

# **RASI Survey of Sites in Petrified Forest National Park 2010**

Kaelin Groom and Rachel Poole

## **Abstract**

Many panels of rock art in the Petrified Forest National Park have fallen victim to extreme weathering and vandalism. By using the Rock Art Stability Index, RASI, the physical condition of these panels can be documented and prioritized for the benefit of Cultural Heritage Management. In summer 2010, six sites were analyzed and recorded: AZQ01-068, AZQ01-434, AZQ01-078, AZQ01-022, AZQ01-202, And AZQ01-207. All six showed a massive degree of natural and anthropogenic weathering. Site AZQ01-022 had especially high amounts vandalism and human impact. Sites AZQ01-078 and AZQ01-434 displayed intense natural degradation and greatly weakened stability.

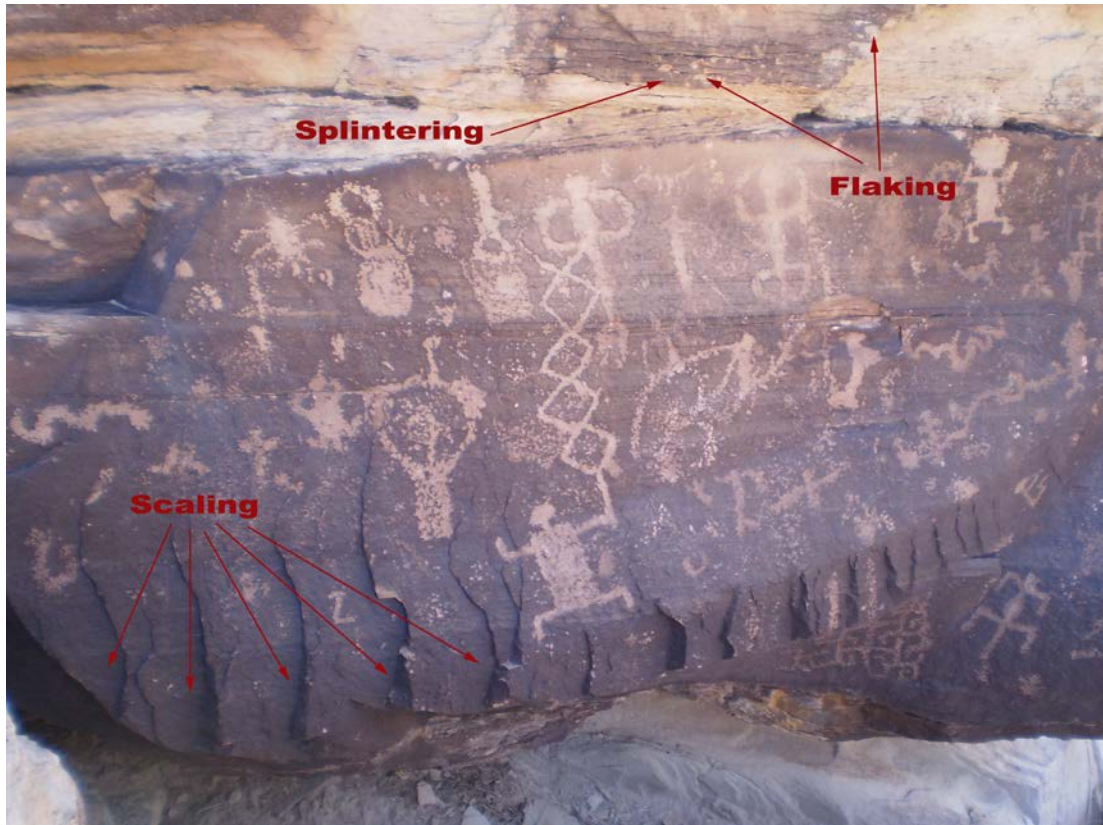
## **Introduction**

While most of the rock art sites in the Petrified Forest National Park have been recorded, the physical conditions of these sites are largely unknown. Exposure to the arduous desert environment and anthropogenic activity leave many of the panels endangered. For Cultural Heritage Management to effectively monitor, protect, and analyze the rock art it is necessary to assess and document the stability of the rocks themselves. This is done using the Rock Art Stability Index (RASI). By analyzing 37 different forms of rock weathering RASI offers detailed and accurate reports of the current state and solidity of the rock art boulders. These allow park management to deploy resources effectively and make informed decisions regarding the preservation of these incredible cultural monuments.

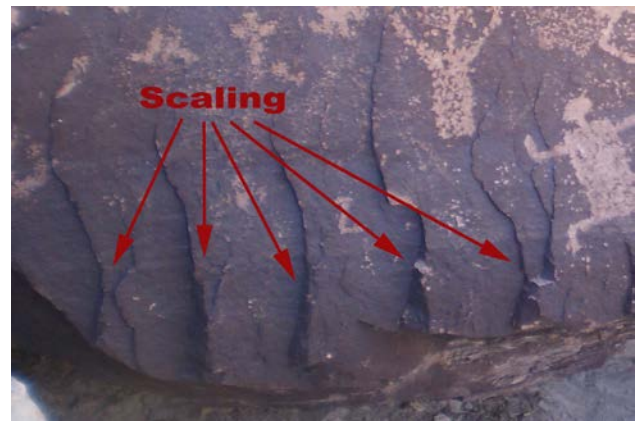
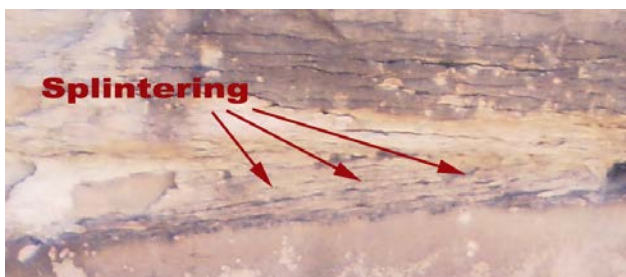
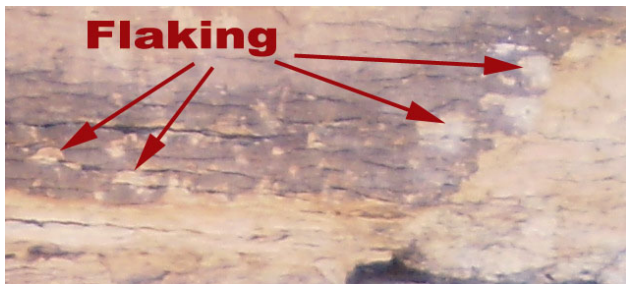
RASI is separated into four categories: the setting of the rock, preparing for detachment, incremental loss, and loss of stone break-off. The setting of the rock looks at the boulder as a whole including factors such as the panel's aspect, stone hardness, present fissures, and lithification (How the rock was formed). Preparing for detachment grades the possibility of weathering in the near future. This could be evident in nearby roots fracturing the rock, undercutting of the boulder's foundation, or the formation of weathering rinds (unstable rock coatings). Incremental loss refers to the detachment of small pieces of rock or superficial issues. Weathering forms such as flaking, gradual disintegration, and loss of rock coating would be considered here. The final section, loss of stone break-off, evaluates larger weathering events, like fire damage, rock fall due to undercutting, and anthropogenic removal.

Researchers rate each form of weathering on a scale of 0 to 3 in all four categories for each individual panel. The sum is then doubled for the final RASI score that indicates the panel's level of risk. There are six degrees of risk that coincide with specific scores:  $\leq 20$ =Excellent Shape, 20-19=Good Status, 30-39=Problems That Could Cause Erosion, 40-49=Urgent Possibility of Erosion, 50-59=Great Danger of Erosion, 60+=Severe Danger of Erosion. These are color coded in the attached databases as blue, green, brown, yellow, orange, and red respectively.

In the case of the sites analyzed by the research team in June 2010 the most dominant forms of weathering were flaking, scaling, and splintering. All three are common in desert environments and can be seen in panel 3-5 from site AZQ 01022 (East Puerco Pueblo):



Flaking and splintering are incremental weathering. Flaking could be described as the loss of fingernail-sized pieces of the rock face. Splintering is similar but the weathering is more linear and the stone literally appears to be splintered like wood. Scaling is the detachment of larger fist-sized chunks of rock and causes greater damage to the art panel.



## **AZQ 01-068**

### **Rainbow Forest (two days)**

-Highest scores:

82, Severe Risk of Erosion, Panel 27

78, Severe Risk of Erosion, Panel 102

76, Severe Risk of Erosion, Panel 128

### **Major Weathering Effects: Multiple scores of three or higher**

-Scaling and Flaking (preparing)

-Splintering

### **Minor Weathering Effects: Scores of twos**

-Fissures dependent of lithification

-Fissursols

-Flaking

-Scaling

Rainbow Forest, site AZQ 01-068, was first documented by the American Rock Art Research Association (ARARA) in 1988, at which time 132 panels were recorded. The ARARA pictures and map proved to be extremely inconsistent and unreliable.

The site is located on the side of a mesa, which contains an unexcavated archeological dig on top. During the 1930s the Civilian Conservation Corps (CCC) built a stairway allowing excessive foot traffic through the site. This greatly increased degradation and damage to the area. The CCC also created their own “art work” on the rocks, such as initials and obscene drawings. They were recorded as historic art, rock art from the 1900’s or later, but are often observed as graffiti. Because this site is open to the public it is still a target for new vandalism.

There are many motifs displayed in the petroglyphs of this site. Some of the artwork includes images of men fighting against one another. The theory is that this site separates Hopi and Navajo land and the images depict the violence that occurred between the two tribes. The site also displayed many pictures of snakes, birds, and people hunting and killing animals. The site also contained many images of squares and mazes, as well as some Kocopellis, a fertility deity of the Native Americans from this area.

The main environmental factors impacting this area are rockslides and the intense desert environment. A large rockslide before the 1930s, and other smaller events, have changed the positions and aspects of many boulders at this site. Some panels are now more vulnerable to weathering, while others are protected or even blocked from weathering due to their new locations. The fringes of the site are more exposed, and therefore more weathered, while the concave center has been protected from the elements. Despite this difference the site as a whole is in decent shape. The site is primarily made up of sandstone, which is a fairly tough and sturdy rock. Vegetation is sparse to none and the wildlife in the area is limited to bats and lizards.

The RASI reports revealed major concerns for scaling, flaking, as well as splintering. The minor issues are fissures dependent on bedding, fissursols (soil wedged fissures in the rock), flaking, and scaling. Since many of these weathering forms are influenced by dust coatings and foot traffic it can be suggested that the site’s proximity to the road, and CCC staircase, have negatively influenced the integrity of its rock art.

## **AZQ 01-434**

### **Crystal Forest (Twin Buttes)**

-Highest scores:

92, Severe Risk of Erosion, Panel 61

80, Severe Risk of Erosion, Panel 47

72, Severe Risk of Erosion, Panel 87

### **Major Weathering Effects: Multiple scores of three or higher**

-Plant Growth near panel

-Scaling and Flaking (preparing)

-Rounding of petroglyph edges

-Abrasion

### **Minor Weathering Effects: Scores of twos**

-Flaking

-Scaling

The original study of Crystal Forest, site AZQ 01-434, was done by the Western Archeological Conservation Center (WACC) in 1998. The WACC recorded 71 panels on the site, but did not produce a map of any kind.

When the park first opened wagons carried visitors to tour the park and Crystal Forest was the first stop. Although it has been closed to the public since then there is still ample indication of heavy foot traffic in the area. An archeological dig is located not too far north of this site.

The motifs at Crystal Forest include mostly desert animals and geometrics. Snakes and lizards are seen on many panels throughout this site. Images of fish have also been found here, which is exceptionally interesting as this area has an intense desert climate. Human footprints, as well as multiple circles, are present.

Environmental impacts are unique at this site. A nearby archeological site containing evidence of a farming community might suggest this area was once under water. Proof of a ruptured earthen dam between the two buttes and soils containing heavier amounts of iron and salts denote water as well. This previous exposure to water greatly reduces the chemical and structural integrity of the rocks, as well as increases the threat of damage caused by wildlife, including lizards and packrats. Larger animal prints and dung have also been found in the surrounding area. Lithobionts, rock digesting mosses and lichen, are very prevalent, even covering entire panels. The desert vegetation is heavy in this area as well causing abrasion and scouring panels. Another big concern is considerable damage from abrasion by water and sediment, much more so than any other site surveyed in this study. This could be due its aquatic history or, more likely, its position in a flood susceptible area, especially for panels near or on the ground.

These environmental factors are reflected in the site's RASI reports. Plant growth near panels, abrasion, preparation for scaling, and rounding of petroglyphs edges all scored high and are reason for concern. Minor issues include flaking and scaling. The weathering in this location is intense but mostly due to its location and the presence of water. The human impact here is noticeable but not critical. That said this site is still in immense danger of erosion. Many panels have already succumbed to lichen or plant related degradation and the lower sitting panels are at great risk of abrasion or being buried.

## AZQ01-078

### West Puerco Pueblo

-Highest scores:

96, Severe Risk of Erosion, Panel# Unknown

96, Severe Risk of Erosion, Panel# Unknown

94, Severe Risk of Erosion, Panel# Unknown

### Major Weathering Effects: Multiple scores of three or higher

-Fissures dependent of lithification

-Fissuresol (preparing)

### Minor Weathering Effects: Scores of twos

-Fissuresol

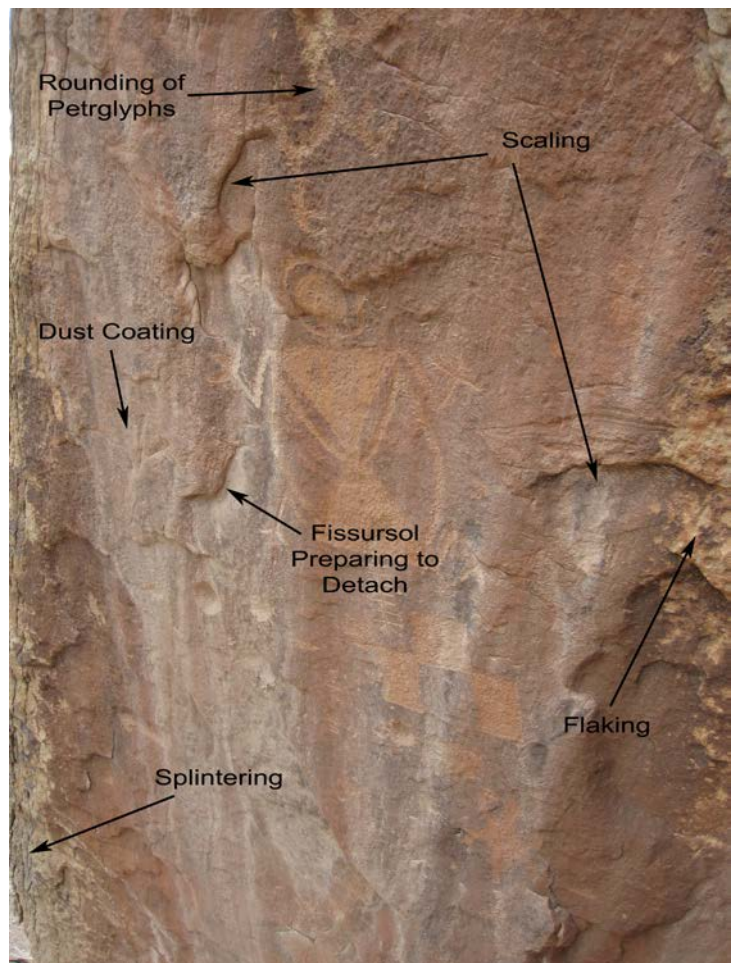
-Flaking

-Splintering

There has been no previous study done on West Puerco Pueblo, AZQ 01-078, due to its proximity to a sacred Hopi site. Despite being closed to the public and research there is still tremendous weathering in the area. A main road runs only 15 feet from the site causing damaging dust coatings and there is evidence of vandalism and historic art.

Like other sites, Puerco West contains petroglyphs of animals and geometric symbols, the most prominent animals being snakes. The themes here are also more religious in nature as they lead the way to the Hopi Cave of Life. The most interesting panel on this site is a solstice marker found near the top of the site.

The geology here is predominantly sandstone and bentonite, which has been extremely weathered and increasingly unstable. The panels in this site are spread out and found high up on the cliff face. There were several panels the required remote analysis because it was too dangerous or the slope was too fragile to get close. There is abundant wildlife around the area including rabbits, packrats, and bats, which further weaken the area.



*Panel # Unknown Puerco West, AZQ01-078, with examples of severe weathering. Final RASI score: 96.*

RASI scores suggest substantial damage from fissures dependent of lithification and fissuresols preparing to detach. Other issues include fissuresols already detached, flaking, and splintering. This site has over 20 panels in severe risk of erosion, almost half. The other panels are either in urgent or

great risk. The dangerously weathered cliff face, unstable geology, and immense anthropogenic impact leave this site in critical condition. All precaution should be taken when visiting this site.

### **AZQ 01022**

#### **East Puerco Pueblo**

-Highest Scores:

100, Severe Risk of Erosion, Panel 3-5

92, Severe Risk of Erosion, Panel 1-5

88, Severe Risk of Erosion, Panel 2-7

#### **Major Weathering Effects: Multiple scores of three or higher**

-Scaling and Flaking (preparing)

#### **Minor Weathering Effects: Scores of twos**

-Scaling (small scale)

-Fissures dependent of lithification

-Fissursols

-Flaking

ARARA first recorded East Puerco Pueblo (site AZQ 01022) in 1988. Their map was relatively accurate aside from a few discrepancies. East Puerco Pueblo is the largest and most visited site in the park. Because of the high volume of traffic this area is highly vulnerable to vandalism, scratching, theft of artifacts and lithics, and littering on the site. There is also a dangerous accumulation of dust coating kicked up by visitors.

The motifs of this site are much more diverse than others surveyed in this study. Probably due to its proximity to the sacred Hopi area of West Puerco Pueblo, the panels here are much more spiritual and include the images of prayer sticks and dances. Pictures of herds of deer and sheep are also found throughout this site, as well as images of the Nata'aska. This site is almost completely void of lithics, which is thought to be due to raids before the park was established.

The most dominant, and damaging, forms of weathering in this site are scaling and flaking. Minor, but still problematic, effects include fissures dependent of lithification, fissursols, and flaking of the rock panels. The highest scoring panel on this study was found here. Panel 3-5 recorded by Marcia Aden had a final RASI score of 100. This is the highest RASI score possible and is an ultimate demonstration of panel instability and degradation. This panel displayed advanced scaling, flaking, splintering, undercutting, abrasion, alveolization, rounding of petroglyph edges, and many other natural and anthropogenic concerns (such as graffiti found throughout the site). While this is an extreme case many other panels in this site showed disturbingly similar deterioration.

Closing the site to public access would be the most affective means of protecting the petroglyphs but it is clear that would difficult, if not detrimental, to the success of the park. That said it is highly advisable to increase surveillance and limit the amount of foot traffic allowed in this area to decrease the risk of vandalism and ware on the panels.

### AZQ 01202

#### Mountain Lion Mesa (North)

-Highest Scores:

68, Severe Risk of Erosion, Panel 3-1a

62, Severe Risk of Erosion, Panel 3-1b

58, Urgent Risk of Erosion, Panel#

Unknown

#### Major Weathering Effects: Multiple scores of three or higher

-Scaling and Flaking (preparing)

-Scaling

#### Minor Weathering Effects: Scores of twos

-Crumply disintegration

-Flaking

-Lithobiont pitting

### AZQ 01207

#### Mountain Lion Mesa (West)

-Highest Scores:

72, Severe Risk of Erosion, panel 64

70, Severe Risk of Erosion, panel 6

70, Severe Risk of Erosion, panel 3-2

#### Major Weathering Effects: Multiple scores of three or higher

-Scaling and Flaking (preparing)

-Glandular disintegration

#### Minor Weathering Effects: Scores of twos

-Fissures independent

-Fissures dependent

-Undercutting

-Alveolization

-Rounding of petroglyph edge

Mountain Lion Mesa (sites AZQ 01202 & AZQ 01207) was recorded by WACC in 1988. Their map was relatively inconsistent and unreliable.

Because this site is distanced from the trail and closed public access, there is very little anthropogenic impact on the panels. This site has an archeological site on the top of the mesa as well around the base. The entire area is surrounded with potsherds and lithics.

Appropriately named, this site includes several petroglyphs of mountain lions, along with snakes and paw prints. This was also the location of a good number of geometrics. Some were very intricate and detailed.

This area houses the most wildlife out of all sites surveyed on this study, even surpassing Crystal Forest. This could be due to its private location and the protected cliff faces offer shelter from the elements. The wildlife found here are mountain lions, bats, packrats, and lizards. Animal activity can weaken the surrounding area. Splintering and scaling are among the major problems at the site. Also, heavy headwall erosion has caused loss of rock face and the displacement of many rock art boulders.

Consistent with the majority of the park, RASI showed the major concerns include scaling, flaking and granular disintegration. Minor issues are crumbly disintegration, flaking, lithobiont pitting, fissures independent and dependant on lithification, undercutting of the rock, alveolization and rounding of the petroglyph edges. The anthropogenic impacts are definitely not as evident in this location but animal activity and natural events, especially on the west face, are weakening the site stability. So although this site did not have the highest scores in the park it contains a wider variety of weathering patterns and should be watched closely.

## **Conclusion**

The Rock Art Stability Index offers the ability to make educated decisions regarding the conservation and study of petroglyphs. In the summer of 2010, all sites analyzed had evidence of advanced weathering. This can be expected in any harsh environment. The locations with heavy human traffic, such as East Puerco Pueblo, show great wear and anthropogenic impact and should be observed closely. Sites currently closed to public, but that are in naturally weakened states like West Puerco Pueblo and Crystal Forest should remain closed to public. To do otherwise would be detrimental and cause massive amounts of erosion and deterioration. By documenting the current physical conditions of the boulders, as well as future predictions, management can now prioritize preservation efforts and well and monitor locations the most at risk.