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Developing a Methodology for Evaluating the Sensitivity of Rock Imagery Sites to Vandalism in Washington County, UT

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DEVELOPING A METHODOLOGY FOR EVALUATING THE SENSITIVITY OF ROCK IMAGERY SITES TO VANDALISM IN WASHINGTON COUNTY, UT

by

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ABSTRACT

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Intentionally caused damage to archaeological sites is steadily increasing as outdoor recreation also increases. Rock imagery sites are often at the forefront of this damage in Washington County, Utah as they are widespread, and they are located near major tourist hubs like Zion National Park. Previous archaeological studies have assessed site attributes and how they contributed to site damage after it occurred, yet there is no existing methodology that uses these attributes to analyze and evaluate for the potential of severe damage occurring. This study uses statistical analyses to assess the commonality and severity of current damage to rock imagery sites and apply this information toward a probable significance ranking table for severe levels of vandalism to evaluate the potential sensitivity to vandalism at rock imagery sites. This damage index is generated using the analysis of site attributes such as proximity to roads, available facilities, visibility, environmental impacts such as erosion, and accessibility in correlation with the severity of vandalism to aid in evaluating the potential for severe damage to a site. The results of this study include an index that land managers and cultural resource managers can use to assess sites for potential damage. Assessments utilizing the index can aid and support potential mitigation plans to facilitate the preservation of rock imagery sites. The results show that the most statistically significant correlations exist between damage and the site's proximity to roads and trails. At the same time, the number and types of elements present on individual panels and other attributes such as affiliation have less significant correlations with the severity of damage.

(89 pages)

PUBLIC ABSTRACT

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Erin C. Haycock

This study uses statistical analysis to examine the relationship between the characteristics of rock imagery (also known as rock art) sites and intentionally caused damages in Washington County, Utah. This project aims to create an index for public land managers to respond proactively to vandalism at rock imagery sites. Included here is an analysis of the severity and frequency of damage to the sites and an inventory of the types of site damage to determine the most common and destructive types of vandalism. Site attributes such as the number of figures in a panel, the type of images, and panel location are also considered to investigate the relationship between these characteristics and existing damage at an archaeological rock imagery site.

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CHAPTER I INTRODUCTION

Vandalism is an intentional and predatory human action that can cause considerable damage to archaeological sites, such as pits from active looting, graffiti and site marking, and other destructive behaviors that result in irreparable degradation (Nickens et al. 1981). Awareness of these malicious activities is essential for protecting archaeological sites from vandalism. Vandalism is a global problem that affects archaeological sites, however, recently, this issue has become more rampant (Bertilsson 2008; Keyser et al. 2005). The rise in visitation and outdoor tourism contributes to the upsurge of vandalism, and outdoor recreational areas expect an increase in visitation by approximately 30 percent within the United States by 2030 (White et al. 2016). The COVID-19 pandemic led to an unprecedented surge of interest in outdoor activities, resulting in tourism growth at National Parks and other outdoor locations across the western United States (Landry 2020; Taff 2021).

Rock imagery sites are one of the most vulnerable types of archaeological sites since many are in or near the same places that are ideal for activities such as ATV trails and rock climbing. Unfortunately, these outdoor activities can cause irreparable damage to the sites. This includes vandalism and destruction due to climbing gear, such as anchor points and chalk, and damage to rock faces and the surrounding landscape from recreational vehicles (Gunn et al. 2020). In early 2021, there were notable reported cases of climbers and vandals damaging rock imagery in Utah. One such graffiti incident occurred at one of the most iconic rock imagery sites in the state, The Birthing Panel, located near Moab (Kunze 2021). This type of vandalism is not only damaging to these important historical sites, but it also harms the natural environment because it causes erosion and destruction of the rock surfaces.

Previous studies on vandalism at archaeological sites and monuments in the western United States focus on site accessibility and visibility, and how these factors may contribute to site destruction in the Four Corners Region (e.g., Anon 1981; Kvamme 1990; Simms 1989; Vella 2015; Yates 2022). In Southeastern Utah, Kvamme (1990) assessed vandalism on a site-by-site basis and offered general observations for the region, such as that sites closer to roads appeared to have more damage, and that visitors frequent dwelling sites with more regularity than other site types. In the same region, Simms (1989) noted that site access is a major factor in increased occurrences of vandalism. Yates (2022) takes the issue of vandalism at rock imagery sites in the American Southwest and focuses on the issues faced when policing these sites for vandalism, such as a lack of presence in the region by law enforcement. Importantly, what is missing from these previous works is any assessment of how site access, site attributes, and visibility can aid in predicting the types of sites vandals that are likely to target. In contrast, this study takes a proactive approach, and assesses the patterns of damage using statistical and quantitative analysis to provide predictions for what sites, or which specific attributes at a site, are correlated with more severe damage. By doing so, we can predict which sites will experience elevated levels of vandalism damage based on their characteristics.

This study builds upon previous work on archaeological damage by developing a set of expectations for predicting where future vandalism is most likely to occur. By observing correlations between damage and site attributes, I expect to be able to predict and mitigate the severity of damage that sites may suffer. By combining previous studies with new data and analytics, this research takes a more comprehensive approach to predicting potential areas that are at risk for vandalism. Additionally, it provides insights into how to best prevent these occurrences and to protect cultural heritage. To determine the likelihood of rock imagery sites experiencing more severe rates of intentional damage, several factors are considered, including common damage areas, site attributes, and locations near roads. This is invaluable for developing strategies that can protect these sites from vandalism, theft, and other forms of intentional destruction. Importantly, predictive analytics will aid land managers so that they can anticipate destructive behaviors at particularly sensitive sites. These predictions can provide them with the foresight to take proactive steps and implement measures that will mitigate potential damage before it occurs.

This project's geographical focus is on rock imagery in Washington County, southern Utah. Recently, there has been increasing concern about rock formations in this county due to its proximity to Zion National Park, which has been particularly susceptible to damage caused by humans and other environmental pressures. The increasing volume of outdoor recreational tourists results in damaging activities, such as climbing and the operation of off-roading vehicles (Taff et al. 2021; White et al. 2016). Other environmental factors, such as wind and sand erosion due to decreasing rainfall in recent years, have resulted in worn-down rock faces. This makes vandalism such as graffiti harder to mitigate and treat due to the instability of weathered and worn rock faces (Yates 2022). As a result, it is critical to document the unique geology and rock imagery found in this area before both natural and human-caused forces destroy them (Schaafsmaa 2002; Simms 2010). Rock imagery is abundant in Utah, particularly in the central and southwestern parts of the state. Unfortunately, because of its widespread dispersion, law enforcement cannot regularly monitor rock imagery sites, and they are often subject to an extreme level of human-induced damage by climbing and other forms of vandalism.

Establishing a set of guidelines for predicting vandalism on rock imagery in Washington County will not only serve as an important case study and model for counties in Utah and surrounding areas, but it will also provide valuable insight into how land managers can prevent or minimize vandalism in these areas. This study also provides a severity index with associated characteristics that would enable land managers to be more proactive in damage mitigation, rather than simply responding to the situation after it has already happened. Land managers can use the index as a tool to plan and take preventative measures before potential damage occurs.

This study offers a comprehensive and rigorous quantitative assessment of the correlation between the proximity to a road and the extent of damage that a particular site incurs. The results go beyond simply emphasizing this issue; indeed, they challenge the long-standing assumption that closer proximity to roads inevitably leads to increased vulnerability to damage. Interestingly, the data discussed here do not support this commonly held belief and highlight other noteworthy attributes including the proximity of sites to trails, the type of imagery depicted on the panels, and the number of elements present within each panel. By quantitatively evaluating these aspects, this study collects information that was previously unavailable due to limitations in how researchers traditionally recorded and analyzed these sites.

The methodology for this study utilizes data from the Utah Archaeological Site Form (UASF) which offers a comprehensive and meticulously designed template that enables the systematic documentation of a variety of damage and their corresponding severity percentages at archaeological sites. Utah archaeologists use this form specifically for sites with rock imagery, and it is invaluable for accurately recording and assessing the condition of these sites in a standardized manner. Damage reported and the perceived severity of those damages can be collected and analyzed on a panel-by-panel and site-by-site basis to gain insight into the correlation between site attributes and the damages that occur at those sites. It is important to note that this study looks for correlation, rather than causation. Causation of vandalism takes place within the behaviors of those committing the damaging actions and is beyond the scope of this initial research.

Reports derived from the Utah Cultural Site Stewardship Program augment the data analyzed within this study and may provide further avenues of research into the topics discussed here. This program diligently monitors and assesses managed sites biannually, thus allowing for a more in-depth analysis of the prevailing trends outlined herein. This program facilitates collaboration between over 300 volunteers and researchers and provides an invaluable opportunity for further exploration and a more nuanced understanding of the subject matter. Although the program’s information is only a year old, over time these reports will provide longitudinal observations about site conditions for future research. Furthermore, these collaborations offer an invaluable supplementary measure for land managers who are responsible for overseeing rock imagery sites within their area to mitigate and monitor rock imagery sites. By leveraging the preventive and predictive insights derived from the study, they can effectively manage these sites by appointing a designated site steward whose role is to diligently monitor and provide comprehensive reports on a biannual basis, ensuring optimal preservation and maintenance.

With the previously mentioned studies and factors in mind, the following research utilizes information to investigate the correlation between the present damage and site attributes. The use of site forms achieves this by providing the site attributes from forty-six different rock imagery sites. These attributes include the proximity to a road or trail, how many elements are present on a panel, the association of the panel with defined cultural groups, and the types of imagery present. This study utilizes the reported damage types and severity of said damages to conduct the analysis presented in Chapters IV and V.

Six main chapters comprise this thesis. Chapter II reviews previous research on rock art vandalism and provides an overview of the most represented rock imagery, cultural group affiliations, and the geography of Washington County. Chapter III presents the methodology utilized while Chapter IV presents the study results. Chapter V discusses the implications of this study and how land managers can utilize the information to implement mitigation strategies. Finally, Chapter VI addresses some of the possible prospects for future research on vandalism and rock imagery sites in the western U.S. This thesis will provide land managers with useful tools and information to predict where damage to rock imagery is likely to occur and to be proactive in mitigation to better preserve these fragile components of the archaeological record.

CHAPTER II BACKGROUND

Research on the impacts of vandalism at archaeological sites shows that outdoor recreation such as climbing, and site visitation are responsible for the rapidly increasing rates and severity of damage throughout the world (Brady and Tacon 2016; Knudson 1989; Kuwanwisiwma et al. 2018; Nassaney 2019; Pokotylo and Guppy 1999; Ravaiolo 2020). These studies indicate that the degree and intensity of vandalism increases as tourism and visitation increase. They demonstrate that vandalism is a global issue and not limited to the outdoor spaces of the American West. This trend is alarming and could potentially lead to irreparable damage to some of humanity's most important cultural heritage sites if it is not adequately managed and addressed soon. Such destruction would be a tragedy for future generations, who may never be able to experience the beauty of these sites in their original form. This destruction of cultural history impacts living people too as the destruction of heritage and cultural resources destroys the identity of associated communities and erases the history of landscapes (Albert et. al. 2022; Brodie and Renfrew 2005; UNESCO 1972).

One effective tool for mitigating the effects of archaeological vandalism involves public archaeology and collaborating with stewards within a preservation context (Erdman 2019; Fagan 1995; Gao 2016; Pokotylo and Guppy 1999; Ravaiolo 2020; Smith 2014). As Smith (2014) discusses, archaeologists should mobilize volunteers from universities and archaeological societies to work with the public to understand and appreciate these important sites. This encourages a local and community sense of responsibility which in turn protects sites from damage, fosters an appreciation for local history, and educates the public on the importance of preserving our past.

One important technique for encouraging stewardship is the type of signage used at archaeological sites. According to Podolinsky (2022), within Utah, the use of moral-appeal signage (which relates to a sense of mortality rather than punishment), such as “Be Kind to Rock Imagery” or “Protect our History” was found to be more effective at reducing both unintentional and intentional damage when compared with threat-appeal signage (which threatens fines or imprisonment). This finding further reinforces the notion that moral appeals can be a powerful motivator for encouraging people to act responsibly. Podolinsky’s study on the effects of threat-appeal and moral-appeal signage on vandalism revealed that sites with threat-appeal signage had greater levels of damage, while sites with moral-appeal signage showed a decrease in damaging behaviors. This demonstrates that the use of such signs can influence people's actions when it comes to vandalism and other destructive activities.

Due in part to its long history of archaeological research, the U.S. Southwest is the location of numerous archaeological vandalism studies (Ahlstrom 1992; Hedquist 2014; Kvamme 1990; Nickens et al 1981; Simms 1986; Spangler 2006). These studies highlight that a common characteristic of sites with high rates of vandalism is the ease of accessibility, which considers factors such as terrain difficulty, visibility of the site, and proximity to a paved road or trail. In one study, Simms (1986) pointed out that an easily accessible location is one of the key contributors to the likelihood of vandalism occurring at a particular site in southeastern Utah. For example, an accessible area without regular surveillance encourages individuals to commit acts of vandalism, and law enforcement is less likely to catch individuals who commit vandalism in these areas. Additionally, if there is a lack of public visitation to the site, this can further embolden potential vandals and encourage them to act on their impulses (Al-Barmalgy et. al 2014; Cannon and Miller 2020). Though researchers note these observations across multiple sites, the study provides no quantifiable measure for how access to a site impacts the level and severity of damage. In a detailed study of road proximity in Arizona, Hedquist (2014) finds that a three-zone evaluation system for road locations may be effective in measuring the damage done by vandalism. Sites located 100 meters or less from a road are more likely to experience destruction than those in the range of 200 meters to 500 meters. Sites that are 500 meters or more away are expected to experience the least amount of vandalism.

These accessibility studies are an important start for developing robust predictions of vandalism and where it may occur, though they do not assess the severity of the damage. Additionally, a vast majority of archaeological studies conducted in Utah have primarily focused on Ancestral Puebloan sites rather than other pre-contact sites (sites constructed or inhabited before European contact) such as those that are associated with Fremont occupations between AD 1 and AD 1300 (Ahlstrom 1992; Nickens et al 1981; Simms 1986). This is due to the abundance of preserved Ancestral Puebloan sites found in the region. Even though previous research has provided a great deal of insight into the observable effects that site attributes may have on damage, these data have yet to be utilized in a way that would successfully reduce the instances of archaeological vandalism at sensitive sites.

In addition to the physical preservation of archaeological and rock art sites, the natural environment plays a significant role in their long-term preservation. Natural climatic and geological events such as flooding, erosion, and tectonic shifts can impact a site's condition. Weathering and erosion can affect the integrity of a rock imagery site, leading to greater challenges when it comes to removing graffiti and a decreased stability of the site over time (Battiau-Queney 1996; Fitzner 2002). Water or wind erodes at the surface and chemical weathering can cause physical changes to the rock's composition that make it more unstable. Without careful preventive measures, these events may lead to irreparable damage or destruction of a site. Rock faces with severe erosion are harder to treat for damages such as chalking, scratching, or graffiti as the surface becomes more fragile due to the damage (Dorn et al. 2008; Fitzner and Heinrichs 2002). In Utah, where there is a megadrought that is the most extreme since the Middle Ages (Kim 2021), wind and sand erosion makes the open-face rock surface vulnerable to increased levels of erosion and thus damage (Fitzner and Heinrichs 2002).

One method of measuring and accessing erosion to rock surfaces regarding rock imagery is the Rock Art Stability Index. The Rock Art Stability Index is a useful metric for assessing the stability of rock imagery sites, developed to provide non-specialists with a comprehensive understanding of the environmental contexts and potential human-caused damages that affect these sites. It offers an analytical framework for evaluating the preservation status of rock art sites, enabling researchers and site stewards to identify sources of deterioration or damage and to prioritize conservation efforts. Professional rock imagery recorders assess and consider several factors when making their assessment regarding the long-term stability of a rock imagery site. These factors include erosion, the surrounding site setting, any coatings present on the panel, and if there is any evidence of vandalism such as graffiti or traces of visitor impact (Dorn et al 2008).

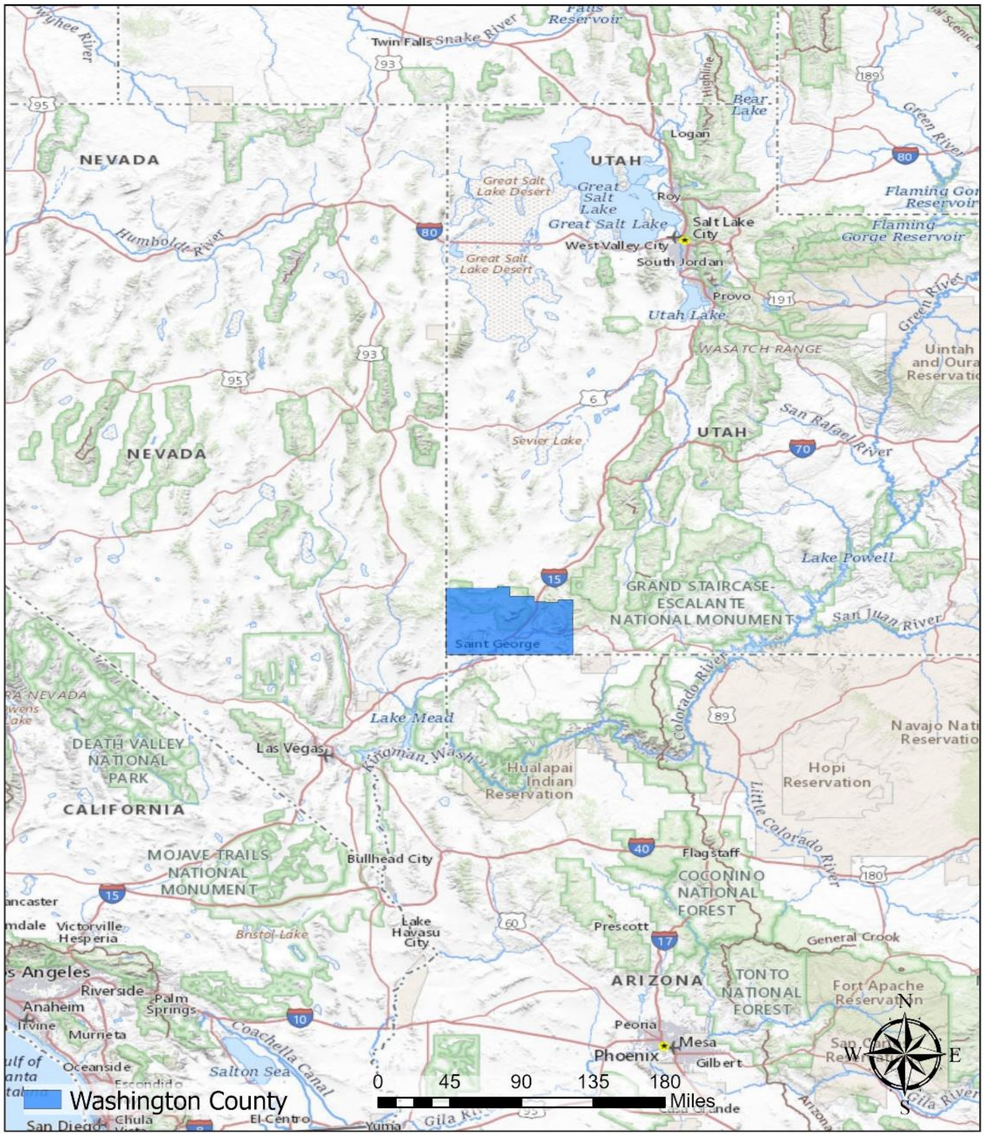

Figure 1: A map depicting the research area, of Washington County, Utah. Map data obtained from the USGS Online GIS Database through ESRI. Washington County is displayed in blue in the center of the map.

Cultural Context, Washington County, Utah (Figure 1): Located in the far southwestern corner of Utah, Washington County represents a dense collection of rock imagery that experiences prominent levels of visitation due to the presence of Zion National Park. The region is home to a rich and diverse collection of rock art spanning various cultural periods, including Paleoindian (12,000 BC - 10,000 BC), Archaic (6,500 BC–AD 700), Fremont (AD 1 – 1300) and Ethnohistoric (AD 1500 – 1950). Images are found on many kinds of surfaces such as boulders, cliffs, and rock shelters, and they depict scenes from everyday life (e.g., hunting big horn sheep) as well as symbolic representations (e.g., depictions both in specific imagery of shaman figures and more abstract imagery of spiritual ceremonies). Rock imagery tourism has become increasingly popular in the region, especially at sites that include the dominant Fremont-style imagery. For example, Nine-Mile Canyon is renowned for its numerous rock imagery sites, with over 1,000 documented sites, drawing in large numbers of visitors due to its accessibility and the vast amounts of information available online (Deacon 2006). This widely available information has helped to promote tourism in the area, while also providing visitors an opportunity to observe the rock art firsthand (National Park Service 2022; Spangler 2003; Taft 2021; White et al. 2016).

Ethnohistoric rock imagery, which includes Ute, Southern Paiute, and Goshute styles, is also widespread in Utah and neighboring states, and the sites have become popular tourist attractions. Many tourism websites such as Utahoutdooractivities.com and visitutah.com advertise these rock imagery panels, while an internet search reveals many more sites with drawings and photographs of the art. A simple internet search with the phrase “Rock Art Utah” returns over thirty million results, many of which provide precise location information for visitors and tourists, as well as the best times to visit. Among the numerous websites that provide information, many specifically dedicate themselves to highlighting rock imagery. These include websites such as archaeologysouthwest.org, outdoorproject.com, hyperallergic.com, and archaeology-travel.com, as well as official websites for the Bureau of Land Management and National Park Service.

Washington County is a particularly attractive destination for visiting rock imagery due to its abundance of stunning rock formations and its moderate climate, which allows for year-round accessibility. This county includes Zion National Park, which attracted an average of over four million visitors in 2022 (National Parks Service 2022). The recent influx of visitors to the area during and after the COVID-19 pandemic has led to a greater number of visitors to nearby rock imagery and archaeological sites (National Park Service 2022; Taft 2021). As this study shows, the increase in visitors has also led to a rise in cases of vandalism and the destruction of cultural heritage.

Cavernous slot canyons, red rock arches, and seasonal run-off riverbeds make Washington County a dynamic landscape that is appealing to outdoor enthusiasts. Within this research's scope, many of the studied rock imagery sites have been tucked away in rock shelters or up difficult-to-navigate cliffs. Meanwhile, several sites have been discovered in more accessible areas such as those close to prominent visitor trails or on boulders near popular locations frequented by climbers and all-terrain vehicle drivers. Consequently, rock imagery sites are often visited frequently and suffer from the damage caused by that visitation (National Parks 2020). Efforts to reduce the damage to archaeological sites caused by human-caused vandalism are often reactive, typically being implemented after the destruction of these sites is complete. Importantly, there is a unique opportunity to be proactive in our approach to diminishing the occurrence of intentional vandalism of these archaeological sites through the analysis and examination of information that is customarily recorded and documented by archaeologists in standardized site forms for rock imagery sites.

Site forms for rock imagery sites found in Utah typically rely on Part D of the Utah Archaeological Site Form, which is the standard for recording archaeological finds in the state. This form is used to document the various panels, figures, elements, and geographical aspects of a given site, with one dedicated form needed for each panel present within a certain site. In addition to recording the components of a rock imagery panel, a recorder can identify and note the damages present at each panel. The site forms used to record such data distinguish between two types of damage: those caused by natural impact agents and those caused by cultural impact agents. Natural damages, such as wind erosion, vegetation abutment, and sediment accumulations, as well as cultural impact agents, such as graffiti (as seen in Figure 2), panel removal (as seen in Figure 3), bullets (as seen in Figure 4), livestock impact, and the impacts of campfire are all examples of these impacts that can be recorded at sites on the UASF site forms.

Figure 2. A photograph of a rock imagery panel in Washington County that has been damaged by spray paint graffiti. The original prehistoric imagery is barely visible to the left of the face in blue spray paint—photo credit: Utah Cultural Site Stewardship Program.

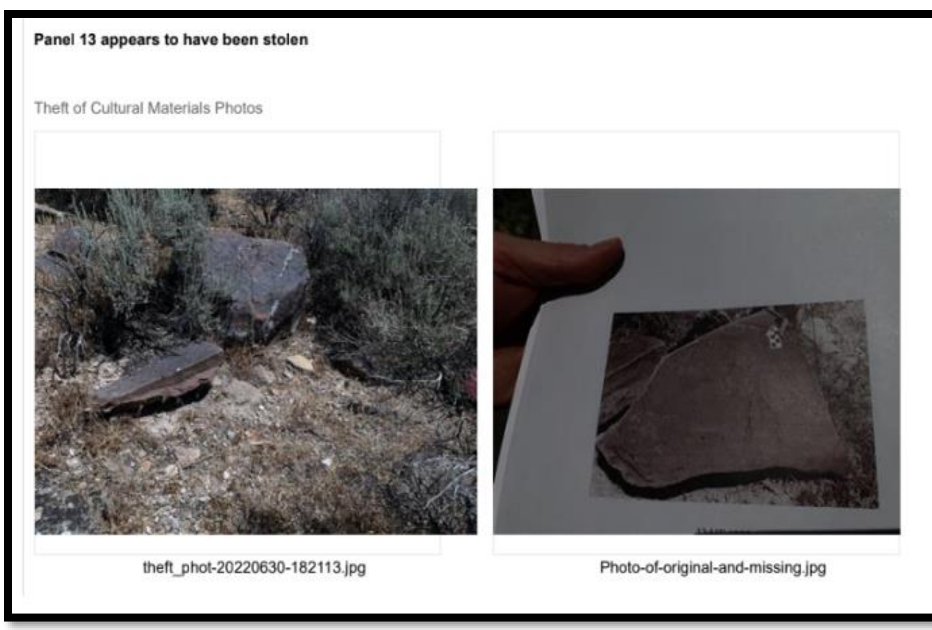

Figure 3. This photograph is of a stewardship report from 2023 depicting a stolen rock imagery panel. The original panel section is depicted on the left of the ground. A photo of the now missing panel is on the right—photo credit: Utah Cultural Site Stewardship Program.

Figure 4. This photo is of a sign at the Lake Mountain Rock Art District on the West Side of Utah Lake. It shows bullet damage that also impacts the nearby rock imagery—photo credit: Utah Cultural Site Stewardship Program.

Site forms also can effectively monitor and analyze the probable cultural association of a rock imagery panel, although this association can vary depending on the researcher's experience. In Washington County, there are commonly observed associations with cultural groups called the Virgin Puebloan, Southern Paiute, and the Archaic period. The Virgin Puebloan rock imagery, which is linked to the Virgin Puebloan branch of the

Ancestral Puebloans, is associated with the Four Corners Region (i.e., parts of Utah, Arizona, Colorado, and New Mexico). This art form typically comprises anthropomorphic depictions resembling humans and abstract spirals. The anthropomorphic figures often consist of pecked dots and shorter lines (Casjens 2004). Archaic-associated associated rock imagery is a broad category that covers a considerable period (6,500 BC–AD 700) and is often represented by abstract spirals and stylized anthropomorphic figures. The commonly observed Archaic style has been dated between 6,500 BC and AD 700 and is not affiliated with a specific cultural group and resembles the Barrier Canyon style rock imagery with triangle-shaped bodies, with geometric lined headdresses (Stoffle et al. 1995). The Southern Paiute rock imagery is more likely to be pictographs, or painted imagery, than petroglyphs, or carved and pecked, imagery. The most used pigment colors are white, followed by red, black, and yellow. Anthropomorphic figures are the dominant element style, and hands, feet, eyes, nose, mouths, and ears are often not depicted on these figures, which delineates this style from those previously mentioned. The zoomorphic figures are often shown with curved horns and rectangular bodies (Stoffle et al. 1995). "Unknown Prehistoric" is another common phrase used for rock imagery that serves as a catch-all category for imagery that cannot be stylistically associated with a specific cultural group.

Several factors can impact rock imagery and other archaeological sites that are important for this study. The various cultural impact agents that are recorded and have the potential to cause damage to cultural heritage sites and artifacts can be classified as alteration or defacing, graffiti obliteration, removal of soil to expose figures, bullet marks, latex mold residue, paint, smoke blackening, chalking (using chalk to fill in carved, pecked, or scratched figures), livestock grazing, attempted removal of elements or objects from the site, construction activities in the vicinity of the site, names or initials and dates marking the site without permission from authorities as well as representing any other form of damage. An evaluator who measures the influence of a certain agent will quantify the extent of its impact on a rock imagery panel in terms of percentage. This data can then be leveraged to gain further insight and a clearer understanding of how the agent is impacting that panel. This data provides a comprehensive look into the condition of rock imagery panels by offering both a quantitative and qualitative assessment. It also presents the opportunity to further investigate what factors, both natural and human-caused, may be contributing to higher levels of damage at archaeological sites (Al-Barmalgy 2014).

While numerous studies have documented the rise in the occurrence of vandalism, most fail to shed light on its deeper causes and which sites are at a higher risk of experiencing these types of damages. Furthermore, there is a lack of research that explores why certain areas are more prone to vandalism than others. When research has been done to investigate vandalism, especially at pre-contact sites, attributes are mentioned in an observational manner, which is not to be wholly discounted, but it does not provide distinctly measurable data to compare vandalism and site attributes across a spectrum of sites, or sites across a landscape in a way that lends itself to statistical analysis. This project develops proactive solutions based on identifying site characteristics significantly associated with heightened levels of cultural impact agents. The results of this project and the suggested solutions will ideally facilitate strategies for limiting damage to rock art.

CHAPTER III METHODS

Washington County was selected for the location of this study based on a variety of factors, including the high density of rock imagery sites throughout the area as well as the presence of Zion National Park. The popular park makes it likely that there will be many visitors to some sites within the park itself as visitors are directed to various panels, but not to those outside of the park due to their locations in rugged terrain without trails (National Parks 2022). These differences in visitation allow for the sampling of sites from both highly visited websites and those that are more difficult to access, thus providing a comprehensive data set.

Sites were selected via a set of criteria. These included sites that are in Washington County with visible rock imagery, and that have been recorded or updated within the last five years. This five-year timeline covers the periods before, during, and after the outbreak of COVID-19. The National Parks across the United States have recorded a substantial uptick in outdoor tourism during the peak of the pandemic which has continued to increase (National Parks 2022). By considering this period, we can gain insights into the scope of recent visitation and its impacts.

After identifying the set of criteria required for a site, the Utah Historic Preservation Office provided a comprehensive dataset containing all sites that possessed these qualifications. Upon further investigation, 60 sites met the predetermined criteria. Each site was carefully examined for comprehensiveness by the researcher and any sites that were deemed to be incomplete were removed from the study sample, meaning that in the case of a Utah Archaeological Site Form (UASF) site form, it is essential to ensure that all required portions (Parts A, B, C, and D) have been completed and that the documentation of present damages discussed in Part A are adequately represented through the use of panel photos, illustrations or other recording methods. Failure to adhere to the criteria for adequate sampling could have resulted in incomplete information being included in the sample. These sites were excluded from further consideration. After conducting an extensive analysis, 46 sites were deemed appropriate for inclusion in the sample. A site is different than a panel in that it is archaeologically significant and contains either 15 or more artifacts or one or more features. Panels are the sections of stone that contain rock imagery, and there can be multiple panels within a single site. Panels are recorded as features in the UASF form.

Sites were carefully reviewed in an Excel spreadsheet to compare and correlate site information with the reported damage. Multiple factors are accounted for within each site, such as the presence of any additional features like artifact scatters or architectural features, the cultural affiliation of the site, its type (prehistoric, historic, multicomponent), the number of panels present on the site, and how many elements are present on each panel. Also, any signage, trails, or facilities reported within the site form are considered. This information was pulled from UASF site forms Part D, but Part A was reviewed to account for any factors not explicitly mentioned on the Part D form. A blank copy of the Part D form is in Figure 16 and Figure 16A in the appendix.

Additional factors were also documented. Importantly, the frequency of various imagery types was noted. For instance, if any panel contained anthropomorphic, zoomorphic, and abstract elements, they were tabulated and reported as primary, secondary, and tertiary based on their relative frequencies. The element type exhibiting the highest frequency was declared as the primary element type. A table of all recorded and analyzed attributes is available below in Table 1, and the raw data collected is available in Table 7 of the appendix.

Attribute Table

Attribute	**Example (If needed)**	**Corresponding Line in the UASF Form Part D**
Number of Panels at Site		1
Panel Location	Boulder, cliff face, outcrop, etc.	3
Surface Orientation	Vertical, Horizontal, Overhead	4
Imagery Category	Petroglyph. Pictograph	7
Repatination		8
Number of Figures		9
Natural Destructive Agents		18
Cultural Destructive Agents		19
Imagery Type	Zoomorphic, Anthropomorphic	Taken from Descriptions in line 20 or the included pictures.
Affiliation	Prehistoric, Ancestral Puebloan	Taken from UASF Part A if not mentioned in line 20
Site Class	Historic, Prehistoric, Multicomponent	Taken from UASF Part A if not mentioned in line 20
Other Site Characteristics	Structural Features, Artifacts	Taken from UASF Part A
Distance from a Road		Taken using the UTMs in the Part A
Distance from a Trail		Taken using the UTMs in Part A, or site descriptions

Table 1: This table outlines the recorded attributes used to facilitate analysis. Lines 5, 6, 10-13 were not used as all site forms had the same results recorded. Panel Dimensions were not tracked in favor of the number of elements on a panel. The Part D form is available in Figures 16 and 16A.

Rock art damage was divided into three distinct categories based on the kind of impact that could be reported by a UASF Part D form. First, intentional damages are defined as willfully inflicted injuries or damages, often caused by malicious actions or behaviors, which bring about harm to the archaeological resource. Such damage typically consists of activities that have been purposefully undertaken with the clear intent of destroying the archaeological resource in question (Hedquist 2014; Swadley 2016). Intentional damage to a panel can take many forms, including alteration or defacing, graffiti, obliteration, bullet marks, painting, chalking, attempted removal of names/initials/dates or other markings, and removal. All of these are acts of intentional damage that were done with the direct intent to alter the panel in some way.

Secondly, unintentional damages are actions that were perpetrated by human actors but were not deliberately intended to hurt the panel or site. The amount of unintentional damage recorded as culturally impacting the panel includes soil removal to expose figures, latex mold residue, smoke blackening, livestock grazing, and construction activities. While these activities are all caused by human behavior, those responsible did not intend to alter or interfere with site structure or integrity. In the site sample for this study, the only unintended consequence noted was smoke that had blackened surfaces due to campfires.

Finally, natural damage is caused by natural forces without any human interference. These can result from a wide range of natural forces such as extreme weather events, earthquakes, and other environmental phenomena. There are numerous characteristics found on the surfaces of the panels resulting from high pressure and environmental conditions. These include the presence of bird and insect nests, eroded surfaces, mineral deposits, vegetation abutments, cracks and fractures, areas exposed to wind and rain, dust deposits, lichen growth, and spalling.

After initially identifying the type of damage, it was further categorized as primary, secondary, and tertiary to fully document the extent of human or natural impacts. Primary damage is defined as damage with the greatest reported magnitude of impact, or damage that appears to be the most severe. This is evidenced by the highest percentage of impact being reported at that location. Secondary damage is the damage with the second highest reported percentage of impact, while tertiary damage is the damage with the third highest reported percentage of impact.

Out of the 46 eligible sites, 19 showed intentional damages, but sites that only had natural damages, or were deemed unintentional, were assessed for correlations between site attributes and the reported damages. 125 individual panels have been closely examined for the types of damage, a panel being a single surface with imagery determined by the individual that originally recorded the site. A panel is often a single surface with the same orientation. For example, a boulder with imagery on both the north and south sides will be separated into two panels, a north panel, and a south panel. It can also be a single surface, with a significant space (between 6-12 inches or more) between images or groups of images.

The severity of the damage is determined by the reported statistics listed in the forms on-site, which are then combined and calculated at the site level and reported as percentages. By determining the percentage of lichen growth on each panel (e.g., one panel with 5%, another with 5%), it is ensured that the reported impact on the total size does not exceed 100%. It can be inferred from the term '100 percent' that the damage inflicted is comprehensive and affects the entirety of the site in terms of its scope. A higher percentage of severity is considered more serious relative to a lower percentage (Merrill 2011; Swadley 2016; Wildesen 1982). To better understand the data, the analysis is conducted on a macro-level overview of the entire site and on an individual panel basis. This allows for an in-depth and comprehensive exploration of the collected data by looking at trends between sites, which may have a single panel or multiple, and between individual panels themselves.

The overall severity of the damage was determined by calculating the average percentage from both a comprehensive site overview and an individual panel basis. Furthermore, the commonality of the damage can be identified by gauging its frequency within the sample analyzed, while the severity is established by assessing the percentages of its effects reported on-site forms averaged across all reported instances of the damage. The averages of the reported severity and the frequency with which damage is reported determine the level of impact a damage is supposed to incur.

Correlations with natural damage were also analyzed using RStudio. These analyses did not produce significant results and are thus not discussed further. The graph showing the range and average of reported natural damages is available in Figure 16 in the Appendix. Further information regarding natural damage within the sample is available upon request.

An attempt was made to measure geological outcrops digitally using Adobe Photoshop's measuring tools in combination with the scale bars present in the photographs. The results of this method were compared to five sites that were measured manually on two vertical cliff faces, one horizontal bedrock surface, and two sloping boulders. After taking digital measurements of the vertical cliff faces, the results were determined to be within ten centimeters of the actual measurements. However, the photos did not accurately or adequately depict certain portions of the panels, while other surfaces' measurements within the digital platform were calculated to be off by more than 20 centimeters. This discrepancy is likely due to the differences in perspective when compared to the photos taken of the vertical cliff faces, where they had a straight-on view. This is unfortunate because adequate pictures could have been an effective means of remote data collection in this study. All data used in this study were instead sourced from the reported numbers and percentages on the most recent site form for each site.

Since many previous studies note a site’s distance from a road, road distance is a principal factor for evaluating whether the assumption is that the closer to a road, the higher the severity of damage a site will experience. To evaluate this assumption, road distance as an attribute was calculated using the Near tool in ArcGIS Pro, and by measuring the shortest distance from a site location to the nearest state-recorded road on the Utah Roads and Trails file from the U.S. Geological Survey (USGS). Roads are either paved or maintained and graded dirt roads intended for typical vehicles or ATV travel. Trails are intended for on-foot or horseback travel. This measurement was recorded from an established site about the nearest documented Utah Trail or Pathway according to the USGS's File of Utah Trails and Pathways. According to Hedquist (2014), it can be expected that sites with relative proximity (500 meters) to roads will experience more severe levels of vandalism due to their accessibility when compared to more remote areas. This is illustrated in a map (Figure 5) depicting the different zones identified in Hedquist's study based on the study area.

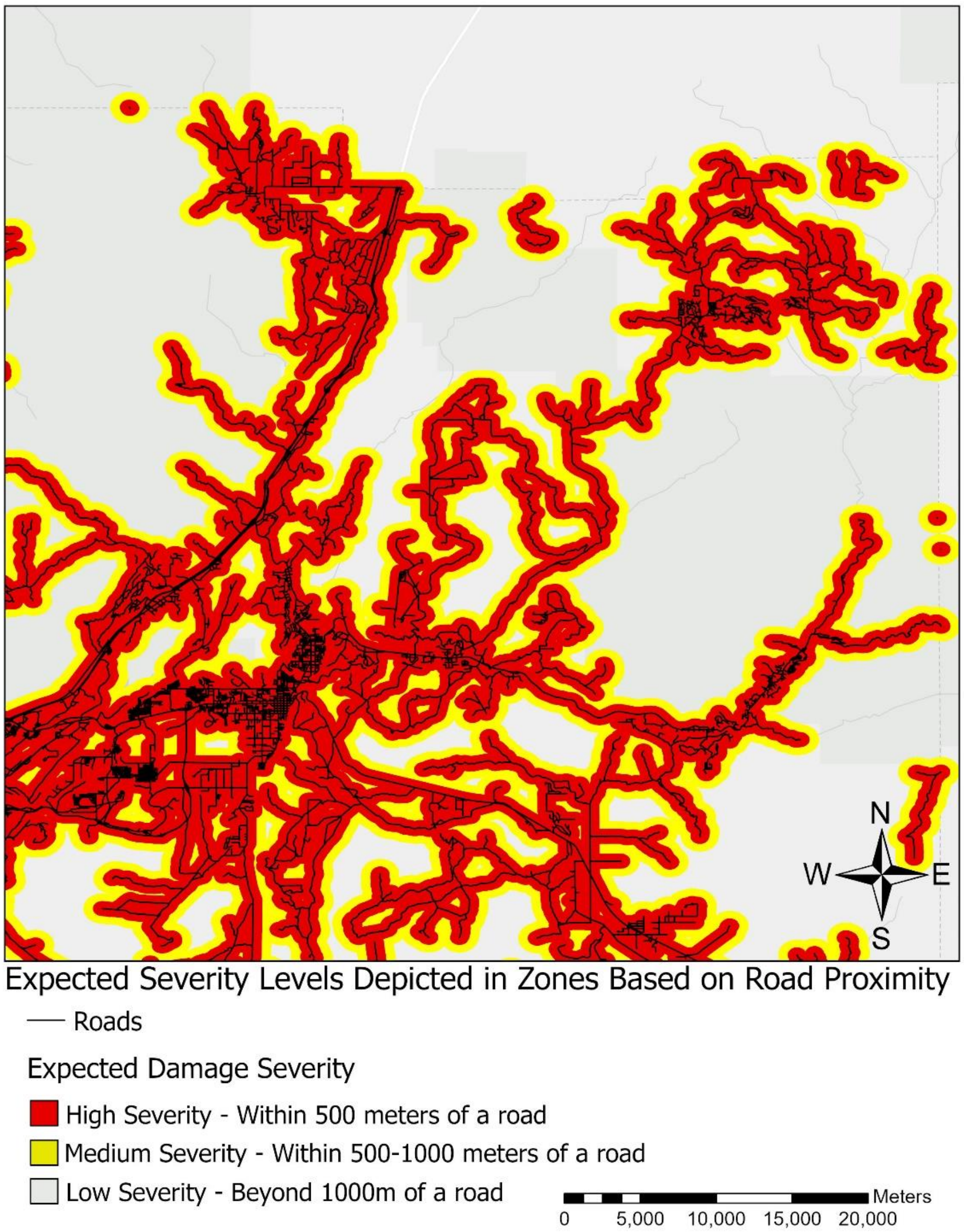

Figure 5. A map depicting the zones as discussed in Hedquist (2014), depicted in the study area. The zones are based on the road data file. Road data was obtained from the USGS, and site location information was obtained from the Utah State Historic Preservation Office.

This map provides a visual representation of the distances between sites and their respective road accesses. The red zones are within 500 meters of a road and are expected to experience more damage than those in the 500 meters – 1000 meters range, depicted in orange. Those outside of a colored buffer zone are more than 1000 meters away and are expected to experience exceptionally low levels of damage. It is anticipated that sites that are more easily accessible and do not require specialized equipment such as climbing equipment to access will present more severe damage than those that do require specialized equipment to be accessed. Nevertheless, it has been observed that sites that employ more encouraging, rather than intimidating, signage are likely to experience lower levels of destruction (Podolinsky 2022). The resulting map can be found in Chapter IV: Results (Figures 14 and 14A).

To efficiently process and analyze a large amount of data input into an Excel spreadsheet for tracking, R and RStudio software was used to generate statistical analyses. These summaries provided an overview of the frequencies of sites at both overview and individual panel scales. The programming language R was also employed to generate the box plots that effectively analyze and evaluate the reported values for primary, secondary, and tertiary damages, and for intentional, unintentional, and natural damages. These plots determined the range and mean of reported percentages of damage to determine which damages are most frequently reported at more severe levels.

R programming was used as a tool to assess any correlation between the damages reported and associated factors. These factors include additional site characteristics such as the number of panels present at a site, the variety of elements found on a panel, any additional artifact types discovered at the site, panel location, imagery category, distance from a state-recorded road, and the presence of trails, guest registries, or signage. These factors should all be considered when assessing the potential for damage at a site.

Severity rates were further organized for a better understanding of the extent of damage and for quantitative purposes. Damage was designated as low (0-35% reported damage severity), moderate to high (36-70% reported damage severity), and high (70-100% reported damage severity). These rates are used to predict the expected rate of degradation about road distance and proximity to trails. It is important to note that any damage done to rock imagery sites can be permanent and even minor damage can contribute towards the overall loss of these unique sites.

The utilization of these various methodologies allows for the comparison and correlation of site attributes with the reported damage severity and frequency of reported damage. Ideally, the combination of techniques strengthens future assessments regarding which sites are more likely to experience damage than others. The results of this study and significant findings appear in the following chapter.

CHAPTER IV RESULTS

This chapter reviews the results of various statistical analyses performed using the information gathered from the UASF site forms as described in Chapter III: Methodology. The results are presented in graphs and maps along with an interpretation of the results as they relate to the question of predicting damage to rock imagery. Tables are utilized to report simple frequency information.

Initially, it was observed that not every instance of recordable damage had been logged within the sample dataset. In addition to the various cultural impacts that were observed and reported on-site, certain aspects remained unrecorded. These included bullet marks, construction activities, latex mold residue, paint, obliteration, removal of soil to expose figures, attempted removal, and livestock. Moreover, it was reported that the only unintentional damage that occurred was smoke blackening, which transpired at a single site from the sample and had a severity rate of 100%. This was also the only cultural impacting agent to be reported as that site.

The analyses presented here focus solely on correlations related to primary intentional damages unless there is a strong and noteworthy correlation that can be observed regarding secondary and tertiary damages. If a correlation with secondary or tertiary damage is not presented, the analysis returned a correlation with a p-value less than 0.5, which is considered not significant and therefore will not be further discussed. The frequencies of the reported intentional damage are in Table 1 below. Frequencies of natural damage are included in Table 5 in the Appendix for review, though only statistically significant correlations regarding intentional damages will be discussed and analyzed within the results of this research.

*Reported Damages and Frequency***:** Table 2 below outlines the reported damages and the number of times they were reported.

Reported Damage Frequencies.

Primary Damage Type	**Frequency**
None Reported	92
Graffiti	14
Names, Initials, Dates	11
Alteration/Defacing	5
Chalking	2
Looting	1

Table 2: This table displays the reported frequencies of primary damages at 125 panels. While the majority had no reported damage, graffiti is reported most frequently. The total number of panels that reported damage is 33.

It is noteworthy that out of the 125 sampled sites, 73% did not report any cultural impact agents. The remaining 27% of sites with reported intentional damage had graffiti as the primary agent, making up 41% of reported damages, followed by names, initials, and dates at 32%. The range and average magnitude of the severity of the impacting agent are in Figure 6.

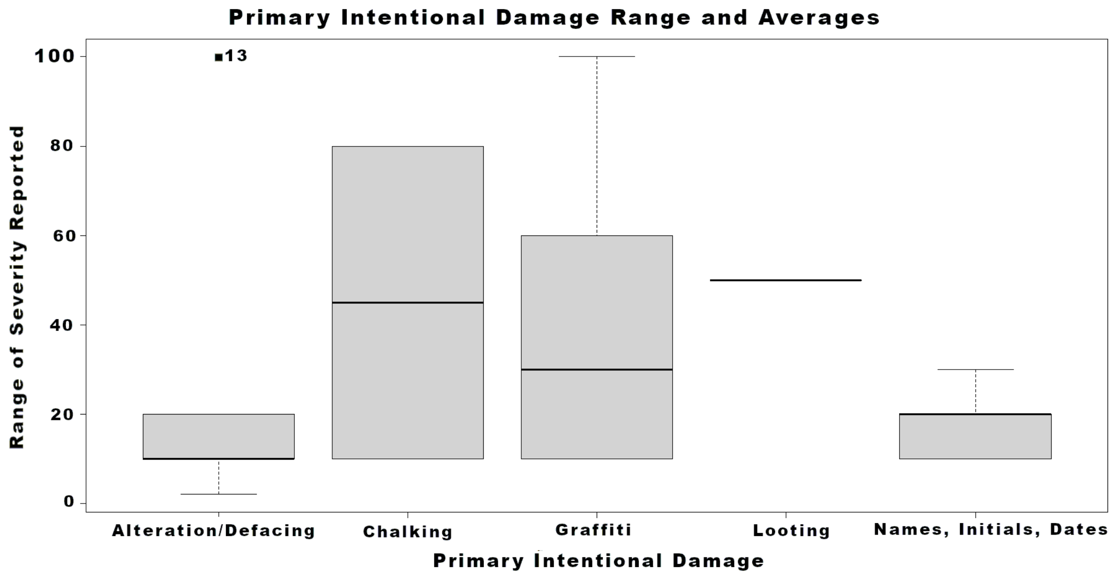

Figure 6: This graph shows the average and range of severity of the reported primary damages. While chalking has a high average, there were only two reported incidents. Graffiti has the greatest range of severity and the highest average severity, followed by Names, Initials, Dates.

As anticipated, based on the previous research on vandalism, graffiti has been found to have the highest average severity and the most extensive spread of severity ranging from 10-100% with an average of 30%. Chalking has a significantly higher average severity compared to other impacting agents; however, it was only reported twice in the survey results. It is observed that names, initials, and dates present an average of 20%, with a smaller range ranging from 10-30%. According to frequency and average data, graffiti is the most pervasive form of primary damage that is encountered, exhibiting a higher-than-average severity. The results of the current study indicate that further research may be necessary for a more accurate assessment of the prevalence of chalking, should it be found to be more present within the sample. However, due to constraints in sample size, it is not possible to provide a more comprehensive analysis on this matter. Looting should be noted as having the most extreme average severity impact among all other criminal activities, despite being recorded only once. Though it is not necessarily the most frequent crime, it will cause the highest levels of damage, making it a significant issue.

Affiliation: To proceed further, analyses were conducted on a panel-by-panel basis. For reference, Table 3 below provides details about the reported affiliations, such as how many panels reported that affiliation and the percentage of the sample that affiliation accounted for. It was observed that not all affiliations reported had associated panels that suffered from any form of intentional damage.

Reported Affiliations

Affiliation	**Count**	**Percentage of Sample**
Virgin Puebloan	43	34.13
Virgin Puebloan; Southern Paiute	17	13.49
Unknown Prehistoric	16	12.7
Basketmaker; Ancestral Puebloan; Historic	10	7.94
Basketmaker; Pueblo I	9	7.14
Archaic; Virgin Puebloan	6	4.76
Archaic	6	4.76
Historic	4	3.17
Virgin Puebloan; Historic	4	3.17
Basketmaker III; Pueblo II	3	3
Late Basketmaker	3	2.38
Basketmaker III	2	1.59
Late Basketmaker; Virgin Puebloan	2	1.59

Table 3: The number of reported cultural associations and the percentage of the total sample of 125 panels.

In this analysis, the correlation between the affiliation of the panel and the severity of primary damage is presented (see Figure 7). Given the predominance of damage at Virgin Puebloan and Southern Paiute affiliated sites, other attributes such as the average number of elements at these sites, other site characteristics, average distance to a road, and distance to a trail were assessed by their correlation to the severity of damage reported. None of these additional inquiries provided statistically significant results that would explain the associated severity of damage at Virgin Puebloan and Southern Paiute affiliated sites.

As evidenced by Figure 7, panels identified with Virgin Puebloan and Southern Paiute affiliations experience significantly more severe primary damage on average when compared to the other panels in the sample, despite only representing a small proportion of the total. Although Virgin Puebloan-affiliated sites make up the greatest portion of the sample, they do not experience the highest average and range of severity when compared to other sites. The observed correlation between Historic affiliation and higher severity levels is likely due to the limited number of historically affiliated panels found within the sample. Panels with unknown Prehistoric affiliations have demonstrated an average severity level that is second only to those of Historic affiliation, but exhibit a greater range in terms of severity, which can range from as low as 10% to as high as 100%. Consequently, sites in Washington County associated with the Virgin Puebloan and Southern Paiute people are more likely to experience a higher degree of severity with intentional damage than sites with other affiliations.

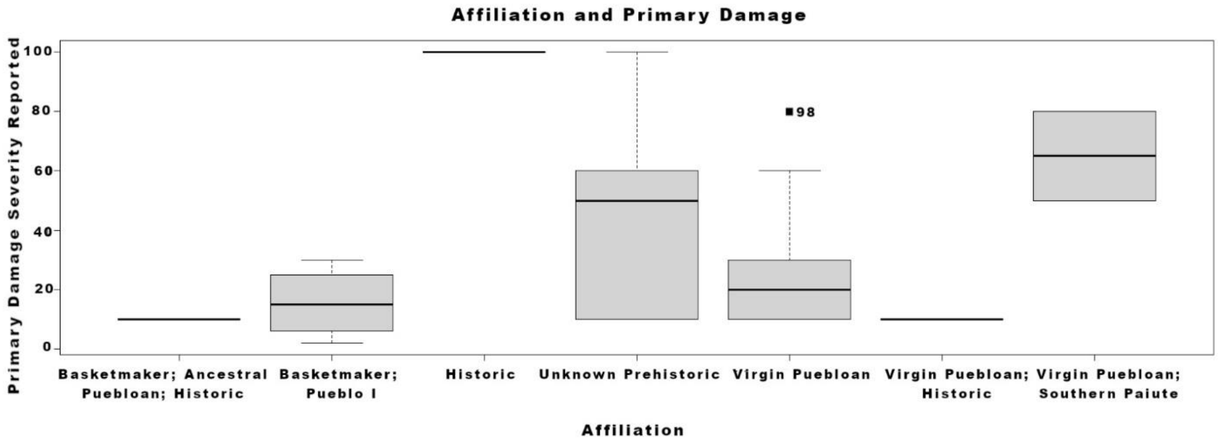

Figure 7: This graph shows the severity of reported damage in correlation with the cultural association of the panel or site. Virgin Puebloan: Southern Paiute-associated panels have the highest average severity and a higher overall range, despite not being the most prevalently reported association. This only includes panels that reported damage. 33 panels reported damage.

Another finding is that panels of an unidentified prehistoric origin appear to have experienced more considerable ranges and averages of secondary damages reported, in comparison to other categories (Figure 8). It is observed that sites affiliated with the Virgin Puebloan and Southern Paiute affiliations experience the next greatest magnitude of damage, although it should be noted that very few sites of these affiliations have reported any secondary damage. An analysis of the severity rates of primary damages in comparison to the severity rate of reported secondary damages indicates that it is highly likely that a higher degree of primary damage will result in a heightened severity rating for any resultant secondary damage, with there being an evident positive correlation between primary and secondary damages (Figure 9).

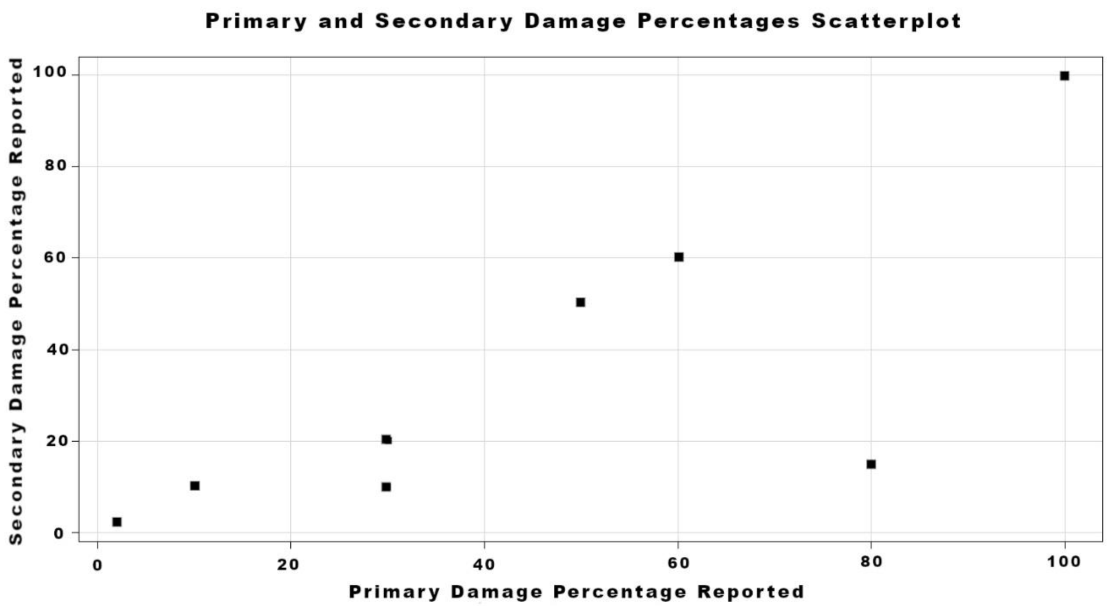

Figure 8: The graph shows that when secondary damage is reported, sites associated with unknown prehistoric cultures experience a higher severity of damage. 8 sites reported both primary and secondary damages.

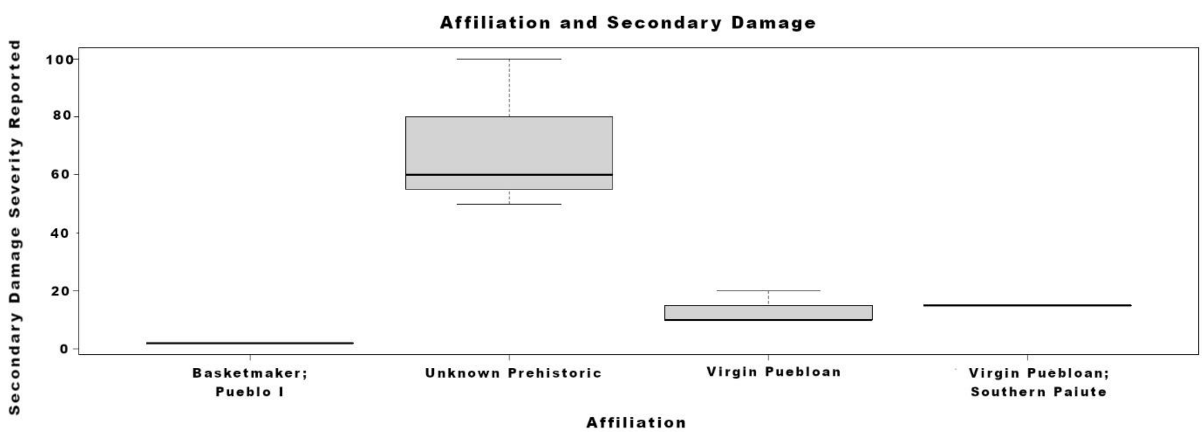

Figure 9: The graph indicates a general, minorly significant trend that the more severe the primary damage, the more likely the secondary damage reported will also have a higher severity. This only includes the 8 sites where secondary damage was reported.

Number of Elements. Interestingly, research on the correlation between the number of elements on a panel and the severity of reported damage indicates that there is an inverse relationship between these two factors. On average, as the number of elements or figures contained within a given panel increases, the severity of associated damage decreases. There is some degree of variability in the severity of damage reported on panels with fewer elements; however, in general, the trend suggests a negative relationship between them, as illustrated below in Figure 10.

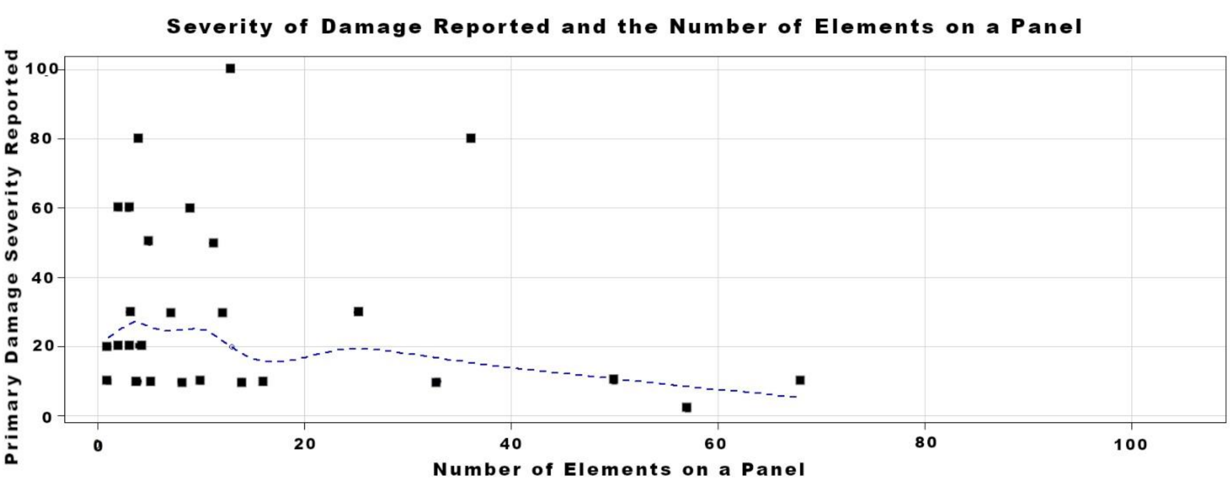

Figure 10: This scatterplot shows a negative relationship between the number of elements on a panel and the damage reported. As the number of elements increases, the severity of damage reported decreases. Due to the number of elements being recorded on Part D forms in intervals, there is a significant overlap in reported numbers, and not all 125 points are represented due to this as many have the same reported value.

A correlation test was conducted to investigate the possibility of any links between the affiliation and the types of damage a panel might be subjected to, however, the results of this test indicated that the p-value was greater than 0.05 which is indicative of not having a significant correlation. This may be attributed to the sample size and the large degree of variability between results.

Site Characteristics: The UASF part D is an invaluable tool when it comes to analyzing archaeological sites, as it allows researchers to record a wide range of characteristics in the landscape including artifact scatters, architectural features, and notably, the presence of rock shelters. The results of the analysis conducted to investigate the presence of any additional characteristics compared to the reported severity of the primary damage have indicated that sites or panels that lack extra features or characteristics tend to experience a much wider range of severity when compared to sites with additional features and characteristics, with an average potential severity level estimated at around 20 %.

Archaeological sites that contain artifact scatters tend to experience an average of the same severity of damage as other sites, however, they have a more restricted range of severity. One such example was the panel located within a rock shelter which revealed that all the primary intentional damage recorded was at a full 100% severity (as can be seen in Figure 11 below).

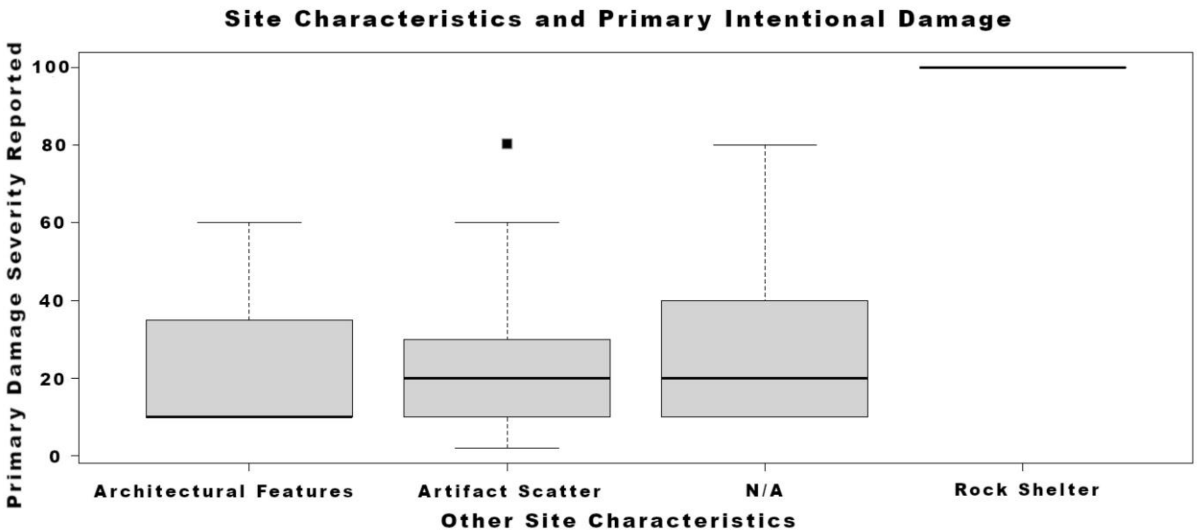

Figure 11: In this graph, the additional site characteristics are assessed regarding the severity of primary damage. The rock shelter has the highest severity but was only reported within the sample once. When a site has no additional characteristics, it has the highest severity and broadest range of severity of reported primary damage. 33 sites reported damage.

Imagery Type. Six distinct types of visual elements were reported to be present in the imagery, namely zoomorphic, anthropomorphic, abstract designs, initials, dates, and a category labeled as undetermined or N/A which represents those elements that could not be classified into any of the categories. This classification system was based on the distinctive style or subject of the various visuals present in each of the elements evaluated. Names, initials, and dates were only reported three times or fewer and thus did not provide enough information to generate reliable results. Panels featuring zoomorphic imagery have the greatest average and range of severity compared to other imagery types. Upon analysis, these panels have demonstrated an average severity rating of approximately 55%, ranging from 10% up to 80%. The abstract panels experienced the highest average and broadest range of severity of primary intentional damage, with an average of 20% and a range from

10% to 60%. This study has determined that panels with anthropomorphic imagery as the primary focus experience an average of 10% primary intentional damage severity, with a range of 5% to 30% (see Figure 12).

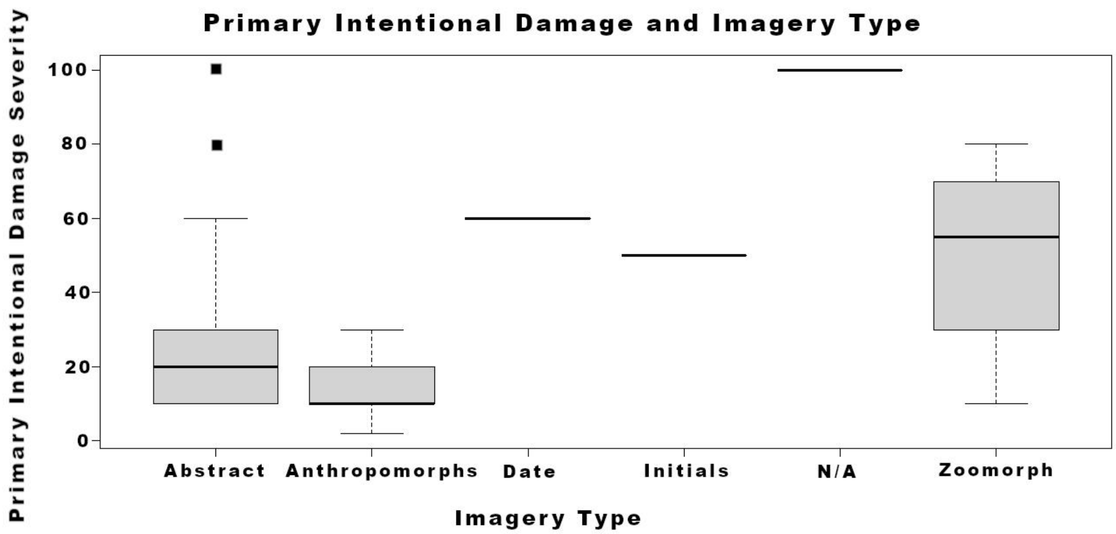

Figure 12: This box plot indicates the range of damage severity reported at panels with specific imagery types. Zoomorphs experience the highest average severity of damage, while anthropomorphs experience the least.

Panel Location: In the given sample of sites, seven distinct panel locations were reported. The reported locations are the pre-determined locations that are marked down on UASF site forms and only one location type can be marked. As such, there are panels with multiple locations recorded.

Reported Panel Locations

Panel Location	**Frequency Reported**
Cliff Face	59
Boulder	28
Cave Interior	19
Rock Shelter Interior	12
Bedrock	3
Outcrop	2
Small Stones	2

Table 4: The table shows the reported locations of the 125 panels. Cliff faces were reported most, followed by boulders, cave interiors, rock shelter interiors, bedrocks, outcrops, and small stones.

To ensure that the data collected was comprehensive and could provide a wide range of information, each panel was considered and included in the study. The locations reported included boulders, cliff faces, boulders, cave interiors, rock shelter interiors, bedrock, outcroppings, and small stones. There were too few occurrences of outcroppings and rock shelter interiors reported to provide significant results within the analysis.

Despite cliff faces being identified as the most frequent location for panel sites, it was found that panels located on boulders had the highest average severity of 30%, with a range of severity between 10% to 100%. Despite having an average severity of 20%, cliff faces, and cave interiors display considerable variations of severity levels. More specifically, panels situated on cliff faces experience a much wider range of severity levels, ranging from 10% to 60%, while panels located in cave interiors tend to have a much lower range, varying from 0% to 30%. Rock shelters and outcrops had only had one reported damage each and do not provide any significant data. Small stones and bedrock did not have any reported damage and are therefore not included in Figure 13 below.

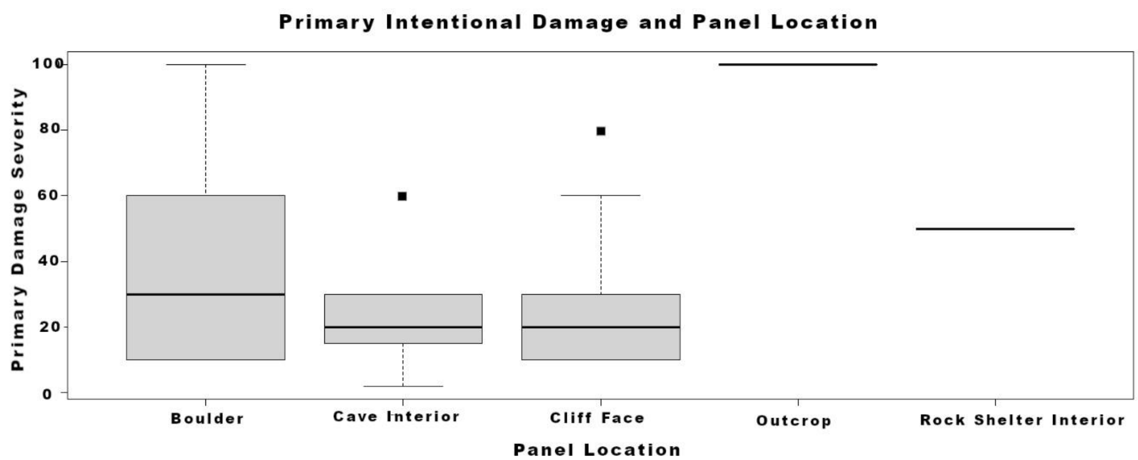

Figure 13: This box plot shows the range of severity of damage documented at different panel locations. Boulders show the highest severity and greatest range, while cave interiors show the least. This graph uses the data from the 125 panels analyzed in this study.

Distance from Roads and Trails: The geographic parameters of the sites in which the study panels were recorded were analyzed to determine the distance from roads and trails. A correlation test between the severity of primary damage and the distance to a road revealed a statistically significant relationship ($p < 2.2e-16$). The correlation value of 1 indicates a perfectly positive relationship between road distance and severity, but this result is opposite to that which was expected based on prior research (Hedquist 2014; Kvamme 1990; Simms 1989; Vella 2015; Yates 2022). When it comes to the amount of destruction caused by intentionally caused damage, the further away a site or panel is from a primary thoroughfare, the more severe the damage that is likely to be experienced. Figure 14 shows what was expected to manifest, in that sites closer to roads would experience higher levels of results based on this correlation test.

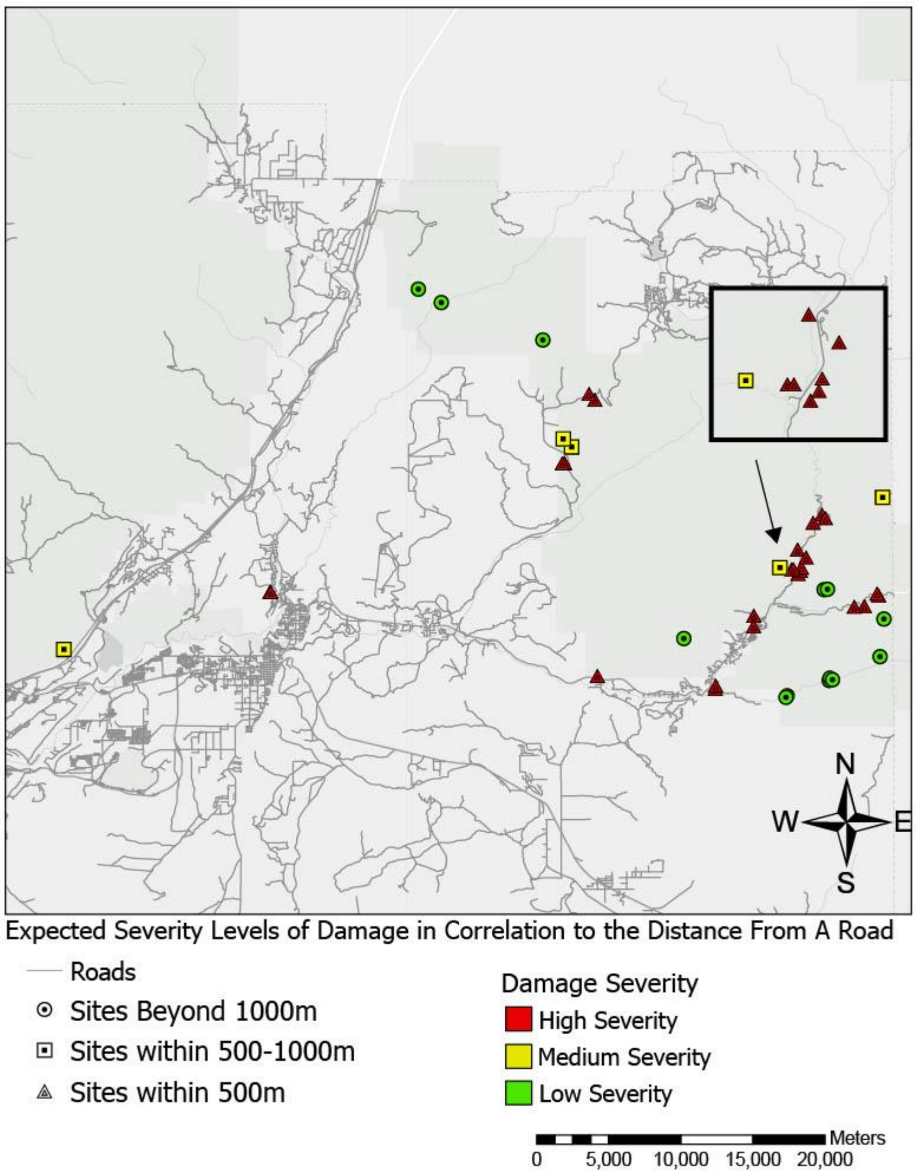

Figure 14. The map depicts the expected severity of damage for the sites in correlation with their distance from the road. Sites beyond 1000m are depicted with a circle, sites within 500-1000m of a road are depicted with a square, and sites within 500m of a road are depicted with a triangle. The colors indicate the expected severity of damage present based on Hedquist's (2014) conclusions.

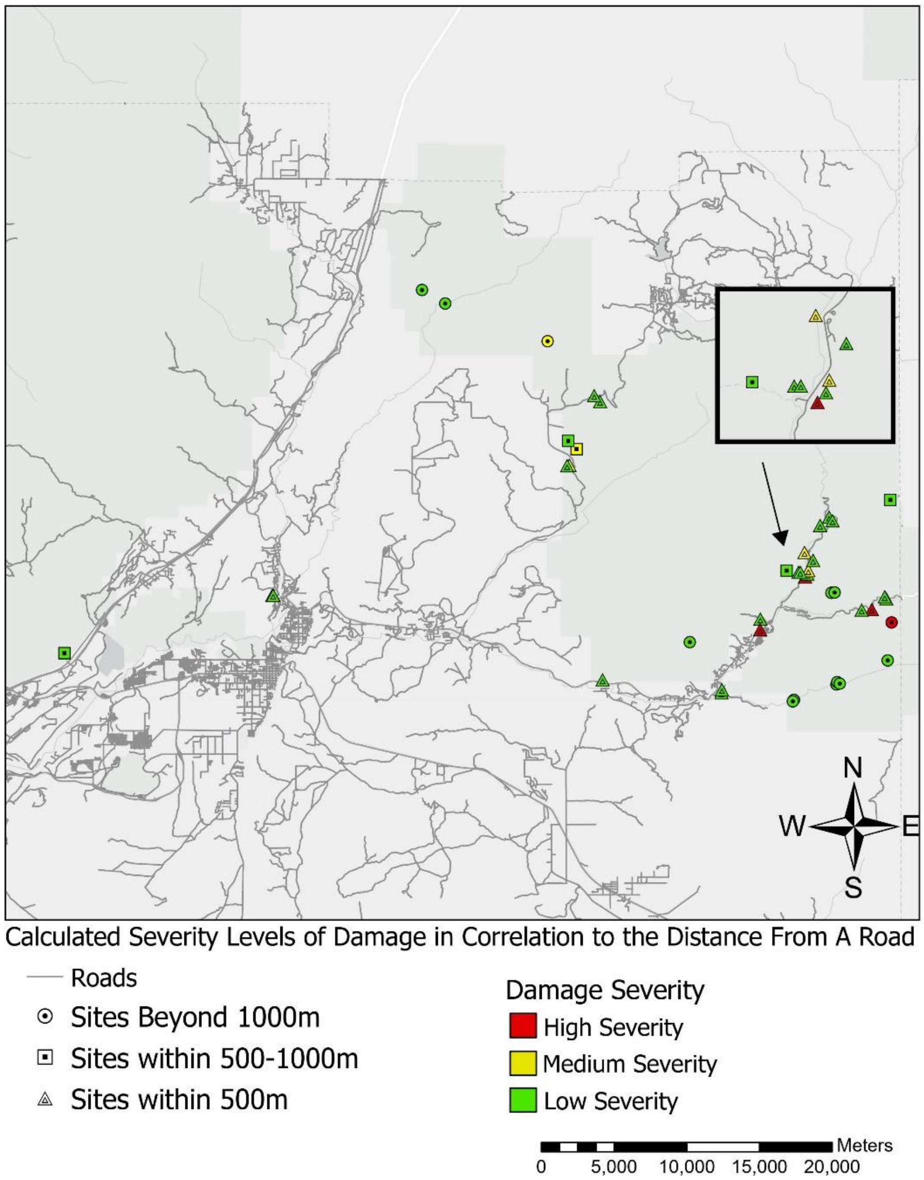

Figure 14A. The map depicts the calculated severity of damage for the sites in correlation with their distance from the road. Sites beyond 1000m are depicted with a circle, sites within 500-1000m of a road are depicted with a square, and sites within 500m of a road are depicted with a triangle. The colors indicate the expected severity of damage present based on this study's results.

In contrast, when a correlation test was conducted between the severity of primary damage and the distance in meters to a trail or pathway, the results were significantly different (see Figure 14A). The recorded p-value was 0.04 and a correlation value of -0.472 was calculated, which suggests that there is a moderately negative relationship between these two variables. This phenomenon demonstrates that the proximal distance of a panel or site from a trail is closely correlated with an increased risk of more severe levels of damage. In other words, the closer a panel or site is to a trail, the more likely it is for them to experience heavier levels of destruction.

In summary, the combined analyses shows that there is a correlation between the severity of damage that a site experiences and some of its attributes. The proximity to roads has a statistically negative relationship (as distance decreases, the severity of damage increases), while the distance to trails has a statistically positive relationship. Affiliation, number of elements, and types of imagery also have statistically significant correlations. Having considered the aforementioned information, it is possible to design and formulate an index that summarizes all of these factors and that provides insight into what each of them could indicate in terms of a site's sensitivity to potential damage.

CHAPTER V DISCUSSION

The results presented in the previous chapter provide a starting point to begin to assess how the attributes of a site are correlated with increased levels of intentionally caused damage and how we can consider implementing proactive mitigation methods. Each attribute investigated must be considered as part of the whole panel or site rather than individually, but each impacts the sensitivity of the site differently. The types of damage, affiliation, site characteristics, and panel location all impact the sensitivity of a rock imagery site differently.

Reported Damages: Results from this sample indicate that graffiti is the most reported type of intentional damage, with a higher frequency and severity level than all other damages reported. On average, graffiti damage occurs more frequently than any other intentional damage and has a higher severity. The conclusions that may be drawn from the analysis of chalking observed in this sample size are similar to what we expect if the sample size was larger. Factors such as the removal of a panel, or bullet marks would have the most impactful and detrimental effect on the findings but were not reported, indicating their low frequency but high severity.

Affiliation: In this case study, it was observed that the panels containing both Virgin Puebloan and Southern Paiute imagery experienced more severe damage even though they were not the most reported affiliations. On average, the panels that were examined had fewer than ten elements recorded, whereas those sites with other reported affiliations had significantly higher averages of elements per panel. This may be a significant factor in why this affiliation group experienced increased levels of damage when compared to others, however, other factors outside the scope of the current research may have contributed to these higher average levels of severity. Therefore, further investigation into such factors is warranted and could be a potential avenue for future research.

Number of Elements: It has been observed that the number of elements present on a panel at a rock imagery site is strongly correlated with the likelihood and intensity of vandalism at said site. Panels with more elements tend to experience less severe levels of vandalism when compared to those with fewer elements. Land managers may benefit from an understanding of the lack of a clear correlation between the number of panels at a site and the number of elements on each panel. By combining this information with the affiliation attribute, land managers can employ proactive mitigation strategies that are tailored to each location. However, a comprehensive analysis is essential to accurately assess which regions are more susceptible to damage, as the individual associations of archaeological sites can vary significantly by region.

Type of Elements: The number of elements on a panel goes hand in hand with the type of elements present. The results of this research demonstrate that panels whose primary imagery is zoomorphic suffer from more damage compared to abstract figures and anthropomorphic scenes, in that order. By accounting for the number of elements present, a land manager can surmise that panels with fewer than 10 elements featuring primarily zoomorphic imagery are more likely to suffer from higher levels of intentional damage and destruction, whereas those with humanoid or humanlike imagery may not experience as severe levels of damage.

Site Characteristics: Other site characteristics, such as a present artifact scatter or a structure did not have a significant correlation to increased levels of damage. This data could change with a larger sample size of sites with additional characteristics apart from rock imagery. This may also change region by region based on the tourism aspect in the area. If there are more structures or artifact scatters associated with rock imagery, the correlation may be more significant.

Proximity to Road: Initially, the results obtained from the analysis provide a solid foundation for gaining insight and forming a greater understanding of the current trends and patterns of vandalism targeting archaeological sites. In this sample, the most prominent factor that had the highest correlation to the severity of vandalism reported at a particular site was its distance from a documented road. With a perfect correlation value of 1, research has revealed a strong correlation between sites that are situated more than five hundred meters away from a road and a significantly higher level of vandalism with the same levels of severity present in sites that are located closer to recorded trails within the same sample. This correlation is likely to be due to the amount of visitation a site may experience (Shaffer 2019).

Previous studies have hypothesized, based on observational data gathered through surveys, that sites which are located in closer proximity to a major thoroughfare are more likely to be subject to vandalism (Ahlstrom 1992; Hedquist 2014; Kvamme 1990; Nickens et al 1981; Simms 1986; Spangler 2006), however, the results observed within this sample provide a strong indication that the contrary is true. Considering the facts discussed above, land managers can anticipate that more remote sites may be subjected to greater destruction, even if such instances occur less frequently. However, if a site is located near a trail, it is likely to face more frequent and extensive levels of damage due to combined road and trail factors.

Panel Location: Lastly, it has been observed that rock panels located on boulders tend to experience more damage compared to those located on cliff faces. This phenomenon could be the result of increased accessibility of these locations, as they are typically closer to trails than those located in rock shelters or cave interiors. This is another potential exploration area left unexplored within this current research.

Natural Damage: It is important to note that while natural damages did not display any statistically significant correlation with damage severity, it is still necessary to acknowledge that the condition of the rock imagery panels, which can be impacted by natural deterioration factors, will have an influential bearing on how much intentional damage will permanently affect a panel as the per measurements for rock imagery panel stability noted in Dorn et al (2008). By understanding this, land managers may be able to pinpoint which sites are going to be more challenging to manage post-vandalism, since modern graffiti removal methods such as elephant snot are not as proficient at cleaning stone or surfaces that have been heavily weathered and eroded (Deacon 2006, Dorn et al. 2008).

Site Sensitivity Based on Attributes, and Mitigation: Table 5 illustrates the attributes in order, from top to bottom, and ranked 1 through 6 (1 being the most significant correlation with higher damage severities and 6 being the least significant correlation), of the properties that are most likely to experience deliberately caused damage by vandalism to those which are least likely. An additional breakdown of each attribute with the results previously discussed ordered in probable damage significance is displayed in Table 6. It is essential to be aware that even if a particular element may appear to have a low likelihood of experiencing damage according to the present analysis, it should not be assumed that damage is impossible and thus appropriate preventive measures must still be implemented. The purpose of this chart is to provide a quick summary of the several factors and site attributes that could contribute to a higher prevalence of intentional damage, for proactive mitigation activities to be employed rather than relying solely on reactive mitigation strategies. This information may be invaluable for informing the mitigation strategies suggested during archaeological surveys and reporting for both federal and state projects and private projects. Consequently, collecting this data can potentially help to further our understanding of archaeological sites and promote long-term preservation efforts.

Probable Significance Rankings for Severe Levels of Vandalism

Significance Ranking	**Site Attribute**	**P-Value**
1	Proximity to Road or Trail	p < 2.2e-16
2	Number of Elements	p = 0.015
3	Imagery Type (Abstract, anthropomorphic, Zoomorphic)	p = 0.03
4	Panel Location	p = 0.035
5	Panel Affiliation	p = 0.03955
6	Other site characteristics	p = 0.050001

Table 5: The table displays a ranking of the analyzed attributes from most significant to least significant correlation to the severity of reported damages. The proximity to a road has the highest significant correlation with severe damage. Other site characteristics have the least significant correlation.

Probable Significance Table – Results Summary

Site Attribute	Characteristic (Most impacted to least Impacted)
Proximity to Road	
	1000+ Meters
	500 – 1000 Meters
	0-500 Meters
Number Of Elements	
	1 to 10
	21 to 30
	11 to 20
	31 to 40
	51 to 60
	41 to 50
	61 to 70
	100+
Imagery Type	
	Zoomorphic
	Abstract
	Anthropomorphic
Panel Location	
	Boulders
	Cliff Face
	Cave Interior
	Outcrop
	Rock Shelter Interior
Panel Affiliation	
	Unknown Prehistoric
	Virgin Puebloan; Southern Paiute
	Virgin Puebloan
	Basketmaker; Pueblo I
	Historic
	Basketmaker; Ancestral Puebloan; Historic
	Virgin Puebloan; Historic
Other Site Characteristics	
	None
	Artifact Scatter
	Architectural Features
	Rock Shelter

Table 6: This table shows the breakdown from Table 5 to include the individual characteristics investigated. They are sorted from the most likely to have severe levels of vandalism, to the least likely to experience severe vandalism within each attribute. It does not include factors that were not reported.

The data gathered for this study was obtained through site forms, and with certain modifications to the information recorded, it could be readily replicated for other types of sites. The Part D form of the Utah Archaeological Site Form (UASF) offers a unique advantage in that it provides quantitative information in a numerical format, which is not currently available for other site types across Utah when utilizing only the site forms as the source of data. In addition to the on-site data collected during this study, supplemental information may be gathered for further analysis. However, due to limitations in the current site recordation process and forms, it is not feasible to replicate this type of study for other site types such as artifact scatters, structures and dwellings, or linear sites like canals or bridges. This investigation can be replicated in other areas of Utah that contain rock imagery sites if the appropriate Part D forms are available. A comprehensive analysis across Utah could even be conducted with comparable results, though such an endeavor was beyond this current study's scope.

The comprehensive discussion of site attributes and potential damage is highly informative and provides a solid foundation for taking proactive mitigation measures. According to existing research as well as emerging research in the field, several combined approaches for damage mitigation are recommended, including moral-appealing signage rather than punitive threatening signage (Podolinsky 2022), visitor logs, or other options for behavior displacement (Kuwanwisiwma et al. 2018; Nassaney 2019). Other options may include proposing an alteration in the pre-planned routes for trails to ensure a greater distance between the trail and any form of rock imagery sites, with the ultimate objective of reducing anticipated levels of destruction or utilizing stewardship programs as an effective way to increase the presence and reporting at sites that are located further away from roads and other areas of easy access. Such programs can help bring greater visibility to remote sites, allowing organizations to better understand the impact and frequency of vandalism. Over time, stewardship reports that occur twice a year at each site can provide observations and data over time, year to year, that future research can closely observe to track changes over time.

Though we can plan for mitigation and preservation, until we understand why people do or do not commit acts of vandalism, we can never truly stop vandalism from occurring. The motivations for vandalism were not explored in the main body of this thesis but based on my experiences working in public archaeology across Utah, and experiencing the outdoor tourism in Washington County, I briefly discuss some of the possible motivations below.

In my personal experience and anecdotally, people want to make their mark on places they have visited, and places that they connect with on multiple levels. Graffiti or markings on rock imagery panels would be considered "Public Graffiti" and is often used to communicate viewpoints and to be a part of whatever discussion is happening in a public space (White 2001). I suspect most graffiti or markings are a desire to make their mark in a space that impacted them. Other graffiti, such as the most recent vandalism of the Birthing Panel in Moab, Utah, that resulted in the graffiti of white supremacist symbols and slogans over indigenous rock imagery, seeks to communicate the individuals' ideals or beliefs while suppressing opposite views.

Alternately, I think a large contributing factor towards why people do not engage in vandalism or damaging behaviors is a mix between widespread moral ideals of respect and the idea of shame in public spaces. While the idea of shame and guilt as methods of controlling behavior is often associated with religion, it is also seen as a widespread occurrence within cultures themselves regardless of religious affiliation (Merz 2019). People do not like being perceived as “bad” or engaging in “bad” behaviors. This is one reason I suspect that the severity of damage close to roads and trails is lower than those further away is due to the chance of being caught performing an action that society in the region has determined to be bad. This is also a reason I suspect that the morally appealing signage from Podolinsky (2022) was found to work better than the threat-appealing signage, as it appealed to overall morals and the implied shame in society of participating in these damaging activities.

The “why” of vandalism regarding rock imagery is another great and expansive avenue available for future research, which in turn could aid land managers further in preserving archaeological sites of all types in public lands. As with everything, we need to start somewhere, and there are many ways in which we can build off the research and results conducted within this thesis, not only within the archaeological sphere but anthropological as well. We cannot understand the damage being done to archaeological resources without understanding the conditions that influence modern people to engage in damaging actions.

Having discussed the results and some of their implications, I outline some recommendations based on these findings and previously conducted research discussed in the background section. While every site will have unique needs and have different available mitigation options, morally appealing signage decreases vandalism instances and is a fantastic option in areas where it can be installed (Podolinsky 2022). Options for displacement behavior such as a guest or visitor log, or a designated area in which to sign one's name or put dates down could be another option, as offering a space for people to make their mark may discourage them from damaging the imagery (White 2001). Sites further out that may not have available facilities or be in a landscape that is conducive to the previous two examples may need more creative mitigation options. Remote sites benefit from increased monitoring and would be excellent candidates for stewardship programs (Erdman 2019).

Considering this and utilizing the significance ranking table, a mitigation plan formulation may occur as follows: A site is identified by a land manager or consultant in Washington County (or other areas if this methodology has been applied) and the characteristics are compared to the significance rating table. The more significant attributes present at a site, the more likely it is to experience elevated levels of vandalism. If it is far from a road, has few elements, and those elements are zoomorphic, the panel at that site is likely to experience vandalism and the land manager can be proactive in their mitigation strategy to try and lessen the impact through morally appealing signage or assigning a steward. A consultant might look at the same site and suggest moving a planned road or trail in accordance with the distance that would lessen the chance of high-severity vandalism occurring. This needs to be assessed on a site-by-site and panel-by-panel basis to achieve effective results.

Unfortunately, we are unlikely to be able to stop those bent on performing these damaging behaviors from performing them, but we must start somewhere and while we do not have the “why” yet to fully utilize in mitigation, we can start to understand the patterns associated with vandalism and particular sites in order better utilize the tools and methods we currently have on hand, and begin to develop new methods as we continue to gain new knowledge and insight into archaeological vandalism.

Finally, some limitations are important to understand in conjunction with the results discussed in this chapter. One of the most prevalent limitations is the data collection standardization in site forms. Though there are standardized options from which a recorded can select (i.e., patination levels in specified percentage ranges, or the percentage of a panel affected by a particular damaging agent), each recorder will have a different perception as to which of these standardized responses are correct. This lack of standardization creates a variability that cannot be addressed when using site forms to collect data.

The lack of standardization within documentation also creates some variables within the analysis, especially in multi-component sites, that are difficult to separate. Many of the Virgin Puebloan panels had other cultures' work associated in the same area or on the same panel. Thus, these sites were recorded as Virgin Puebloan; Southern Paiute for example, and the different components could not be assessed separately in a geographical and statistical sense.

Additionally, the number of characteristics and attributes at rock imagery sites that are not numerical limit the amount of analysis that could be done with the available software. Analysis such as a PCA would be beneficial for increasing understanding of the available data but was out of the researcher's scope.

It is also important to note that these results are unique to Washington County, Utah due to the present cultural groups and conditions, but the methodology can be applied anywhere that the available data is present or can be collected.

Finally, regarding limitations, the sample size is a significant limitation. Some attributes were not reported, while others were common. An expanded sample beyond the limitations of time and location set out in the methods section could yield different results regarding significance. The result here reflects the limited sample studied.

CHAPTER VI CONCLUSION

Vandalism and other forms of intentional damage to archaeological sites are issues that are unlikely to be completely resolved, yet the results from this study have the potential to aid land managers and the public in limiting long-term damage, and hopefully decrease the long-term effects of such behaviors. As the number of tourists and visitors to these sites steadily increases, so will instances of vandalism (National Parks 2020). Previous research conducted has identified patterns in the vandalism that has been inflicted upon archaeological sites, and reports and scholarly articles have discussed the alarming nature of said vandalism, highlighting the damage it has caused to both the immediate integrity and long-term preservation of these important sites (Albert et al. 2022; Deacon 2006; Gutchen 1983; Keyser 2005; Merrill 2011; Vella et al. 2015; Zain 2020). These pertinent observations serve as an essential starting point as research and exploration progress within this pressing issue, providing invaluable insights into the discernable patterns that can then be obtained statistically from data collected from site forms and reports.

The impact that a site's distance from a road has long been recognized as a major factor contributing to increased levels of vandalism, and this study has provided further evidence of this phenomenon unexpectedly compared to the findings of previous research (Simms 1986; Hedquist 2014; Spangler 2003, 2006, 2007, 2008). Other studies have merely noted the occurrence of vandalism and its subsequent consequences, yet they fail to gain an in-depth understanding of the underlying factors contributing to the prevalence of vandalism across sites. Further research is necessary to investigate and identify the root causes associated with this phenomenon (Yates 2022).

This study serves as the beginning of the quantitative and statistical research that may be conducted on archaeological sites, considering their attributes and characteristics, as well as exploring any potential contributors to increased instances of vandalism and the severity of damage caused. The results of the study demonstrate a strong correlation between increased road and decreased trail distances and the severity of intentional damages at rock imagery sites. Consequently, expert consultants working for state, federal, and private agencies can provide uniquely crafted mitigation strategies that could potentially help preserve these valuable cultural sites and reduce the number of instances of vandalism that may occur.

It is well-established that the data about the distance of roads and trails from a site is highly relevant in evaluating potential damage. Nonetheless, additional factors such as panel affiliation, imagery types, and number of elements can also be utilized to provide valuable insight into determining the severity of damage at a given site. The results of this study demonstrate that panels that are composed of a smaller number of elements, those that primarily contain zoomorphic imagery, or are located on boulders are likely to suffer from higher levels of deterioration and damage. This information can be applied by land managers and consultants to identify areas that may be vulnerable to potential harm, allowing them to take proactive measures and develop mitigation strategies to prevent the damage from occurring instead of having to address it after the fact.

It is evident that more opportunities for data analysis exist within this dataset, as well as similar datasets that can be produced, than could feasibly be addressed in a single work. Utilizing cross-attribute analysis, establishing distance thresholds, and similar analyses could be immensely beneficial in broadening our understanding of why some sites are more prone to vandalism than others. Such strategies would provide additional insight into the factors that contribute to increased sensibility and vulnerability to acts of vandalism. Enlarging the sample size beyond five years in this study would be beneficial and could facilitate a more comprehensive and in-depth temporal study of observed trends.

Furthermore, further research into the root causes of these destructive behaviors should be investigated, although this type of research would necessitate studies from the field of psychology. Interdisciplinary and multidisciplinary collaborations on the topic of vandalism at archaeological sites could produce more comprehensive results, due to the ability to consider modern human behavior to provide a more detailed and precise examination of the patterns outlined in this study. It is hoped that this research's results will serve as a foundation for a more rigorous and scientific examination of the patterns associated with vandalism and those that can be documented through site forms. This will provide valuable insights to help inform future decisions. This type of comprehensive analytics could be highly advantageous for other types of sites; however, the site forms currently do not possess the necessary data that would enable this to be done. To bridge this gap, specialized research conducted on a sample of sites could provide valuable insights; however, it would not have the same capacity to track and monitor trends over time as possible with sites form Part Ds.

In summary, the data presented in this study provides straightforward evidence that there is a relationship between the characteristics of a particular site and the level of vandalism that can be expected to occur at those sites. The results indicate that by further understanding these attributes, we can better anticipate the severity of vandalism and better implement strategies to address it. This research also suggests that there is an abundance of additional work to be done to gain a deeper understanding of the patterns observed and reach meaningful conclusions. Considering continuous research and our ever-growing body of knowledge, cultural resource managers are likely to benefit from a greater understanding of the patterns found in archaeological sites. Furthermore, the protection and preservation of such sites may be enhanced through the implementation of both proactive and reactive mitigation practices.

The patterns of damage observed in the previous studies discussed in Chapter II: Background (Ahlstrom 1992; Hedquist 2014; Kvamme 1990; Nickens et al 1981; Podolinksy 2022; Simms 1986; Spangler 2006) regarding access and proximity to roads is not a new concept, but this study provides a new understanding of these observations in a way that can aid in evaluating rock imagery sites specifically for damage. While the other attributes such as the rock formation a panel is located on were not investigated in past studies, these studies still set the stage for looking at the modern patterns of visitation and damage. As our technology and resource base continue to expand, the results from previous studies, this study, and the many studies to come all build a picture of the patterns of vandalism at archaeological sites.

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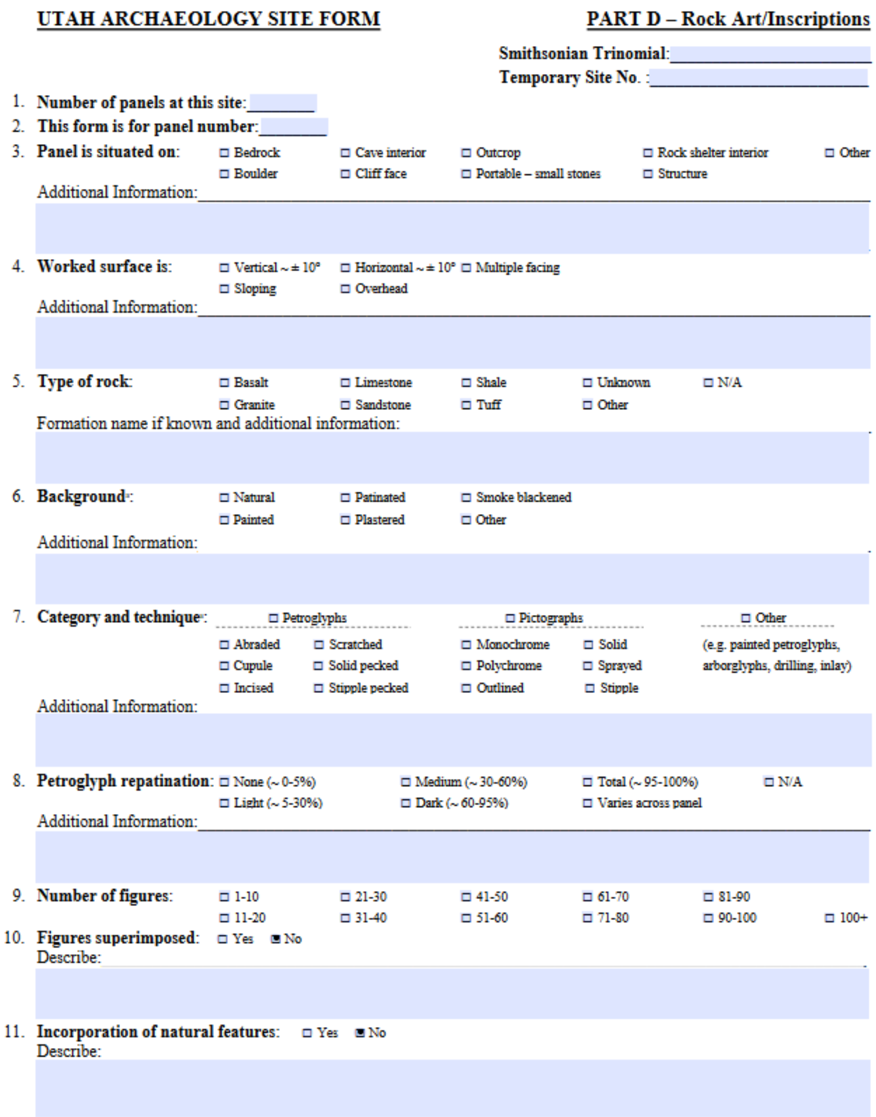
APPENDIX

A. Figures

UASF Part D Form



UTAH ARCHAEOLOGY SITE FORM **PART D – Rock Art/Inscriptions**

Smithsonian Trinomial:_______________
Temporary Site No. :_______________

1. **Number of panels at this site:**______
2. **This form is for panel number:**______
3. **Panel is situated on:** ☐ Bedrock ☐ Cave interior ☐ Outcrop ☐ Rock shelter interior ☐ Other ☐ Boulder ☐ Cliff face ☐ Portable – small stones ☐ Structure
   Additional Information:_______________
4. **Worked surface is:** ☐ Vertical ~ ± 10° ☐ Horizontal ~ ± 10° ☐ Multiple facing ☐ Sloping ☐ Overhead
   Additional Information:_______________
5. **Type of rock:** ☐ Basalt ☐ Limestone ☐ Shale ☐ Unknown ☐ N/A ☐ Granite ☐ Sandstone ☐ Tuff ☐ Other
   Formation name if known and additional information:
6. **Background:** ☐ Natural ☐ Patinated ☐ Smoke blackened ☐ Painted ☐ Plastered ☐ Other
   Additional Information:
7. **Category and technique:** ☐ Petroglyphs ☐ Pictographs ☐ Other
   ☐ Abraded ☐ Scratched ☐ Monochrome ☐ Solid (e.g. painted petroglyphs, arborglyphs, drilling, inlay)
   ☐ Cupule ☐ Solid pecked ☐ Polychrome ☐ Sprayed
   ☐ Incised ☐ Stipple pecked ☐ Outlined ☐ Stipple
   Additional Information:
8. **Petroglyph repatination:** ☐ None (~ 0-5%) ☐ Medium (~ 30-60%) ☐ Total (~ 95-100%) ☐ N/A ☐ Light (~ 5-30%) ☐ Dark (~ 60-95%) ☐ Varies across panel
   Additional Information:_______________
9. **Number of figures:** ☐ 1-10 ☐ 21-30 ☐ 41-50 ☐ 61-70 ☐ 81-90 ☐ 11-20 ☐ 31-40 ☐ 51-60 ☐ 71-80 ☐ 90-100 ☐ 100+
10. **Figures superimposed:** ☐ Yes ■ No
    Describe:
11. **Incorporation of natural features:** ☐ Yes ■ No
    Describe:

Figure 15: This is a blank Utah Archaeology Site Form Part D that is specifically used to document rock imagery. All information was recorded as marked on these forms.

UASF Part D Continued

UTAH ARCHAEOLOGY SITE FORM **PART D – Rock Art/Inscriptions**

Smithsonian Trinomial:____________________

Temporary Site No. :____________________

12. **Surface preparation prior to rock art/inscription creation**: ☐ Yes ■ No
Describe:

13. **Prehistoric figure modification**: ☐ Covered with pigment or paint ☐ Obliteration – part or total ☐ Other ☐ Covered with plaster or mud ☐ Reworking / additions ☐ None
Describe:

14. **Direction panel faces**: _______° ☐ Multi-directional (indicate general direction: _______°)

15. **Panel dimensions**: Width or length:_______m Height:_______m Area:________m^2

16. **Distance to the top of the panel from ground level**:_______m

17. **Distance to the bottom of the panel from ground level**:_______m

18. **Natural destructive agents** (indicate percent of panel affected using multiples of 10%)
____% Bird & insect nests
____% Cracks, fractures, breaks
____% Dust deposits
____% Eroded surface
____% Exposure (wind/rain)
____% Lichen growth
____% Mineral deposits
____% Mud deposits
____% Spalling
____% Vegetation abutment
____% Water runoff (streaks)
____% Other
☐ None
Describe:

19. **Cultural destructive agents** (indicate percent of panel affected using multiples of 10%)
____% Alteration or defacing
____% Bullet marks
____% Chalking
____% Construction activities
____% Graffiti
____% Latex mold residue
____% Livestock
____% Names, initials, dates
____% Obliteration
____% Paint
____% Attempted removal
____% Removed
____% Removal of soil to expose figures
____% Smoke blackening
____% Other
☐ None
Describe:

****Include photographs showing overviews, panel setting, and close ups (include a scale). When details are not able to be captured using photography, when lighting is bad, or as otherwise needed, include a field sketch of the panel (indicating different manufacturing techniques, destructive agents, superimposed figures, colors [using a Munsell or other color chart if possible], etc.)****

20. **Additional Part D Comments**:____________________________________

Figure 15A: This is a blank Utah Archaeology Site Form Part D that is specifically used to document rock imagery. All information was recorded as marked on these forms.

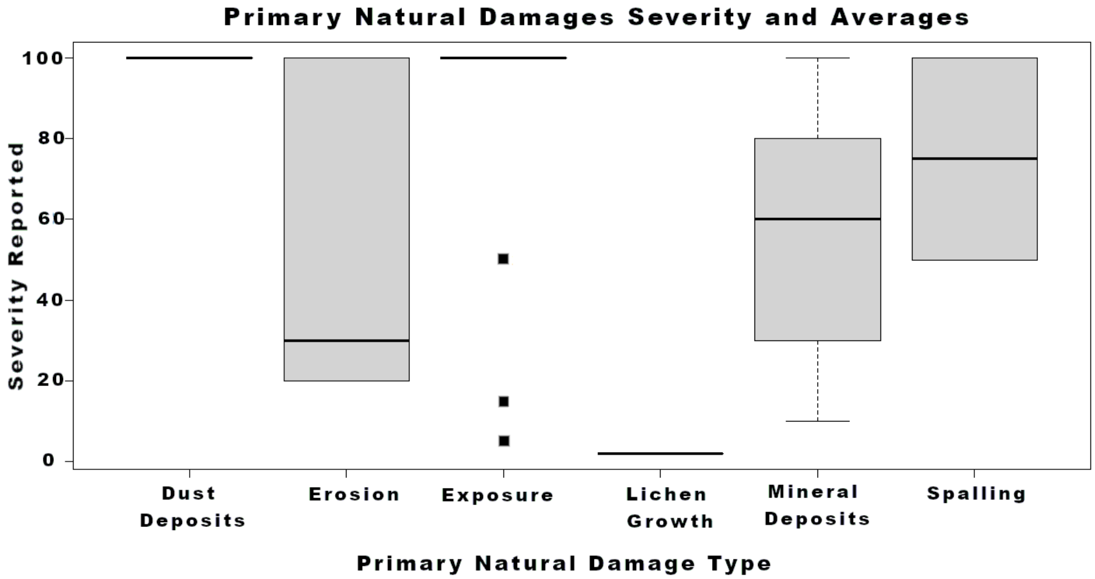


Figure 16: This graph displays the averages and range of severity reported for natural damages. Exposure was reported at 100% in much of the sample. This uses information from the 33 panels that reported damage.

B. *Tables*

Data Collected

Raw Data.xlsx

Table 7: This table is the raw data collected from the Part D forms. Distance from the road and trail was collected from Part A. The file can be downloaded from the icon above or can be sent upon request.

Analyses Performed

Analysis	**P-Value**	**Significant?**
Road Distance * Primary Intentional Damage	p < 2.2e-16	Yes
Number of Elements * Primary Intentional Damage	p = 0.01516302056489	Yes
Other Site Characteristics * Primary Intentional Damage	p = 0.03968123890429	Yes
Panel Affiliation * Primary Intentional Damage	p = 0.039559823748902	Yes
Panel Location * Primary Natural Damage	p = 0.035902384749404	Yes
Primary Image Type * Primary Intentional Damage	p = 0.03 4273495756202	Yes
Site Class * Primary Intentional Damage	p = 0.050101938474838	Yes
Surface Orientation * Primary Intentional Damage	p = 0.051393845658945	No
Other Site Characteristics * Primary, Secondary, and Tertiary Natural Damage	p = 0.0502205788797514	No
Panel Location* Secondary Intentional Damage	p = 0.0600749045357861	No
Secondary Imagery Type * Primary Intentional Damage	p = 0.0791832878523201	No
Surface Orientation * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.0895773492029326	No
Other Site Characteristics * Tertiary Natural Damage	p = 0.090039824012892	No
Number of Panels at a Site * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.111037113362107	No
Image Category * Primary, Secondary, and Tertiary Natural Damage	p = 0.112262031494824	No
Primary Image Type * Primary, Secondary, and Tertiary Natural Damage	p = 0.112838387159159	No
Other Site Characteristics * Secondary Natural Damage	p = 0.112891191617364	No
Number of Panels at a Site * Secondary Intentional Damage	p = 0.125705369457683	No
Panel Location * Tertiary Natural Damage	p = 0.128866072269795	No

Site Class * Primary Unintentional Damage	p = 0.1321254042857	No
Panel Location * Primary Natural Damage	p = 0.136660163183019	No
Signage Present * Secondary Natural Damage	p = 0.144457470645758	No
Other Site Characteristics * Tertiary Intentional Damage	p = 0.152735173431787	No
Number of Elements * Tertiary Natural Damage	p = 0.156429743743963	No
Image Category* Secondary Intentional Damage	p = 0.16554535870035	No
Number of Panels at a Site * Tertiary Natural Damage	p = 0.17046003193449	No
Patination * Primary, Secondary, and Tertiary Natural Damage	p = 0.176320107969525	No
Signage Present * Tertiary Intentional Damage	p = 0.195881309613972	No
Primary Image Type * Primary, Secondary, and Tertiary Intentional Damage	p = 0.19767931107261	No
Number of Panels at a Site * Primary Intentional Damage	p = 0.202477866705692	No
Patination * Secondary Intentional Damage	p = 0.204918136156522	No
Number of Elements * Primary, Secondary, and Tertiary Natural Damage	p = 0.211044855373739	No
Site Class * Tertiary Intentional Damage	p = 0.216475647073788	No
Secondary Imagery Type * Secondary Natural Damage	p = 0.219055139126223	No
Surface Orientation * Tertiary Intentional Damage	p = 0.226183586159533	No
Secondary Imagery Type * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.231968024963237	No
Primary Image Type * Tertiary Unintentional Damage	p = 0.234477340484638	No
Other Site Characteristics * Secondary Intentional Damage	p = 0.237838002747438	No
Site Class * Primary, Secondary, and Tertiary Intentional Damage	p = 0.245124207256563	No
Road Distance * Primary, Secondary, and Tertiary Natural Damage	p = 0.254329392058849	No
Tertiary Imagery Type * Secondary Unintentional Damage	p = 0.257698925117817	No
Panel Affiliation * Primary, Secondary, and Tertiary Intentional Damage	p = 0.275836339517086	No
Panel Location * Primary, Secondary, and Tertiary Natural Damage	p = 0.282618003139476	No
Panel Affiliation * Secondary Intentional Damage	p = 0.286041342365692	No
Surface Orientation * Tertiary Natural Damage	p = 0.301350723976976	No
Panel Location * Primary Unintentional Damage	p = 0.307896447169147	No
Panel Affiliation * Tertiary Unintentional Damage	p = 0.311066126292057	No
Secondary Imagery Type * Tertiary Unintentional Damage	p = 0.313743941208057	No
Secondary Imagery Type * Primary Natural Damage	p = 0.318575273863799	No
Signage Present * Secondary Intentional Damage	p = 0.321375516959228	No

Panel Affiliation * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.329048243503955	No
Image Category * Primary Natural Damage	p = 0.337962815707875	No
Site Class * Primary, Secondary, and Tertiary Natural Damage	p = 0.338709365386299	No
Image Category * Secondary Unintentional Damage	p = 0.343112009914584	No
Signage Present * Primary, Secondary, and Tertiary Intentional Damage	p = 0.363859174546665	No
Patination * Tertiary Natural Damage	p = 0.371561263623355	No
Tertiary Imagery Type * Tertiary Intentional Damage	p = 0.376857062113398	No
Primary Image Type * Tertiary Natural Damage	p = 0.387456696557866	No
Number of Elements * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.390014790221525	No
Surface Orientation * Tertiary Unintentional Damage	p = 0.391017457450485	No
Signage Present * Primary Natural Damage	p = 0.39223163675418	No
Primary Image Type * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.403977479147979	No
Site Class * Secondary Natural Damage	p = 0.404923168148277	No
Number of Panels at a Site * Tertiary Intentional Damage	p = 0.415811849344824	No
Secondary Imagery Type * Tertiary Intentional Damage	p = 0.440809745277441	No
Panel Affiliation * Tertiary Intentional Damage	p = 0.443099671602328	No
Panel Location * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.445208889380286	No
Other Site Characteristics * Primary Unintentional Damage	p = 0.464226967086249	No
Panel Location * Primary, Secondary, and Tertiary Intentional Damage	p = 0.473665622305444	No
Road Distance * Primary, Secondary, and Tertiary Intentional Damage	p = 0.484627005808993	No
Number of Elements * Primary, Secondary, and Tertiary Intentional Damage	p = 0.486506052810738	No
Road Distance * Secondary Natural Damage	p = 0.492589417087082	No
Patination * Primary, Secondary, and Tertiary Intentional Damage	p = 0.500403267311798	No
Image Category * Secondary Natural Damage	p = 0.501154414029422	No
Signage Present * Secondary Unintentional Damage	p = 0.51243098185452	No
Signage Present * Primary, Secondary, and Tertiary Natural Damage	p = 0.519960221132922	No
Secondary Imagery Type * Tertiary Natural Damage	p = 0.521076980540139	No
Tertiary Imagery Type * Primary Natural Damage	p = 0.525870658926299	No
Road Distance * Primary Natural Damage	p = 0.552305582330737	No
Patination * Tertiary Unintentional Damage	p = 0.554749576124297	No

Tertiary Imagery Type * Primary, Secondary, and Tertiary Intentional Damage	p = 0.561389529160718	No
Secondary Imagery Type * Primary Unintentional Damage	p = 0.563628587050405	No
Panel Affiliation * Secondary Natural Damage	p = 0.564712448343375	No
Patination * Primary Intentional Damage	p = 0.572009179950595	No
Tertiary Imagery Type * Secondary Natural Damage	p = 0.578348905544294	No
Patination * Secondary Unintentional Damage	p = 0.578427715746513	No
Tertiary Imagery Type * Primary Unintentional Damage	p = 0.583954216695031	No
Image Category * Primary, Secondary, and Tertiary Intentional Damage	p = 0.585712558484151	No
Signage Present * Tertiary Natural Damage	p = 0.593926202600417	No
Panel Affiliation * Primary Natural Damage	p = 0.601543827666563	No
Tertiary Imagery Type * Tertiary Natural Damage	p = 0.608746092605281	No
Image Category * Tertiary Intentional Damage	p = 0.610054602532897	No
Number of Panels at a Site * Tertiary Unintentional Damage	p = 0.611183642366312	No
Surface Orientation * Secondary Natural Damage	p = 0.613401708047077	No
Other Site Characteristics * Primary, Secondary, and Tertiary Intentional Damage	p = 0.61537612659008	No
Patination * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.618366420101426	No
Surface Orientation * Secondary Intentional Damage	p = 0.623353030291473	No
Panel Location * Tertiary Natural Damage	p = 0.623978117154312	No
Panel Affiliation * Secondary Unintentional Damage	p = 0.627624493260677	No
Signage Present * Tertiary Unintentional Damage	p = 0.631544713419505	No
Secondary Imagery Type * Primary, Secondary, and Tertiary Intentional Damage	p = 0.649927717166577	No
Other Site Characteristics * Secondary Unintentional Damage	p = 0.652291072049554	No
Road Distance * Secondary Unintentional Damage	p = 0.653319984290476	No
Number of Elements * Secondary Unintentional Damage	p = 0.655849795679908	No
Number of Elements * Tertiary Intentional Damage	p = 0.659640964546941	No
Site Class * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.660933647014973	No

Table 8: This table shows all the single analysis runs, their p-values, and if they were considered significant in this research. The ANOVA tests are not shown, but none returned significant results in any category. It is continued in Table 8A.

Analyses Performed Continued

Analysis	P-Value	Significant?
Panel Location * Primary Intentional Damage	p = 0.661412115910707	No
Number of Panels at a Site * Primary Natural Damage	p = 0.670586789891716	No
Surface Orientation * Primary Unintentional Damage	p = 0.673805966486515	No
Road Distance * Tertiary Unintentional Damage	p = 0.681826105339231	No
Panel Location * Primary, Secondary, and Tertiary Intentional Damage	p = 0.682458542444772	No
Surface Orientation * Primary, Secondary, and Tertiary Intentional Damage	p = 0.702653335561898	No
Road Distance * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.706187371932701	No
Number of Panels at a Site * Primary, Secondary, and Tertiary Intentional Damage	p = 0.706782397890061	No
Signage Present * Primary Unintentional Damage	p = 0.707109988431412	No
Tertiary Imagery Type * Secondary Intentional Damage	p = 0.707698386721897	No
Other Site Characteristics * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.710541842891911	No
Secondary Imagery Type * Secondary Intentional Damage	p = 0.712039941988696	No
Primary Intentional Damage *Secondary Intentional Damage * Tertiary Intentional Damage	p = 0.712790248710871	No
Surface Orientation * Primary Natural Damage	p = 0.726642429633797	No
Site Class * Secondary Unintentional Damage	p = 0.735026046478442	No
Signage Present * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.737573429253541	No
Number of Panels at a Site * Secondary Natural Damage	p = 0.740378236404127	No
Tertiary Imagery Type * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.746698161737711	No
Image Category * Tertiary Unintentional Damage	p = 0.747711592038129	No
Panel Location * Secondary Natural Damage	p = 0.764759167646253	No
Number of Elements * Tertiary Unintentional Damage	p = 0.772288033585668	No
Number of Elements * Primary Natural Damage	p = 0.77310374068756	No

Tertiary Imagery Type * Primary, Secondary, and Tertiary Natural Damage	p = 0.778750181805291	No
Primary Image Type * Primary Natural Damage	p = 0.779303856813776	No
Site Class * Tertiary Unintentional Damage	p = 0.794413584523893	No
Tertiary Imagery Type * Primary Intentional Damage	p = 0.794611210914688	No
Primary Image Type * Primary Unintentional Damage	p = 0.801767225066369	No
Site Class * Primary Natural Damage	p = 0.803039914865457	No
Road Distance * Tertiary Intentional Damage	p = 0.803450074754647	No
Other Site Characteristics * Tertiary Unintentional Damage	p = 0.804608519641619	No
Road Distance * Tertiary Natural Damage	p = 0.807287616793489	No
Road Distance * Secondary Intentional Damage	p = 0.816965806034099	No
Surface Orientation * Secondary Unintentional Damage	p = 0.819114854076291	No
Panel Location * Primary, Secondary, and Tertiary Natural Damage	p = 0.820452138051759	No
Panel Location * Secondary Natural Damage	p = 0.822357240202979	No
Primary Image Type * Secondary Natural Damage	p = 0.82250975629417	No
Road Distance * Primary Unintentional Damage	p = 0.824902016211948	No
Number of Panels at a Site * Primary Unintentional Damage	p = 0.826774766213646	No
Primary Image Type * Secondary Intentional Damage	p = 0.829566707950845	No
Secondary Imagery Type * Primary, Secondary, and Tertiary Natural Damage	p = 0.831714658449628	No
Site Class * Tertiary Natural Damage	p = 0.834095360588345	No
Panel Affiliation * Tertiary Natural Damage	p = 0.836469706159954	No
Image Category * Primary Intentional Damage	p = 0.842480721948372	No
Number of Elements * Primary Unintentional Damage	p = 0.845134357390189	No
Number of Elements * Secondary Natural Damage	p = 0.859756461377404	No
Number of Panels at a Site * Secondary Unintentional Damage	p = 0.863882966354975	No
Image Category * Primary Unintentional Damage	p = 0.865095104515586	No
Image Category * Tertiary Natural Damage	p = 0.867527190001865	No
Patination * Tertiary Intentional Damage	p = 0.880304559250469	No
Panel Location * Tertiary Intentional Damage	p = 0.884727271729003	No

Other Site Characteristics * Primary Natural Damage	p = 0.88690502535123	No
Tertiary Imagery Type * Tertiary Unintentional Damage	p = 0.888454346521947	No
Panel Location * Secondary Unintentional Damage	p = 0.891307086777738	No
Site Class * Secondary Intentional Damage	p = 0.896806585975003	No
Number of Panels at a Site * Primary, Secondary, and Tertiary Natural Damage	p = 0.901305588490593	No
Secondary Imagery Type * Secondary Unintentional Damage	p = 0.91444631047415	No
Surface Orientation * Primary, Secondary, and Tertiary Natural Damage	p = 0.920392203100087	No
Patination * Primary Unintentional Damage	p = 0.933475799741642	No
Panel Location * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.936550998147586	No
Patination * Primary Natural Damage	p = 0.947092353839523	No
Primary Image Type * Secondary Unintentional Damage	p = 0.957731527401864	No
Panel Affiliation * Primary Unintentional Damage	p = 0.96090276034546	No
Panel Location * Tertiary Unintentional Damage	p = 0.961340447972481	No
Primary Intentional Damage *Tertiary Intentional Damage	p = 0.963275149537474	No
Primary Image Type * Tertiary Intentional Damage	p = 0.97146277662881	No
Number of Elements * Secondary Intentional Damage	p = 0.973136914266495	No
Signage Present * Primary Intentional Damage	p = 0.973168053702228	No
Panel Affiliation * Primary, Secondary, and Tertiary Natural Damage	p = 0.981861441235049	No
Image Category * Primary, Secondary, and Tertiary Unintentional Damage	p = 0.984814117838615	No
Primary Intentional Damage * Secondary Intentional Damage	p = 0.990587574284051	No
Patination * Secondary Natural Damage	p = 0.992524369208084	No
Number of Elements * Primary Intentional Damage	p = 0.015	Yes
Primary Image Type * Primary Intentional Damage	p = 0.03	Yes
Panel Location * Primary Natural Damage	p = 0.035	Yes
Panel Affiliation * Primary Intentional Damage	p = 0.03955	Yes

Other Site Characteristics * Primary Intentional Damage	p = 0.03968	Yes
Surface Orientation * Primary Intentional Damage	p = 0.041	Yes
Site Class * Primary Intentional Damage	p = 0.0501	Yes

Table 8A: This table is a continuation of Table 8 and shows all the single analyses, performed their p-values, and if they were considered significant in this research. The ANOVA tests are not shown, but none returned significant results in any category.

Total Reported Natural Damage

Natural Damage	Count
Exposure	34
Spalling	18
Erosion	12
Mineral Deposits	9
None	3
Bird & Insect Nest	2
Cracks, Fractures	2
Vegetation Abutment	2
Other (Structural Collapse)	2
Dust Deposits	1
Lichen Growth	1

Table 9: This table displays the number of times natural damage was reported within the sample. Exposure was reported the most, with lichen growth and dust deposits reported the least.