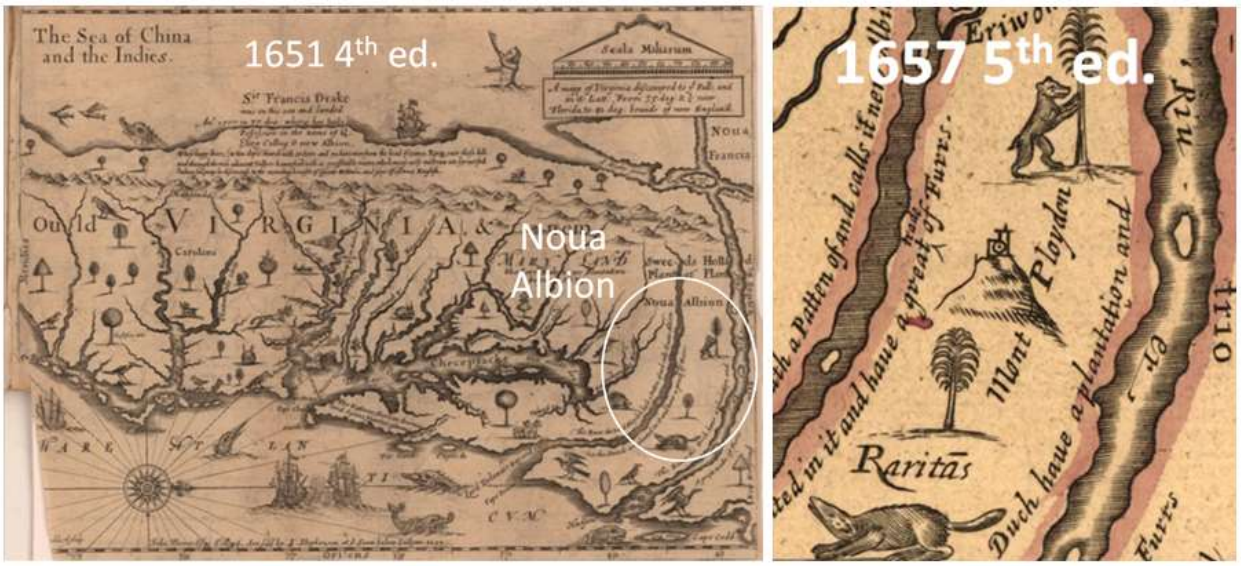
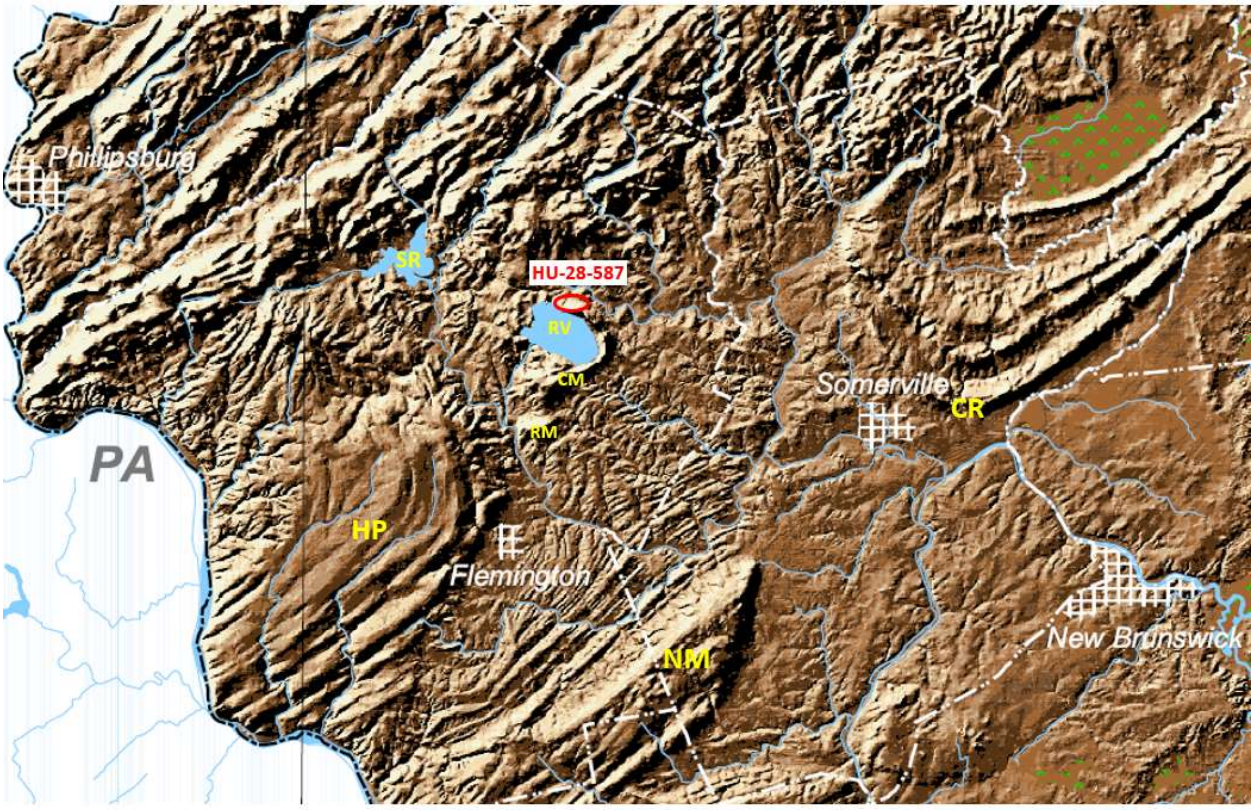


Figure 3. 1651 and 1657 editions of James Farrier's map of 'Ould Virginia' showing Noua Albion, what was to become New Jersey, and the appearance of Mount (Mont) Ployden on the later version.

the region and consequently his namesake mountain is missing on modern maps, but many have speculated that the 'kingly seat' could be Hunterdon's Cushetunk Mountain, or Somerset County's Chimney Rock or Neshanic Mountain(fig. 4) . Some historians have openly cast doubt on Plantagenet's 'extravagant' and 'imaginary state of the Raritan King', but the Cushetunk cairns are described in Snell's work as "piles of stones in the forest arranged in such a manner as to leave no doubt that they had been placed there, when the trees were small saplings, to mark an Indian burial-place." He also reports that James Alexander, who purchased and surveyed large tracts of land in Hunterdon in the mid-18th century (fig. 5) found atop the most rugged parts of Cushetunk Mountain: "a large heap of stones piled together with some regularity that formed a rudely-arched vault containing the remains of seven warriors, with their arms, ornaments, and utensils around them. There were beads of bone and copper, wrist- and armbands of the same metal, and a number of pipes, besides leather leggings and other articles of Indian dress. The general appearance was that they were all warriors of the same tribe, and to each one was affixed the symbolic characters showing the order in which they had succeeded each other. There was nothing in common in these relics with those of the then existing tribe to show that they were the

DIGITAL SHADED-RELIEF MAP OF NEW JESEY , NJ GEOLOGICAL SURVEY OPEN-FILE MAP 30



Abbreviations: RV – Round Valley, SR – Spruce Run, CR – Chimney Rock, HP – Hunterdon Plateau, RM – Round Mountain, NM – Neshanic Mountain

Figure 4. Digital-shaded relief map of west-central New Jersey showing the location of the 5.5-acre archeological site designated 28-HU-587 for the old cairns atop Cushetunk Mountain. Historians have noted the likelihood of Mt. Ployden as being Cushetunk Mt., Chimney Rock (CR) or Neshanic Mountains (NM). The city of New Brunswick is clearly seen from Cushetunk Mountain 15 miles to the southeast.

same people. The trees seemed to have grown there since this vault was built, and the probability is that it was the resting-place of seven generations of kings who had roamed up and down here long before the white people came." The stones were reportedly replaced, "fearing lest the Indians, discovering his invasion of this ancient sepulcher, would be incensed against him."

In 1956, Henry Beck (*The Roads of Home: Lanes and Legends of New Jersey*) raised the Cushetunk Mt. - Mt. Ployden link by noting "the bold eminence" of the mountain (fig. 5), but he noted the southern rim of Round Valley as the likely site of the long-lost warrior kings. As he stated, "Presumably, the graves must have been opened. Recent wanderings and inquires have brought forth no trace of these burials." Norman Wittwer (*The Dawn of Hunterdon*; 1964) also pointed out that Professor Pilhower, 'who devoted more than half a century to the study of New Jersey Indians', thought that Round Valley fit the location of Mt. Ployden if Lake Hopatcong is the 'Sandhay Sea' and the distance to Mt. Ployden was taken along water courses rather than a straight course (fig. 4).

Many of the cairns that we mapped have been apparently disturbed by past foraging (note the central crease in cairn 005 in fig. 1). Whether these cairns are ancient Indian graves or not awaits confirmation through professional archeological work. But in my mind, this site in conjunction with

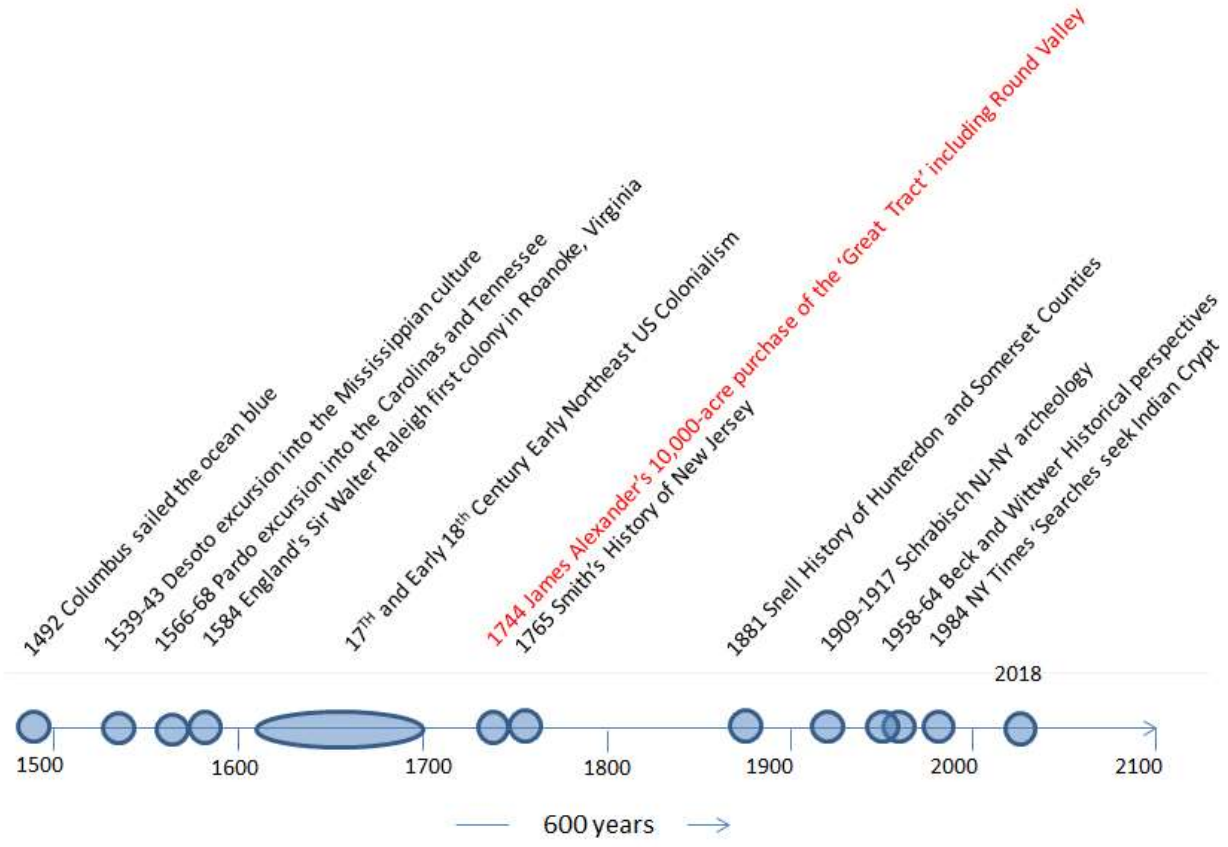


Figure 5. Timeline of European colonialism of the North American continental focusing on the New Jersey region beginning in the 15th century and highlighting recent historical documents used in this research.

adjacent archeological sites about the headwaters of Rockaway Creek points to the high probability of Cushetunk Mountain being Mt. Ployden and the resting place of the fabled warriors, among others. Site-specific aspects of the cairns are detailed below after covering the physiography and geology of the Cushetunk Mountain area.

Physiography and geology of the Cushetunk Mountain area

My perspective on Cushetunk Mountain is both a geological and physiographic one, born from my interests in structural geology, tectonics, and Cushetunk Mountain's 'bold eminence' as viewed from the Atlantic Piedmont and coastal plains (figs. 4 and 6). Part of my geological mapping in the New Jersey region included Cushetunk Mountain (Herman and others, 1992) and its nearby sister intrusions named the Prescott Brook granophyre and Round Mountain (Fig.7; Houghton and others, 1992). All of these igneous bodies sprout from the northern reaches of the Flemington fault (figs. 6 and 7); a significant intrabasinal fault having miles of normal and right-lateral slip (fig. 8, Drake and others, 1996). This fault along with others within and bounding the basin on its northwest side locally mediated magmatic

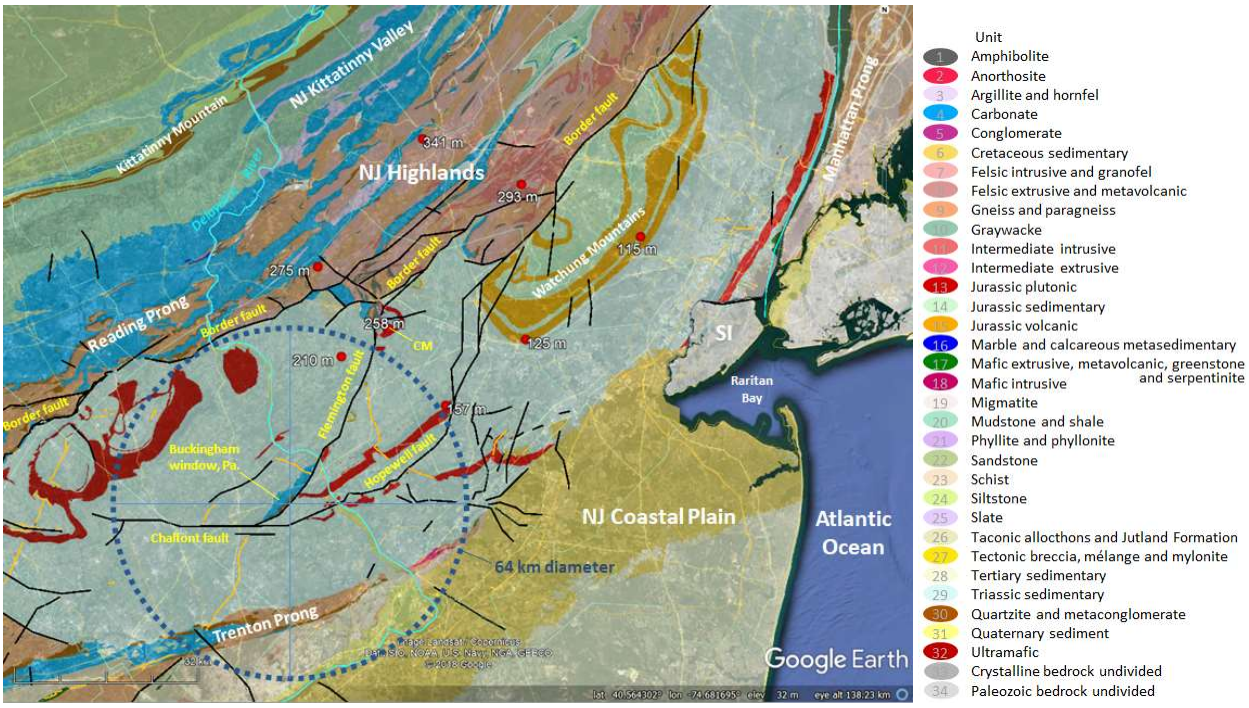
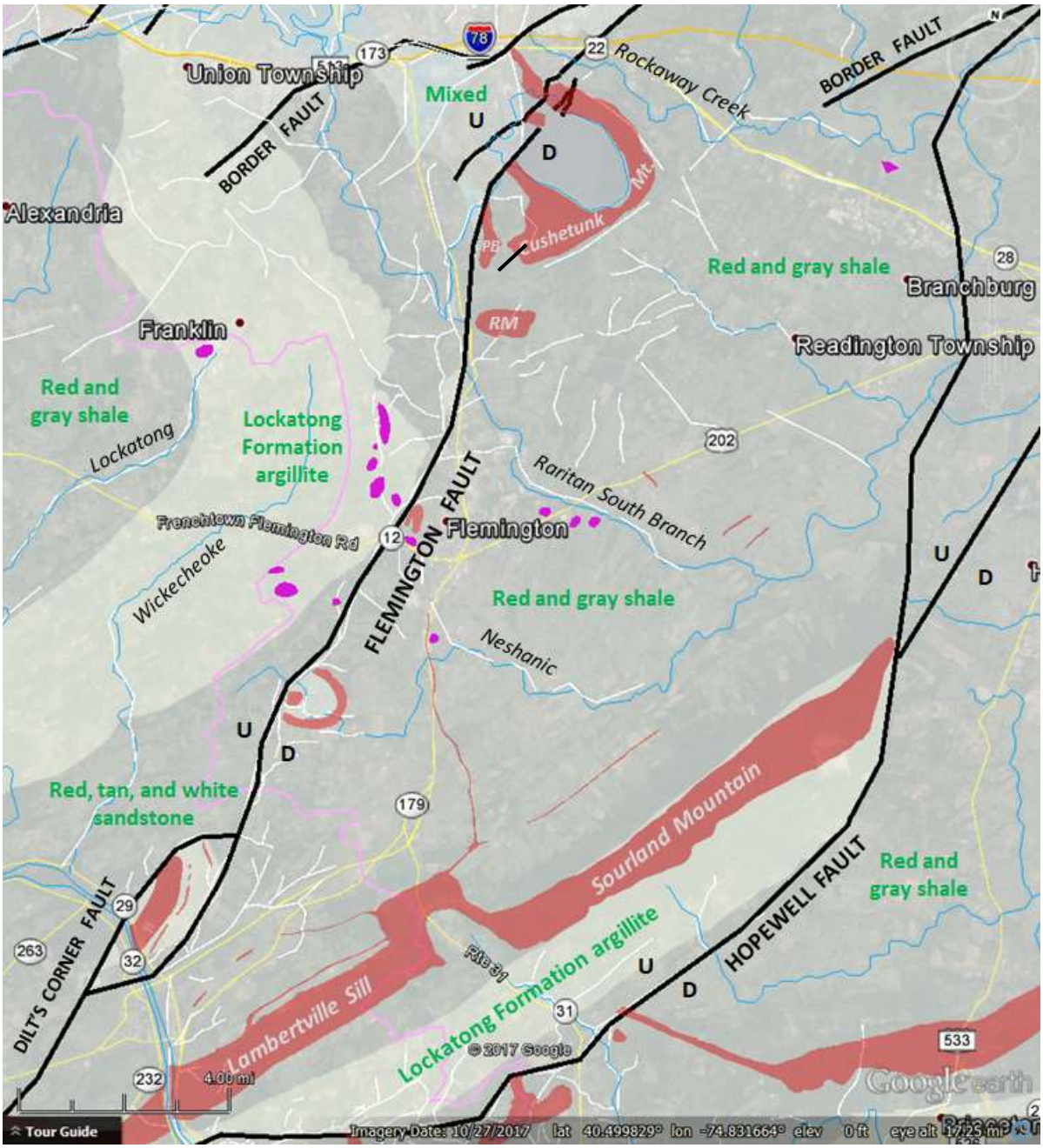


Figure 6. Bedrock geology map of part of the New York recess summarizing major physiographic provinces and features. The Mesozoic Newark Basin along with the older Trenton and Manhattan Prongs sit between highlands crystalline rocks to the northwest and Coastal Plain sediment to the southeast. Cushetunk Mountain crests at 258 meters as a high point in the Piedmont that nearly reaches altitudes seen in the adjacent highlands. The Flemington-Chalfont faults wrap around the Buckingham dome, highlighted here using a 64-km radius dashed circle centered on the Buckingham window, Pa. where Paleozoic rocks are raised and unroofed in the center of the Newark Basin. Abbreviations: CM- Cushetunk Mountain, SI – Staten Island.



EXPLANATION:

U/D Major geological fault (U; up-thrown and D; down-thrown fault blocks)

Creeks and rivers

Indian villages noted in 1913-14.

200-million year igneous rocks

Note: Generalized geology of the Flemington area displayed using Google Earth. Geology adapted from Drake and others, (1996). White lines are fracture traces modified from Herman (2015).

Abbreviations: PB – Prescott Brook Intrusion, RM – Round Mountain intrusion, U – up, D - down

Figure 7. Bedrock geology of the central part of Newark Basin in New Jersey showing large normal faults, small fault and fracture trends, and mapped Indian Villages (Schrabisch, 1917).

ascent through tensional gaps that opened in the crust as it was being pulled apart and stretched over the millions of years leading to the Cretaceous birth of the Atlantic Ocean. These igneous bodies originated very deep within the Earth as basic magma having abundant iron and magnesium and no free silica, and are harder and denser than the surrounding sedimentary crustal rocks. At the time they were being intruded as sills and stocks and extruded as volcanic flows, the areas where the magma ascended through the crust were raised thermally as crustal blisters before being stretched apart and later dropped downward along large extensional faults (fig. 8). The Early Jurassic basalt flows hardened into the orange rock layers comprising the Watchung Mountains and other smaller volcanic remnants that now sit in the gently down warped structural keels or 'synclines' scattered within the northeast

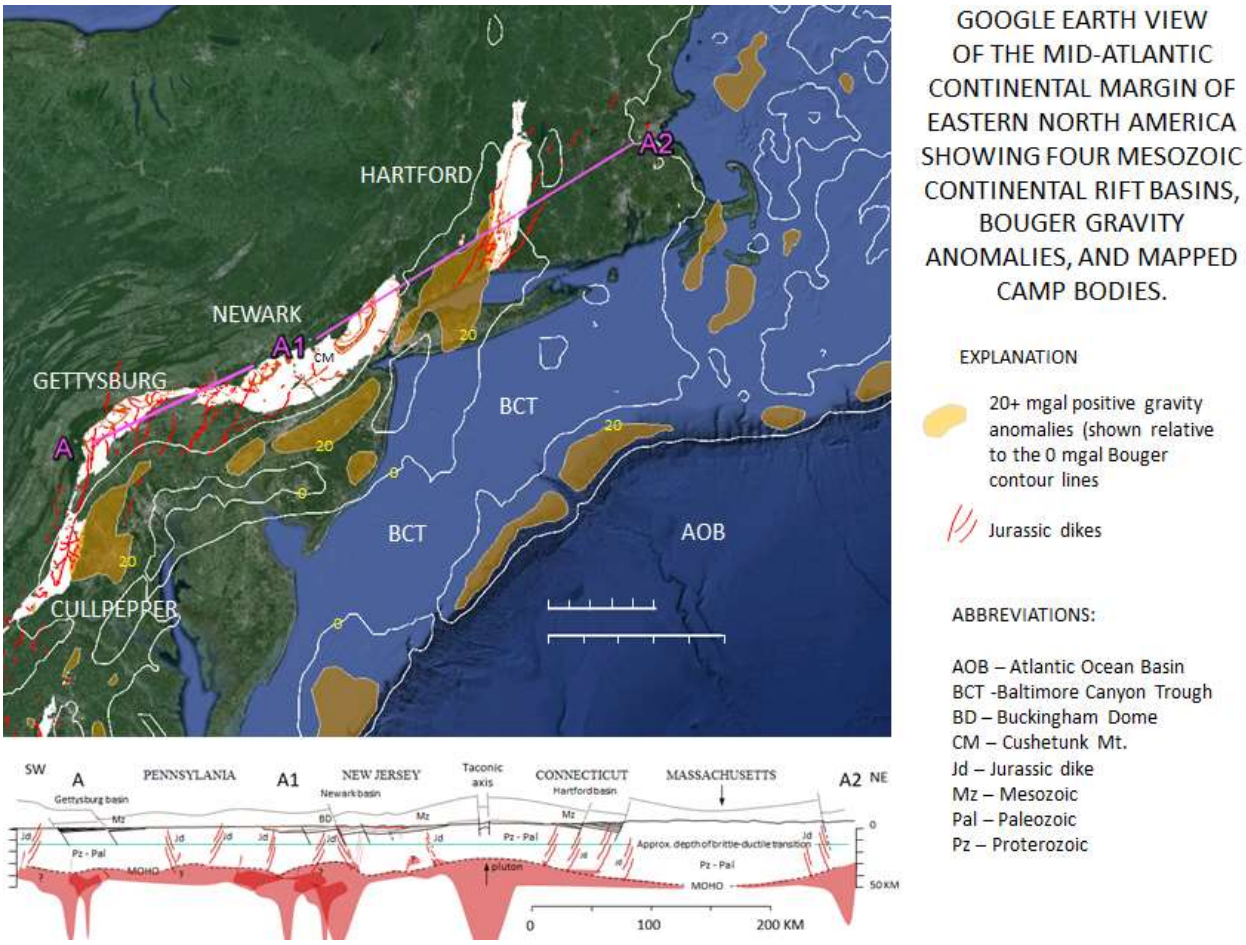


Figure 8. A map (top) and profile (bottom) view of how 200-million-year-old magma accumulated at the base of the crust and was fed upward from deep source areas in Earth's mantle through basic dikes that shredded the North American continental margin as part of the set of brittle, tensile structures developed in a rifted continental margin. The magmatic roots now correlate to the 20+ mgal gravity anomalies along the coastal margin and continental edge (Herman and others, 2013). The crust was locally warped and uplifted from these rising magmatic plumes before collapsing and separating as the Atlantic Ocean basin evolved. Cushetunk Mountain (CM) is solidified basic magma that ascended along dikes and faults in and around the Buckingham dome (BD near A1) that intruded Triassic red and gray shale and mudrock.

part of the basin (figs. 6 and 7). These synclines resemble crustal bathtubs where volcanic flows ponded along with shallow lakes otherwise receiving detritus fed by surface drainages pouring into the basin. Mud and silt slowly settled onto the floor of the freshwater lakes that also held fish that were fair game for the dinosaurs whose tracks were left in the lake-bottom muds eons ago. There were three main pulses of volcanism that occurred over roughly a 2-million-year period (Olsen and others, 2003). These basalt flows were originally shed into crustal depressions but are now topographic ridges owing to their crystalline nature and relative resistance to weathering and erosion in comparison to the softer mud and silt rocks that sandwich them and underlie most other places in the basin. The crystalline igneous rocks in the basin of both volcanic and intrusive (or 'plutonic') origin are now commonly referred to collectively as 'trap rock', a term used in the commercial aggregate-material business. The rocks on Cushetunk Mountain are formally called 'diabase', and sometimes either 'dolerite' or 'black granite' because of the local abundance of dark iron and magnesium-laden (*ferromagnesium*) minerals speckling the otherwise light gray rock. The material contrast between these basic igneous rocks (>3.0 gm/cc) and surrounding detrital rocks of lower density (~< 3.0 gm/cc) provides positive gravity anomalies correlated to subsurface, dense and thick magmatic roots emplaced in the Central Atlantic Magmatic Province (CAMP of Marzoli and others, 1999) that are now drifted apart to define opposing edges to the intervening Baltimore Canyon trough (fig. 8). Because the igneous bodies are harder and denser than the surrounding sedimentary Mesozoic shale and mudrock, they crop out and weather in positive relief with respect to the surrounding valleys (figs. 4 and 9). Cushetunk Mountains' peaks now rise a quarter of a kilometer above sea level, and about 100 meters above adjacent shale plains (figs. 4 and 9). Its peaks have topographic elevations nearly equaling those of the adjacent Highlands (figs. 4 and 9) and provide a commanding view of the area, particularly to the east and south over lower-relief plains underlain by red and gray shale and mudrock in the Neshanic, Raritan, and Rockaway valleys (fig. 7).

A detailed structural geological analysis of the Flemington Fault zone was done by Houghton and others (1992) that included map definition of these igneous bodies and chemical tables detailing their compositional similarity. But this work lacked subsurface interpretations of their structural form that remains speculative today because this is a very complex structural setting where old faults striking northeast-southwest form the northwest border of the basin but also branch southward at a large triple junction into the large, intrabasinal Flemington fault (figs. 6 and 7). The rocks of Cushetunk Mountain were intruded to fill tensional gaps in this junction, and today along with adjacent hills to the northwest and a few dams, these ridges encompass Round Valley reservoir (fig. 9), built by the Army Core of Engineers in the 1960's as regional water conservation efforts were realized to meet the growing fresh water demands by human populations in central New Jersey.

To the immediate South of Cushetunk Mountain is Round Mountain (fig. 7), so named because it is a solitary, round and wide vertical pipe that carried magma upward into, and possibly through the crust. Round Mountain therefore has comparatively simple topographic form in comparison to Cushetunk Mountain which has a boxy, rectangular form like an irregular ring dike, hence the 'square-rock' reference for Mt. Ployden. This shape results from having both sill and dike parts of a

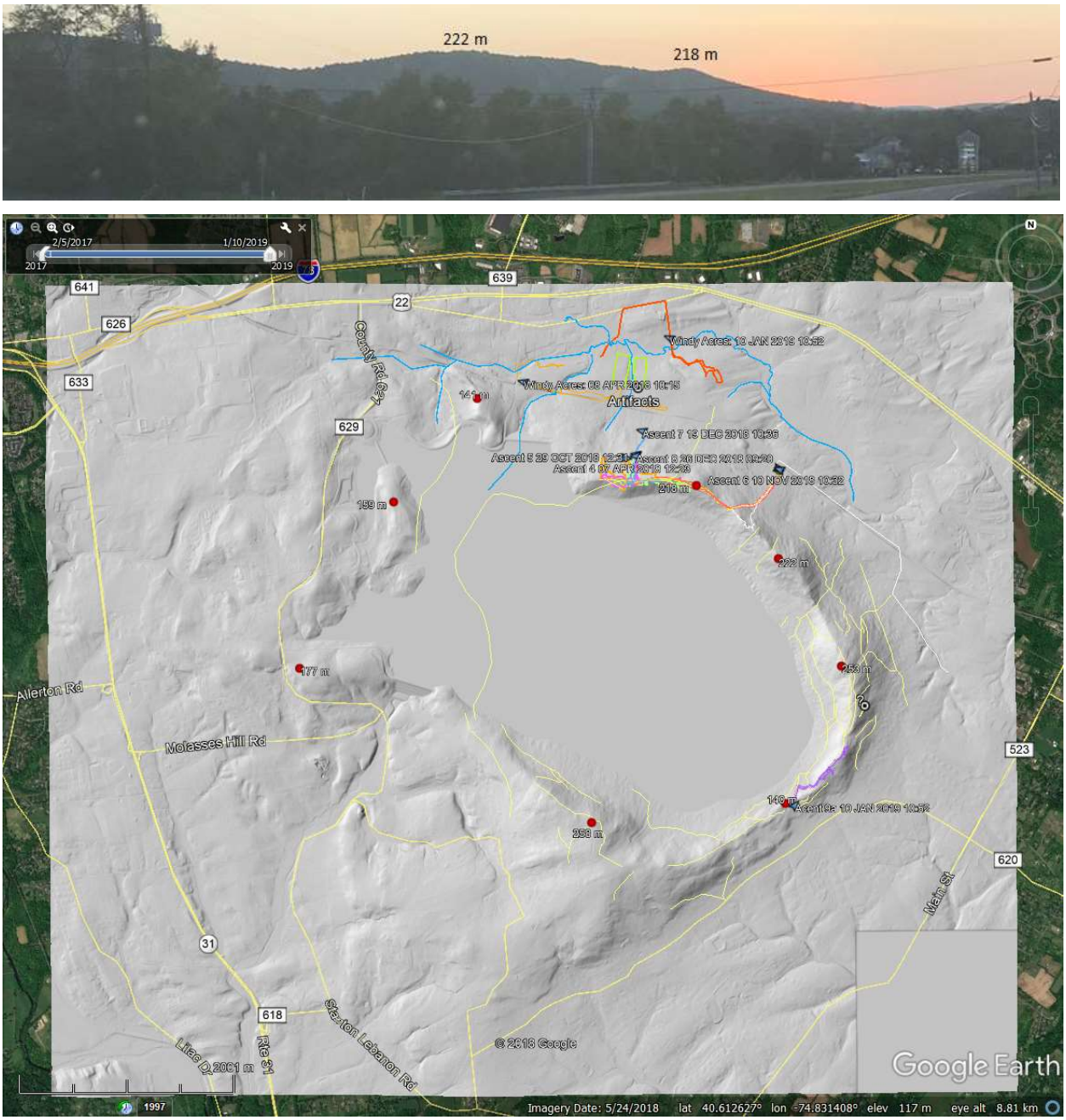


Figure 9. Top photo is a west, sunset view of the northern peaks of Cushetunk Mountain on the eastern limb as viewed from US Route 22 West. Bottom map is a captured Google Earth (GE) view Cushetunk Mt. Showing a shaded-relief overlay derived from laser-based topographic mapping of the NJ Highlands in 2006-2007. The image was separately processed and captured using the QGIS geographic information system, then manually registered in GE. The multicolored hiking tracks are GPS tracks of 2017-2019 field activities. Yellow roads are built into GE whereas the thin yellow lines on the mountain ridges and flanks were digitized for this project using the hill-shaded overlay. A set of spot peak elevations (meters) are shown using red dots. The

headwater of the Rockaway River is shown as light blue lines. The nearby **Artifacts** place mark and light-green rectangles note the Windy Acres Archeological Sites 28-HU-539 and 540.

plutonic complex, with the southern base injected concordant to encompassing sedimentary beds of mostly red shale, but with eastern and western limbs rising discordantly upward through the Triassic section for over a kilometer (Houghton and others, 1992). It is difficult to tell now whether any of the other intrusions in the Cushetunk Mt. Area were crustal conduits feeding nearby lava flows into the basin because a few kilometers of earth has been eroded from the top of this region over the past 65 million years and shed eastward as a sedimentary blanket that thins eastward across the continental-oceanic margin. Much geological material that once covered this region has long since been removed, including many recent continental ice sheets that repeatedly scoured many parts of the New York Recess. An interesting cultural aspect of Round Mountain is that if the premise that Cushetunk Mountain is Plantagenet's Mount Ployden as related herein, then Round Mountain is a good fit as 'Amara Hill, the retired paradise of the children of the Ethiopian emperor'. This is a very intriguing aspect of the 17th century historical account, because it raises the possibility that there were Ethiopian descendants living in Hunterdon at the time of first English contact! The timing is possible for a group of African slaves to have escaped from the Virginia colony and made their way north to freedom in New Albion where they lived alongside the Lenape in the 17th century.

The Hunterdon Plateau lies to the west of Cushetunk Mountain (fig. 4). This upland has slightly less relief than Cushetunk Mountain, and is underlain by hardened gray and red argillite of the Lockatong Formation (fig. 7) that once was deeply buried but was structurally raised and now crops out. Herman (2016) depicted the Hunterdon Plateau as parts of a crustal welt with an estimated diameter of 65 km that became uplifted, then segmented and down dropped along its eastern and southern sides by the linked Flemington, DIlt's Corner, and Chalfont fault systems (figs. 6,7, and 8). The welt originated from thermally blistering as dikes were feeding magma through the stretched crust and eventually leading to the 200-million-year-old (Ma) CAMP volcanism. The welt is cored by the Buckingham window in Bucks County Pennsylvania where Paleozoic rock is unroofed near the center of the Newark Basin (figs. 6 and 8). Remnant lava flows fed by such dikes now fill the keels of down warped troughs along the border and Flemington faults including the great flows of the Watchung Mountain range (fig. 6).

Topographic expression and extents of the suspected Indian burial ground

The topographic expression of Cushetunk Mountain is best represented using remotely sensed digital-elevation models (fig. 9) that also aid in visualizing and accurately locating the larger cairns (figs. 10 and 11). The best-available modern data used for this task were acquired during 2006 to 2007 by the New Jersey Highlands Council using contractors to fly airplane-mounted lasers to detect and range land features (LiDAR). The New Jersey Office of Geographic Information systems began distributing these data in 2008 upon request. The data used here were acquired by J. Mark Zdepski then and shared with me at the time he retired in 2017 from his geological consulting business located in Flemington, NJ.

The laser-based data products were flown at an elevation of about 1890 meters (6200 feet or a little over a mile) and produced digital elevation models (DEM) accurate in three dimensions to less than 1 foot. Sophisticated computer algorithms are used to remove the expression of tree canopies to return what are considered to be accurate, bare-ground representations of land surface. The DEMs can be artificially shaded using variations in Sun azimuth and inclination to highlight land features of certain size and orientation. The azimuth is the direction that it's shining from 0° to 359°, with 0° from the North, 90° from the East, 180° from the South, and 270° from the West. The inclination is simply the angle (degrees) above the horizon ranging from 0° to 90° with the latter having the Sun directly overhead. Area- and site-specific hill shaded maps were generated for this project to help visualize the topography around the cairns (Site Hu-28-587), and help locate old foot paths (figs. 9 to 12). Three different hill-shaded raster (grid) themes were produced using the 2007 Highlands LiDAR DEM (figs. 10 and 11). These were generated using QGIS and using Sun azimuths of 270°, 300°, and 0° and inclinations of 60° or 40° as noted in each figure below. As one can see by comparing figures 10 and 11, certain features stand out using different shading schemes but only cairn 003 shows up on all views. This particular one therefore provides just the right setting and combinations of environmental factors to clearly stand out in shaded relief at this scale. One thing that the DEMs show with certainty is the necessity of locating each cairn in the field because they can't all be seen using LiDAR. They are simply not all of grand enough size or situated on a hillslope with suitable conditions like 003 for confident differentiation of cairns from outcrops or other stone heaps brought up by the roots of a large, fallen trees. At this early stage in the characterization of these cairns, it is difficult to tell if some of the smaller ones are simply natural stone heaps stemming from windswept, toppled trees rooted in rocky soil. It is likely that some of the smaller stone heaps can be eliminated for future archeological consideration after given close

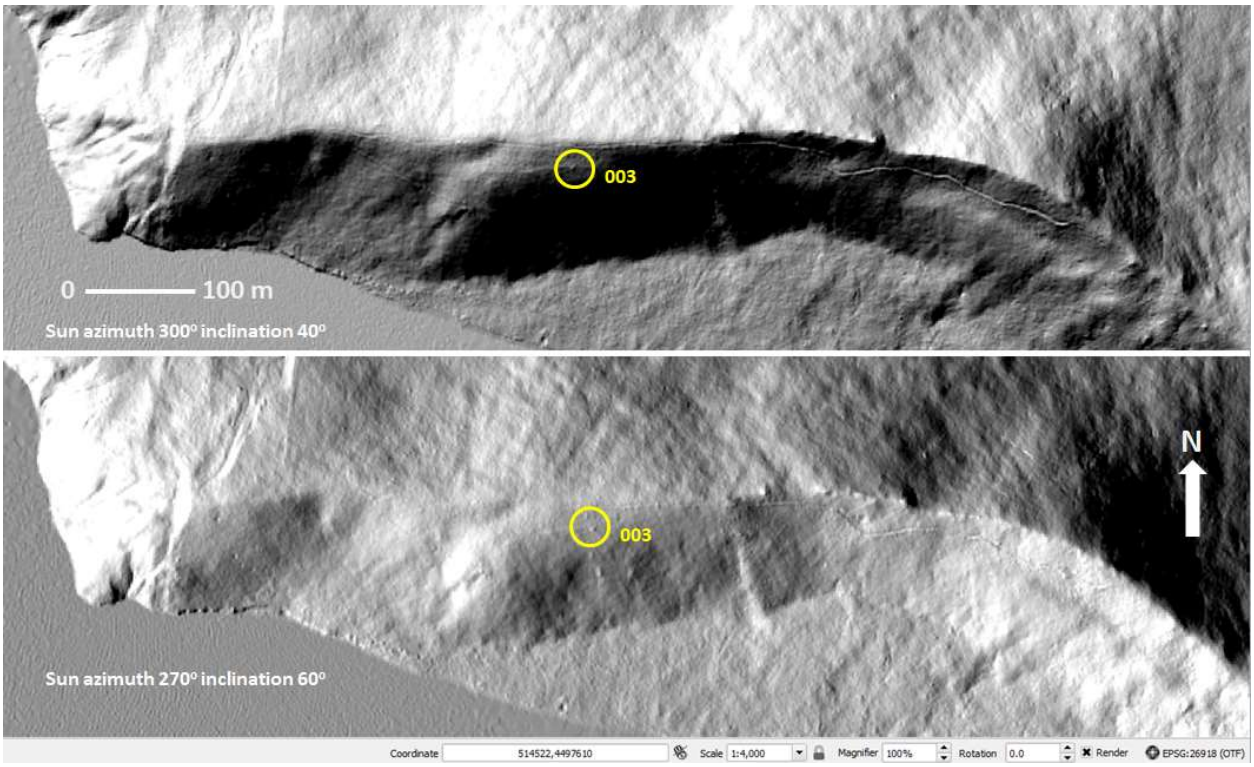


Figure 10. Two hill-shaded views of the 2008 NJ Highlands LiDAR theme showing the expression of cairn 003, one that consistently stands out in the digital-elevation model at the 1:4000 scale. By varying the sun azimuth and inclination, different oriented land features are highlighted.

scrutiny by other sets of trained eyes, and perhaps some preliminary non-invasive geophysical prospecting, metal detecting, etc.

The accuracy of GPS waypoints vary over time because of variability in locations of satellite and receiver positions and atmospheric conditions. Horizontal positional accuracy when using hiking-grade GPS units are generally reported at about ±10 ft. with slightly worse vertical accuracy. A series of repeated readings were taken on the ground near the centers of many of the larger cairns using a

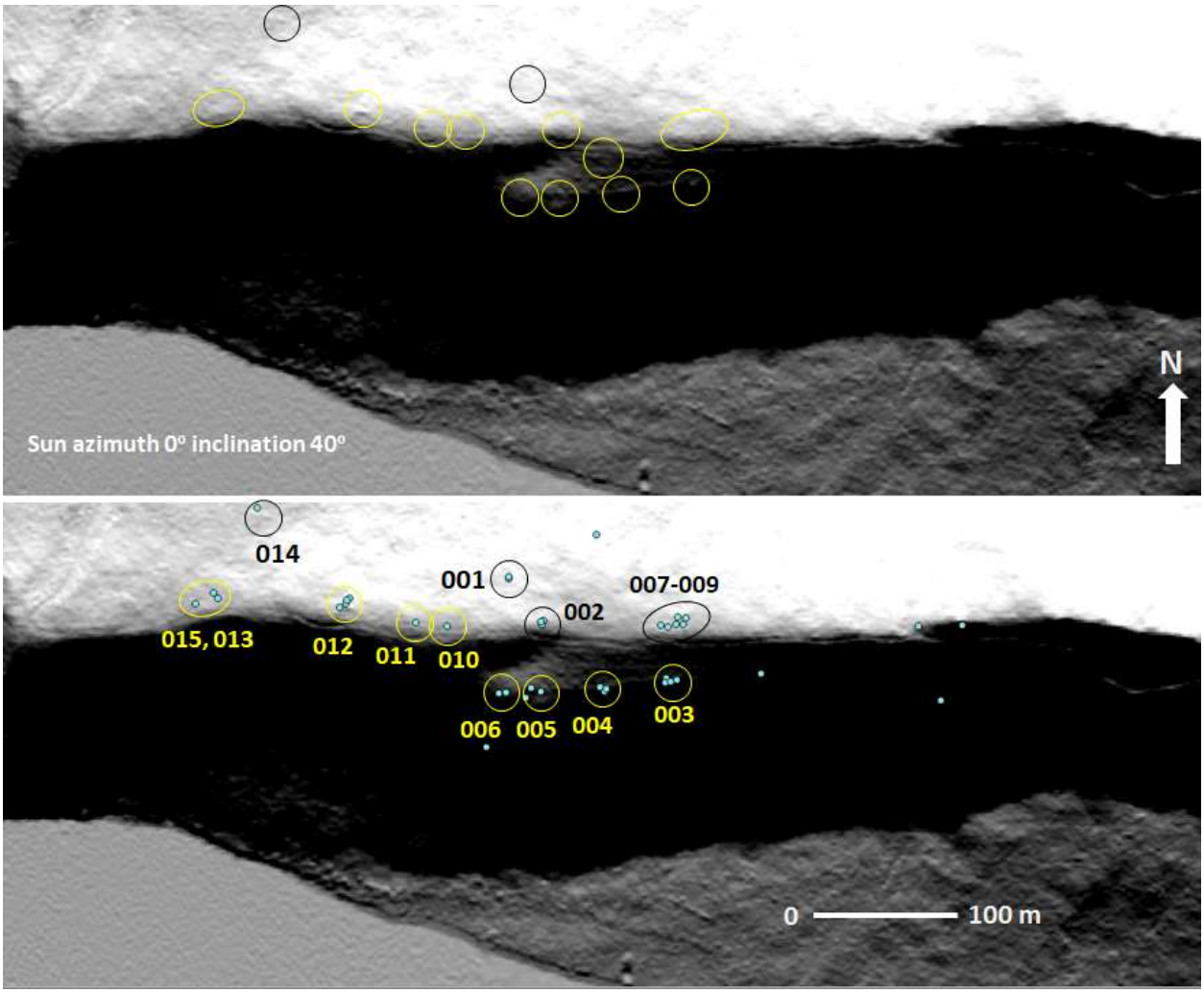


Figure 11. Two views of the same 2008 NJ Highlands LiDAR hill-shade theme using a Southern exposure (azimuth 0°) and a Sun inclination of 40°. Both include yellow or black circles highlighting the locations of individual cairns or ovals where there is more than one in close proximity. The bottom view include multiple generations of GPS (light blue) waypoints taken at the same locations on different dates and showing slight horizontal positional variations up to about 10 feet between readings. The GPS points are turned off in the top view so that LiDAR expression of each cairn site is clear as possible. Cairn 012 is one of the longest, and is stands out on this hill shaded view but not on those using an East (270°) or Southeast (300°) hill-shaded view (fig. 10). Note the one small terrace where a few of the larger ones (003 to 005) are located just to the south and downslope form the ridge crest.

handheld Garmin GPS receiver that plot close together as shown in figure 11. Some locations were reoccupied and recorded up to four times whereas others were more difficult to find and access on repeated occasions. My most recent ascent onto the Cushetunk peaks marks my tenth in two years.

Photographs and physical aspects of the cairns

This section includes photographic and locational details of each cairn along with some notes on their physical aspects. Table 1 specifies their geographic coordinates, physical dimensions, and a few notes on their location and form. Figures 13 through 22 provide photographic details including those having helped map them. Their locations mostly stem from data collected using a hand-held GPS receiver (table 1) with stated accuracy of + 10 feet (~3 m). As the photos show, some cairns are

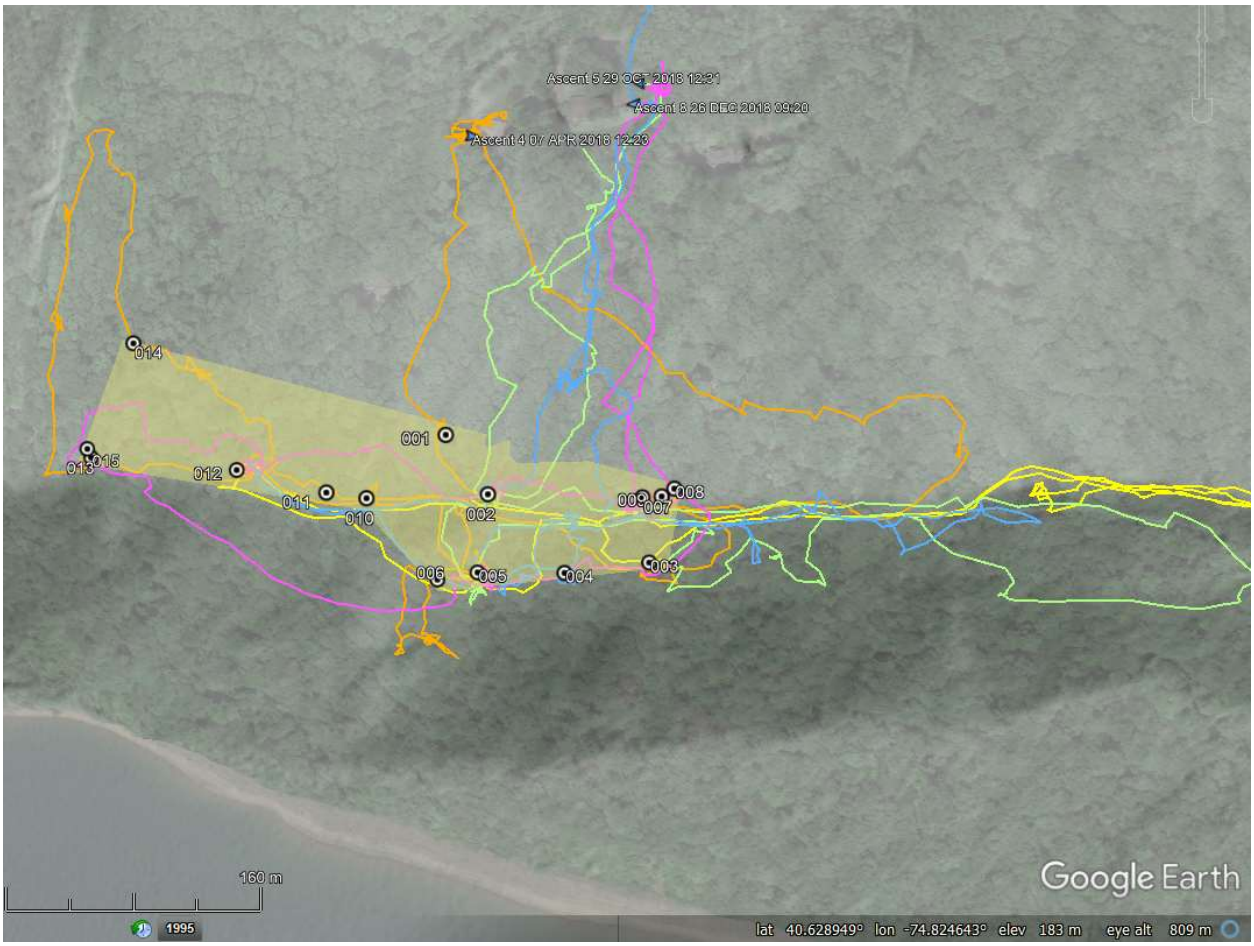


Figure 12. Google Earth display of stone cairn locations showing the associated GPS tracks of five different excursions into the area during 2017 to 2019 to locate and characterize the cairns and define the area of interest for future archeological work. A hill-shaded DEM (Sun azimuth 300 and inclination 40) is shown here overlain at about 70% opacity. Note that four later ascents originated from parking areas at private residences whereas the oldest one (yellow) followed a public access trail originating from the ridge base about one-kilometer away. The placemarks noted above all fall within a 5.5-acre polygonal area.

Table 1. Approximate geographic coordinates and physical dimensions of some cairns on Cushetunk Mountain

No.	GARMIN GPSMAP 64S Latitude°	Longitude°	GE (meters) Elevation	DIMENSIONS (feet(meters)) Length	Width	Height	NOTES: Most of the cairns have lengths exceeding widths along the trend of the ridgeline (~E-W).
001	40.628475	-74.821583	203	14 (4.3)	8 (2.6)	3 (1.0)	Small and unusual location on North slope.
002	40.628182	-74.821311	191	24 (7.4)	10 (3.0)	3 (1.0)	Ridgetop and cleaved by foraging.
003	40.627852	-74.820222	185	20 (6.1)	12 (3.7)	5 (1.5)	SE ridge, little if any disturbance.
004	40.627773	-74.820821	183	19 (5.8)	12 (3.7)	5 (1.5)	SE ridge, little if any disturbance.
005	40.627770	-74.821400	179	28 (8.5)	20 (6.1)	7 (2.1)	SE ridge, excavated toward 145° downhill.
006	40.627734	-74.821666	177	13 (4.0)	10 (3.0)	2 (0.6)	SE ridge, excavated hole in the top.
007	40.628168	-74.820309	210	5 (1.5)	4 (1.2)	2 (0.6)	Ridgetop, small, overgrown and uncertain.
008	40.628211	-74.820102	211	7 (2.1)	3 (1.0)	2 (0.6)	Ridgetop, small, overgrown and uncertain.
009	40.628172	-74.820184	211	6 (1.8)	3 (1.0)	2 (0.6)	Ridgetop, small, overgrown and uncertain.
010	40.628161	-74.822102	199	24 (7.4)	10 (3.0)	3(1.0)	Ridgetop, cleaved in middle toward 225°
011	40.628188	-74.822365	198	8 (2.6)	5 (1.5)	2 (0.6)	Ridgetop, small, and uncertain.
012	40.628284	-74.823004	190	43 (13.1)	10 (3.0)	2 (0.6)	Ridgetop, very long and undisturbed.
013	40.628380	-74.824061	185	9 (2.7)	7 (2.1)	1 (0.3)	Ridgetop, small, and uncertain.
014	40.628923	-74.823691	183	14 (4.3)	9 (2.7)	3 (1.0)	North slope, Small and unusual location.
015	40.628335	-74.824040	185	14 (4.3)	8 (2.6)	3 (1.0)	Ridgetop and small.

Note: Cairn dimensions are estimated measurements with heights being least precise and perhaps off by more than ±1 foot. Cairn 008 is the only one not photographed in this report. It's small, obscured by tree roots, cluttered and needs clearing.

Figure 13. Three members of the four-man team including myself (photographer) that set out on April 7 to locate and photograph each one using a GPS receiver and an IPhone 8 camera. The GPS track is show in orange as the 4th ascent on figure 12.

overgrown with vines and all of them littered with fallen tree limbs and trunks, some of them too big to remove without a chainsaw or future teamwork (figs. 14-22). The physical dimensions presented here are approximate measurements taken using a flexible, 50-ft tape provided by Mark Zdepski, one of a four-man team that set out on April7, 2018 to inventory the cairns and start defining the current perimeter of the 5.5-acre site within which they occur (fig. 13). Some cairns are so littered with natural debris and overgrown that it was difficult to find each one during repeated field visits as little effort was

Figure 14. Cairns 001 and 002 **.**

made to clear trails or surface clutter from them at this early stage, or mark their location using survey flagging, or other colored markers to make reoccupation easy. The site occurs on the northern end of the system of ridge-top hiking trails that are developed in many places around the mountain ridge crest and flanks (fig. 9). The ridge-top trails come to an end at the northern limits of the eastern limb of

Figure 15. Cairn 003

Figure 16. Cairns 004 (top) and distant view of 003 from 004 (bottom)

Cushetunk Mountain where a chain-link fence running north-south and up and down across the mountain ridge blocks access into an environmentally sensitive area where one of three Earthen dams were constructed to fill the gaps in the Cushetunk Mountain ridgelines enveloping Round Valley reservoir (fig. 9). The fence is owned and maintained by the New Jersey Water Authority and prohibits

Figure 17. Cairn 005.

access into the dammed areas. This fence blocks most through-going recreational activity and thus isolates the area containing the cairns in comparison to other parts of the mountain where interconnecting trails cover the mountain.

With respect to the natural character of the cairns, the following set of observations stem from our repeated visits to the area:

1) Nowhere on the mountain sides or top are there any other stones of geological composition other that trap rock (diabase).
2) The cairns are generally oval in map view with the exception of 012 and 002 that have long dimensions more than double their width and therefore take on a cigar shape.
3) The stones range in physical dimensions from the largest being blocky, less than a meter in length and less than one-third meter in thickness and width, to the smallest of size that is rounded and fits comfortably in the palm of an adult human.
4) All of the stones can be found locally on the rocky slopes of the ridgetop nearby, and many of the ridgetop cairns are set among stony soil having similar stones strewn about as part of the natural landscape.
5) With the exception of the longest structure (cairn 012), those on the SE secondary ridge (003-006) are the only ones set on ground relatively clear of other stones.

The rounded, spherical nature of many of the smaller stones is a natural weathering phenomena resulting from trap rock being repeatedly subjected to freeze-thaw cycles. This process slowly exfoliates and rounds the corners off of angular blocks formed as joint-bounded lithons like those seen in place in nearby outcrops, and like the larger, blocky, sub-angular stones excavated previously from the lowest levels of the bigger, disturbed cairns like 005 (fig. 17). These larger blocks now lie strewn atop smaller

Figure 18. Cairn 006 is excavated in the top center.

stones that were originally on top. The larger, angular blocks could have been used in the assembly of 'crude vaults' at the base of the larger cairns. When standing near some of these structures, one sees that many of the smaller, rounded stones pepper the top of the heap, as if placed there through gradual accumulation by passing individuals rather than at once during construction of the cairn.

Figure 19. Cairn 007. Charlie Doodle partially obstructs the bottom view.

A thorough geological discussion on the composition and variability of trap rock surpasses the scope of this report, but suffice it to say that the stones in the cairns are composed of common, medium-grained, grayish white diabase that can be found cropping out or strewn about on the surface anywhere else on the mountain. Fair proportions of plagioclase feldspar are accompanied by dark spots of amphibole and magnetite, the latter being black iron oxide occurring in varying proportions and locally concentrated into thin seams appearing as dark wispy lines cutting through the stones.

DJI Drone flights over the study area

Because of the mature forest setting, formidable intergrowth of underbrush around and on many of the cairns, and the omnipresent wood and deer ticks, I thought it might be a good idea to try to utilize modern drone technologies to further help sense these objects despite the stately tree canopy. Could remotely controlled drones help survey the surrounding hillside for more of these structures to minimize the need to beat the bush in order to define the map limits of the suspected burial ground?

Figure 20. Cairn 009..

As chance would have it, I was contacted by email on October 15, 2018 by Mr. Benjamin (Ben) Brandner, a Raritan Valley Community College (RVCC) student, about my work on the suspected burial vaults that I had just given a talk about at RVCC's science- lecture series. He was in class at the time of the talk, but had a prior familiarity with the historical accounts and was curious as to what I had found. When we

Figure 20. Cairn 010

met for lunch soon after, I was delighted to learn that he is a licensed drone operator and metal-detecting enthusiast who is young, handy and motivated. It was my pleasure to introduce him and his younger brother to the site a week later to gauge the prospects of gathering remotely sensed data using his drone. Encouraged by the field visit, we arranged to conduct the first aerial survey on December 19, 2018. This overflight (fig. 24) gathered digital video (fig. 25) looking straight down from

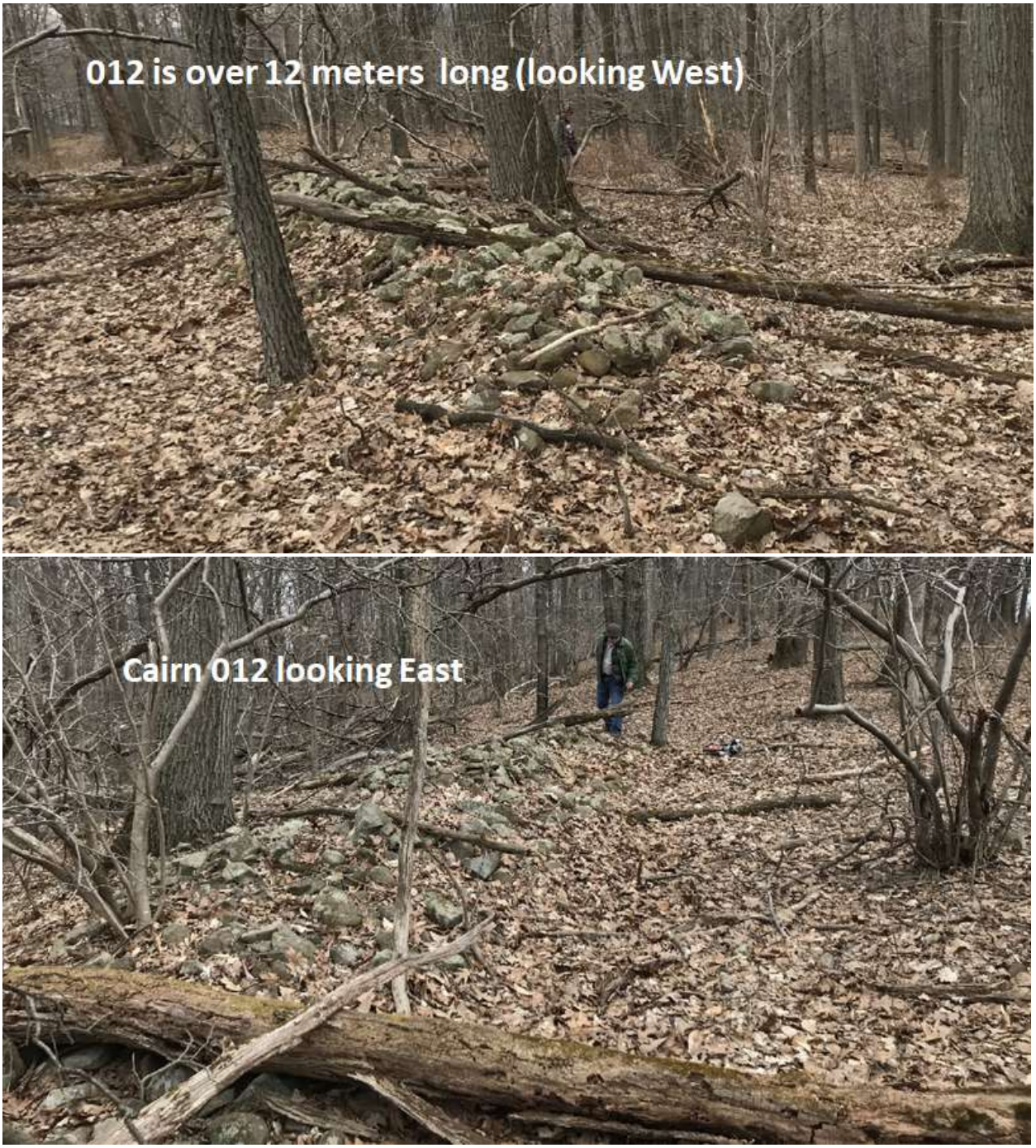


Figure 21. Cairn 012

the drone using a fixed lens focused on the areas of interest as shown in figure 24 with respect to a 7-acre areage of coverage. Adjacent areas of interest where we thought other cairns may occur and that were only lightly covered on the ground by foot were also flown, and have since been ruled out from further consideration. The results of this overflight exceeded expectations, and from the video we captured some still phtographs of a couple of the larger cairns that can be cleary seen from above the tree canopy (Figs.17 and 25). Overflights and later scrutiny of the video from this first flight also helped rule out these other adjacent areas as part of the study focus area. On that first day we generated 6.75 gigabytes (GB) of digital data, all but 0.01 GB which was video either captured by the drone or from using my IPhone 7 camera to show Ben introducing himself, the drone taking off, and the drone-control unit (fig. 24). Video footage captured by the drone was saved in a QuickTime Movie format (*.MOV), with segments of some later converted to either a windows media file format (*.avi) or the 14th edition of the MPEG video standard (*.mp4). Still imagery captured from the footage used either a *.PNG or *.JPG file format (fig. 25).

An additional two overflights were conducted soon after on December 27, 2018 using Ben's drone. Graced with a clear, bright, and calm day on December 27th, we made another trek up the

Figure 22. Cairns 011, 013, 014, and 015.

mountain and this time he acquired overlapping digital photographs of the area that were later stitched together into a seamless, geo-reregistered image (figs. 26 and 27). Two overflights were pre-programmed into the drone as trellis-shaped flight plans with the second overflight covering the area of interest (fig. 26). The first flight covered areas to the south low on the hillside and the reservoir shoreline and has not been considered further for this study at this stage. But imagery stemming from the second overflight covering the site and adjacent areas to the East now includes twenty four (24) TIFF files totaling 381 MB (fig. 27). The imagery could have been managed as a single image, but download and computer display of raster image files of many hundreds megabyte size can be problematic and

Figure 23. GE view of the Cushetunk Mountain area showing archeological site 28-Hu-587 with respect image overlays of NJDEP 1930 aerial photography. The 5.5-acre study area is highlighted yellow and labeled near the top.

Figure 24. A DJI drone was piloted by Ben Brandner to investigate adjacent areas where other cairns may occur. The drone overflights helped set the site limits by providing high-resolution photographic and video footage of the hillside (figs. 25 and 26) for use in Google Earth as image overlays(fig. 27). The top view shows a 3-dimensonal perspective of two separate overflights with most footage shot within 100 meters (328 ft) of land surface. Lower altitudes required navigating between trees to capture still imagery of some of the larger cairns (fig. 17).

Name	Date	Type	Size	Length
Bens Intro.avi	12/23/2018 9:26 PM	AVI File	42,883 KB	00:00:37
Bens Intro.mp4	12/23/2018 12:27 PM	MP4 File	42,732 KB	00:00:37
Cairn 005 still capture.PNG	12/22/2018 8:35 AM	IrfanView PNG File	3,807 KB	
Cairns 004 and 005 still capture.PNG	12/22/2018 8:34 AM	IrfanView PNG File	3,958 KB	
Cairns 004 clearing DJI_0014.MOV	12/19/2018 6:28 AM	MOV File	2,868,941 KB	00:08:43
Cairns 004-003&002 DJI_0016.MOV	12/19/2018 6:38 AM	MOV File	546,988 KB	00:01:39
Cushetunk DJI Drone video1.mp4	12/23/2018 8:40 AM	MP4 File	459,147 KB	00:02:37
Damn_view_DJI_0006.MOV	12/19/2018 5:53 AM	MOV File	78,861 KB	00:00:28
DJI Launch.mp4	12/23/2018 4:59 PM	MP4 File	25,367 KB	00:00:22
DJI Launch.wmv	12/19/2018 4:16 PM	WMV File	26,339 KB	00:00:22
DJI_0005.MOV	12/19/2018 5:52 AM	MOV File	53,318 KB	00:00:09
DJI_0010.MOV	12/19/2018 6:23 AM	MOV File	47,170 KB	00:00:07
DJI_0011.MOV	12/19/2018 6:24 AM	MOV File	47,123 KB	00:00:09
DJI_0013.MOV	12/19/2018 6:27 AM	MOV File	28,998 KB	00:00:06
Eastern coverage DJI_0008.MOV	12/19/2018 5:56 AM	MOV File	2,500,918 KB	00:13:41
IMG_3909.MOV	12/19/2018 4:17 PM	MOV File	33,481 KB	00:00:15
IMG_3910.MOV	12/19/2018 4:17 PM	MOV File	85,044 KB	00:00:37
IMG_3911.MOV	12/19/2018 4:17 PM	MOV File	76,283 KB	00:00:36
IMG_3912.MOV	12/19/2018 4:16 PM	MOV File	50,282 KB	00:00:22
IMG_3913.MOV	12/19/2018 4:16 PM	MOV File	55,514 KB	00:00:25
Mound_5_DJI_0015.JPG	12/19/2018 11:37 AM	JPG File	3,622 KB	

Figure 25. Top image lists the computer files generated from the first two overflights. The bottom image is a screen capture from video footage of flight 1 showing cairns 004 and 005. Cairn 004 is more difficult to see but highlighted where Mark and I were clearing brush off the cairn while collecting digital video footage.

slow to access and display depending upon the generation and power of one's personal computer (PC). Raster data like these covering many acres are best processed and displayed as a set of seamless tiles that can managed and displayed in areas of focus when using GE or a GIS. Use of large data sets like

2019BBCushetunk Mountain Flight 1 Route.PNG	3,174 KB	Orthomosaic-1-1.tif	28,855 KB	Orthomosaic-2-2.kml	1 KB	Orthomosaic-3-3.tfw	1 KB
2019BBCushetunk Mountain Flight 2 Route.PNG	2,846 KB	Orthomosaic-1-2.kml	1 KB	Orthomosaic-2-2.tfw	1 KB	Orthomosaic-3-3.tif	3,101 KB
Orthomosaic-0-0.kml	1 KB	Orthomosaic-1-2.tfw	1 KB	Orthomosaic-2-2.tif	29,782 KB	Orthomosaic-3-4.kml	1 KB
Orthomosaic-0-0.tfw	1 KB	Orthomosaic-1-2.tif	29,373 KB	Orthomosaic-2-3.kml	1 KB	Orthomosaic-3-4.tfw	1 KB
Orthomosaic-0-0.tif	15,175 KB	Orthomosaic-1-3.kml	1 KB	Orthomosaic-2-3.tfw	1 KB	Orthomosaic-3-4.tif	10,591 KB
Orthomosaic-0-1.kml	1 KB	Orthomosaic-1-3.tfw	1 KB	Orthomosaic-2-3.tif	30,570 KB	Orthomosaic-3-5.kml	1 KB
Orthomosaic-0-1.tfw	1 KB	Orthomosaic-1-3.tif	26,340 KB	Orthomosaic-2-4.kml	1 KB	Orthomosaic-3-5.tfw	1 KB
Orthomosaic-0-1.tif	13,811 KB	Orthomosaic-1-4.tfw	1 KB	Orthomosaic-2-4.tfw	1 KB	Orthomosaic-3-5.tif	19,761 KB
Orthomosaic-0-2.kml	1 KB	Orthomosaic-1-4.tif	13,031 KB	Orthomosaic-2-4.tif	31,673 KB	Orthomosaic-3-6.kml	1 KB
Orthomosaic-0-2.tfw	1 KB	Orthomosaic-1-4_.kml	1 KB	Orthomosaic-2-5.kml	1 KB	Orthomosaic-3-6.tfw	1 KB
Orthomosaic-0-2.tif	5,381 KB	Orthomosaic-1-5.kml	1 KB	Orthomosaic-2-5.tfw	1 KB	Orthomosaic-3-6.tif	26,767 KB
Orthomosaic-0-3.kml	1 KB	Orthomosaic-1-5.tfw	1 KB	Orthomosaic-2-5.tif	26,572 KB	Orthomosaic-3-7.kml	1 KB
Orthomosaic-0-3.tfw	1 KB	Orthomosaic-1-5.tif	626 KB	Orthomosaic-2-6.kml	1 KB	Orthomosaic-3-7.tfw	1 KB
Orthomosaic-0-3.tif	521 KB	Orthomosaic-2-0.kml	1 KB	Orthomosaic-2-6.tfw	1 KB	Orthomosaic-3-7.tif	4,560 KB
Orthomosaic-1-0.kml	1 KB	Orthomosaic-2-0.tfw	1 KB	Orthomosaic-2-6.tif	11,011 KB	Orthomosaic-4-7.kml	1 KB
Orthomosaic-1-0.tfw	1 KB	Orthomosaic-2-0.tif	14,094 KB	Orthomosaic-3-2.kml	1 KB	Orthomosaic-4-7.tfw	1 KB
Orthomosaic-1-0.tif	24,619 KB	Orthomosaic-2-1.kml	1 KB	Orthomosaic-3-2.tfw	1 KB	Orthomosaic-4-7.tif	575 KB
Orthomosaic-1-1.kml	1 KB	Orthomosaic-2-1.tfw	1 KB	Orthomosaic-3-2.tif	1,425 KB		
Orthomosaic-1-1.tfw	1 KB	Orthomosaic-2-1.tif	22,889 KB	Orthomosaic-3-3.kml	1 KB		

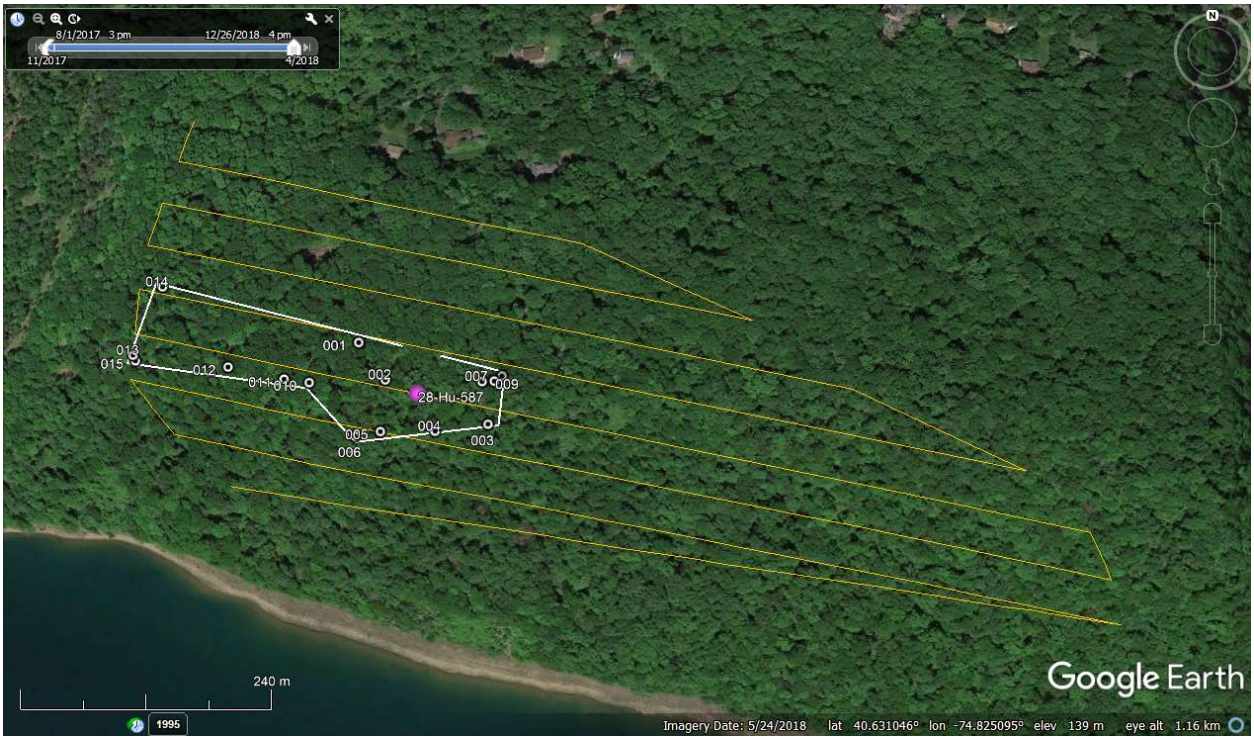


Figure 26. Top image shows the computer files generated from the fourth drone overflight, the second one on the second day. Only file names and sizes are listed. The bottom image is a screen capture of a GE project showing the site relative to a 4-mile flight plan programmed into the drone to generate overlapping photographs for stitching into a digital orthophoto mosaic of the area shown in figure 27. Navigation and photo registration used GPS.

these benefit from having access to the selective subsets of imagery that can be efficiently viewed to conserve computer memory. A second subset of the orthophoto mosaic was thus assembled that covers only the 5.5.-acre area and is 132 MB as opposed to the 380 MB for the entire overflight.

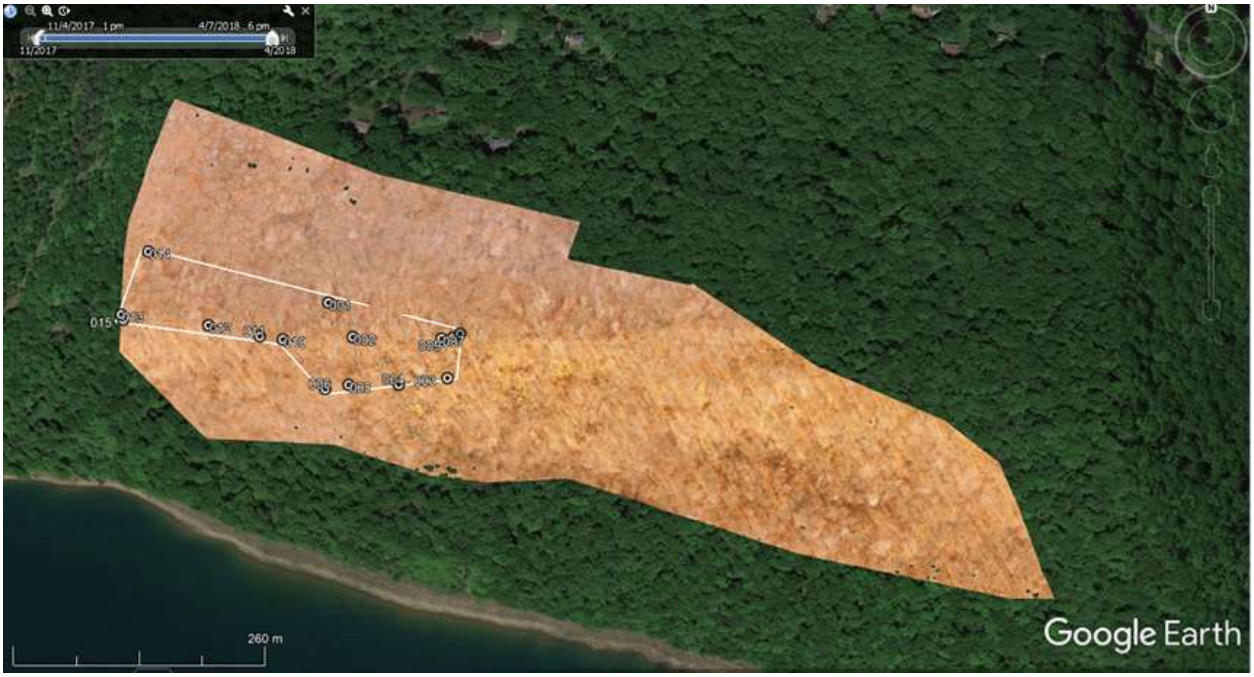


Figure 27. Two captured views of New Jersey archeological site 28-Hu-735 outlined white with placemarks showing cairn locations relative to the area covered by the second drone overflight.

The complete sets of imagery covering Cushetunk Mountain and formatted for Google Earth can be downloaded from the Internet at www.impacttectonics.org/KMLZs/2019 Cushetunk.html.

Summary

Upon rediscovery of this possible burial ground mentioned in 17th through 19th century historical accounts of the area, myself together with a few colleagues set out to define the areal extent of what are characterized here as ancient cairns of probable American Indian origin that could be either of sepulcher (burial) or ceremonial origin. In order to begin to address the latter issue, on October 10th, 2018 Mark Zdepski and I escorted two representatives of the Delaware Tribe of Indians up to the site so that they could see the structures and perhaps shed some insight on their nature. Susan Bachor and Larry Heady of their Historic Preservation office were of the opinion that they are of likely Indian origin, but probably ceremonial in nature rather than containing human remains. They said that they have seen structures like these, and it is common to find nothing beneath them except perhaps for a single artifact like an arrowhead, etc. Susan left with the intent of conducting some cosmological research with respect

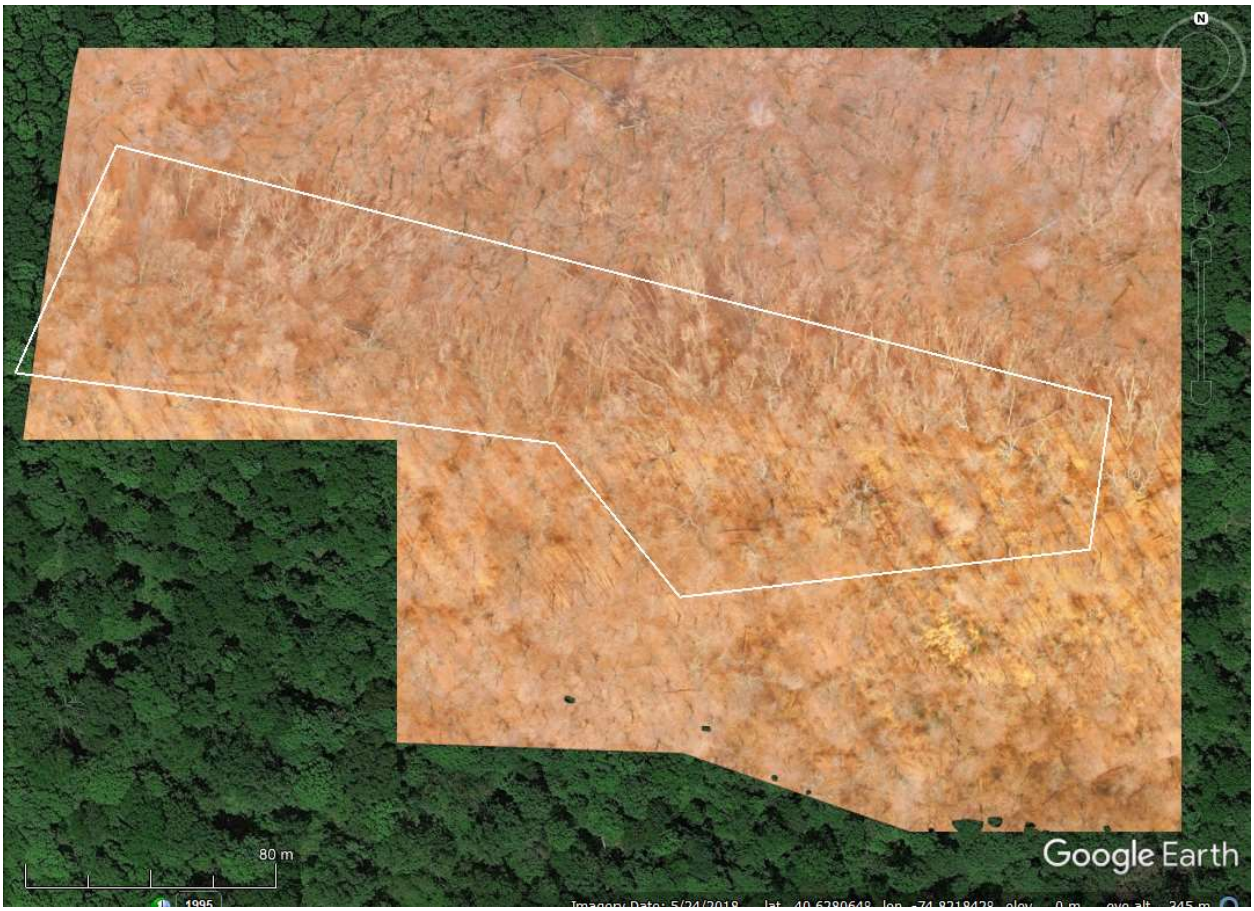


Figure 28. A subset of 5 tiles covering most of the site 28-Hu-587 was assembled and is available for use in GE at the URL specified on page 29.

to the site location and characteristics.

Of the fifteen stone heaps that we mapped inside a ~5.5-acre area, twelve have a long dimension exceeding 4 meters (~13 feet) whereas six are larger structures with long dimensions exceeding 5 meters (~16 feet). We are uncertain whether several of the smaller cairns are natural stone heaps brought up long ago in root balls at the base of large windswept trees. We ruled out a few other small stone mounds from being cairns because they occurred near the base of old, rotting tree trunks. Because of the amount of tree litter and brush that has accumulated on most of the cairns, we will not be able to confirm whether some of the smaller ones should be considered further together with the larger one until the cluttered is removed and their form made clearer. At this stage of the study, we have not disturbed any stone or tampered with the site in any way other than removing a few dead tree branches and vines growing amidst the cairns. We have simply noted their occurrence and tried to define a study area that can be further assessed using other non-invasive remote sensing techniques in order to advance our understanding of their nature. More through descriptions of the cairn stones, including their placement or variations in size and dimensions has not yet been developed here simply because these need to be cleared of debris covering them first. They will need to be carefully attended to first before further examination or excavation. Whether this will happen soon is a matter that has yet to be determined, as is their primary purpose.

Since the 2017 rediscovery, I have been conducting historical research on the occurrence of similar features in the Mid-Atlantic region of the North American continent with the hopes of trying to place these features into an archeological context. But in order to do so successfully, it will be first necessary to gather some concrete scientific data to determine their age and perhaps one day, their internal contents, if any. My current aim is to proceed with non-invasive geophysical testing and retrieve some radio-carbon dates from some of the soil exposed in the bottoms of the existing trenches cut into three of the larger, partly excavated cairns (002, 005, and 010). The non-invasive geophysical tests would be geared toward identifying buried metallic objects, like the copper arm or wrist bands mentioned historically that would produce electromagnetic anomalies, but it uncertain whether they would be large enough to be discerned under the stone heaps covering them, or what approach would be most effective in acquiring electromagnetic data that would produce the most definitive results. These factors and methods have yet to be determined.

In conclusion, repeated hikes on the mountain have yet to produce any Indian artifacts or signs of ancient occupation other than these cairns. We have hiked to the adjacent peaks on the north limb of Cushetunk with the hopes of finding areas suited for the development of a mountaintop fortress, but any one of a number of areas that would suffice evade closer scrutiny owing to the relatively inhospitable terrain encountered away from the well-groomed trails. Generations of mature forestation has resulted in many hilltop areas being covered by groups of tangled, fallen trees or dense underbrush making any visual observation of prior human occupation very difficult. In that respect, it remains a mystery exactly where the kingly seat of the Raritan tribe may have been on Cushetunk Mountain, if at all. In retrospect, I'm appreciating the good fortune on relocating the old cairns and feel as though this

one time, we found the proverbial needle in the haystack, or more specifically, some heaps of stacked stones among many thousands of unstacked ones. What lies beneath them remains to be determined.

Acknowledgements

This work is an outgrowth of some local archeological work that was started in association with the Hunterdon Historical Society in Flemington, New Jersey. I therefore thank Patricia Millen and Pamela Robinson, the HCHS executive director and librarian respectively, for their early support and encouragement when working with their artifact collection and beginning this historical research. I also thank Bob Leith of the HCHS Cemetery Committee in spurring me into organize my thoughts for a public presentation of some early findings that was held on June 19, 2018 at the Presbyterian Church social room in Flemington, NJ. That presentation was attended by Adrian Manning who is conducting similar research on old cairns in Connecticut. Adrian took the time to introduce himself and spend time afterwards discussing these features. We have been corresponding since and sharing related research surrounding the location and nature of these types of features in the Eastern region of the North American continent.

For the initial two Cushetunk ascents, I was accompanied by my trusted hiking companion Charlie Doodle. He also accompanied me and others on later ones (fig. 19). He turns 13 years old in early March and is still nimble and resilient enough to get it done. But after the first couple of hikes, it occurred to me that my dog wasn't going to be helpful in locating stacks of stones in stony terrain locally covered with talus and scree, and where one can easily twist their ankle given a momentary lapse in judgement or simple fate. I therefore asked two former colleagues at the NJ Geological Survey, Drs. Michael Serfes and Donald Monteverde to help me search for the vaults because many sets of eyes are better than one, and they believed my story enough to risk a good hike and comply. They accompanied me on my third ascent onto the mountain one sunny, bright morning in early April 2017, and we were all surprised and thrilled upon finding the cairns. Little did we know at that time their extent or variability in style. Only through persistent reoccupation of the area thereafter with the help of Mark Zdepski, Jacob Buxton, and Ray Simonds were we able to find those catalogued herein and conduct the ground survey needed to verify the extent of the suspected burial ground and the relative sizes of each cairn. This ground-mapping effort was facilitated by residence of Old Mountain Road with houses backing up to the site. Their willingness to let us park at their residence to conduct these investigations saved hours of time hiking into the area and for that I am truly thankful. Accordingly, Laurie Gneiding, Michael Brady, Kirk Van Fleet, and Clarence Shepard cordially provided access to and use of their parking facilities.

I thank Greg Lattanzi, the NJ State Archeologist, for providing the official site designation of 28-Hu-587 within which to place this site into historical context. I also acknowledge the help and guidance received along the way in conducting this research by my friend mentioned above, J. Mark Zdepski of Delaware Township, Hunterdon County, NJ. Mark and I have worked and associated with one another now approaching 30 years. I appreciate his careful approach to solving problems and characterizing natural phenomenon and this work benefited greatly from having him aboard for most of it. I look forward to continuing this study with him going forward. I have also been receiving guidance and

encouragement for this study from Susan Bachor, archeologist for the Delaware Tribe of Indians who works out of their Eastern Preservation Office.

This project gained a higher level of sophistication when Ben Brandner became part of it by using his personal aerial drone to help characterize the site. Ben's easy-going nature and willingness to chip in on a volunteer basis not only provided valuable data in the form of video and photographic records, but also exposed me to an emerging form of scientific data recovery that is part of this magnificent digital revolution that we are immersed in. I am absolutely thrilled with the prospect of what the use of personal drones holds for revolutionizing modern archeology, but also what the future holds when we can deploy synchronized units to remotely and thoroughly characterize the physical nature of a target.

Lastly, I acknowledge Michael Serfes and Mark Zdepski for providing timely reviews of the first draft of this report and thank them helping sharpen its thoroughness, focus and clarity.

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