LOW ALTITUDE UNMANNED AERIAL PHOTOGRAPHY TO ASSIST IN ROCK ART STUDIES

Robert Mark and Evelyn Billo

Robert Mark, Ph.D. (rmark@infomagic.net) Rupestrian CyberServices. Evelyn Billo, Rupestrian CyberServices.

Examples of low altitude unmanned aerial photography of rock alignments, geoglyphs, and petroglyphs illustrate advantages to researchers who require a plan view to accurately map sites that are accessible via drone flights. Land managers who need surveys or periodic documentation of sites that may be threatened by natural or human disturbance also benefit from this relatively low cost supplement to traditional forms of documentation. The use of Unmanned Aerial Systems (UAS; aka, drones) for archaeological applications is growing throughout the world. But in the United States, their commercial use has been delayed. The Federal Aviation Administration (FAA) has taken the position that a UAS can only be used for recreation until regulations are promulgated.

We first became interested in UAS technology after completing our three-year project that documented the rock art of Sears Point, Arizona. The study area included seven geoglyphs, defined as large earth figures with either geometric or representational designs, and large numbers of rock alignments, rock rings, and rock piles. During the study, a hot-air balloon traverse, a light aircraft, and even a helium-filled balloon were used to photograph some of these features (Weaver et al. 2012:35–38). None of these techniques were fully satisfactory, although all gave limited results, and the altitude at which the Cessna aircraft flew was particularly good for large overviews of the 3 km^2 study area. After the completion of the project, the DJI Phantom quadcopter became available at a relatively low price. Although it could not be used for our contract work due to the FAA interpretation of their regulations, we purchased the original Phantom, a GoPro camera, and began a new hobby. Since 2013, we have used the Phantom and the Phantom 2 Vision+ to photograph rock art panels, geoglyphs/intaglios, and rock alignments. These photographs assist in seeing associated features, such as rock piles, trails, and disturbed areas. Our first recreational activity was to photograph a very complex rock alignment near the Sears Point study area. Created from hundreds of relatively small stones that could be easily disturbed and presented an enigmatic pattern from ground level, the entire alignment would be difficult to map accurately without the aerial view (Figure 1). We are unaware of any publications that mention or discuss the origin, meaning, or use of this rock alignment. This successful flight was followed by a return to the Sears Point area to photograph some of the archaeological features best seen from the air, including the mesa top with the Agua Caliente racetrack (Johnson 1983:79). At other locations we were able to see rock alignments in the UAS photographs that we had not documented during the ground survey. The use of UAS in archaeological survey and mapping projects could substantially improve site documentation.

There are probably several hundred intaglios in the southern Arizona and California deserts, most along the lower Colorado River corridor (Ezzo and Altschul 1993:5; von Werlhof 1987:1) and generally associated with the Colorado River tribes. Many intaglios are poorly documented, and are being degraded by natural weathering processes and by human impacts including off-highway vehicle use. Wilshire et al. (2008:295), and Kockelman (1983:422–23) mention a growing concern with ORV damage to intaglios and other desert archaeological sites. Several sites have been fenced, but not always before damage occurred. Early pre-damage aerial photographs of some of the better-known intaglios exist, but they are rare. A more complete photographic record of these fragile desert features is needed. Figure 2 shows a comparison of photographs of the Parker Rattlesnake taken from an airplane in 1983 (Bridges 1986:66) and 22 years later by the quadcopter camera. Degradation in the head, tail, and body outline is obvious. In addition to weathering, visitors appear to have removed the rocks that formed the rattles. We have continued with our activities by locating and photographing 13 intaglios with the quadcopter over the last two years (http://www.rupestrian.com/intaglios.html). Figure 3 provides an example of one of the more complex designs asso-

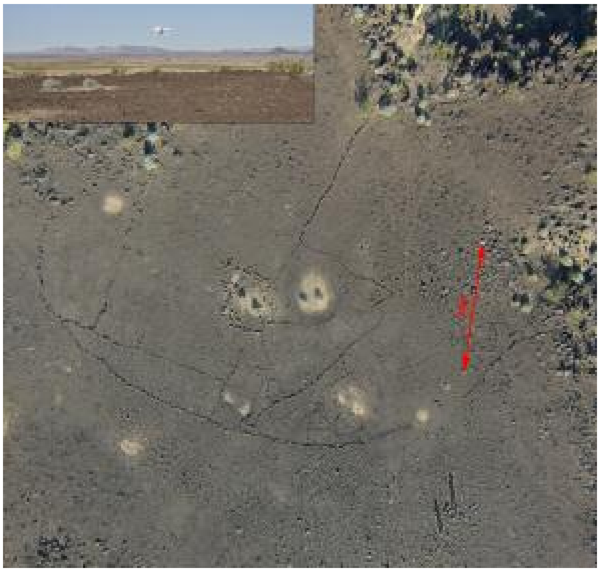

Figure 1. Complex, fragile rock alignment near Sears Point, Arizona, seen from above, and from the ground in the inset. UAS is a practical, noninvasive method to accurately document this feature.

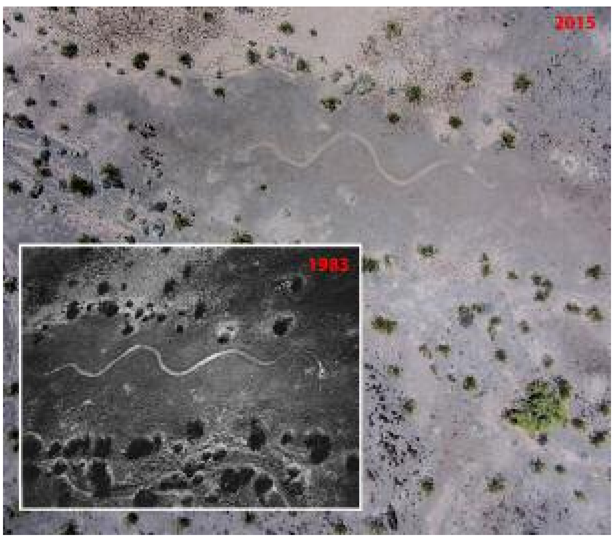

Figure 2. Parker Rattlesnake Geoglyph photographs taken 22 years apart show the effects of time. Inset, with permission, © Marilyn Bridges 1983 http://marilynbridges.com/pages/portfolio_ancient/native_america_ParkerRattlesnake_Parker_Arizona_information.html. Quadcopter image taken by Evelyn Billo using DJI Vision on the iPad to communicate with the camera on a Phantom 2 Vision+.

Figure 3. One of the clusters of geoglyphs within the Ripley Intaglio complex, near the lower Colorado River, south of Blyth, California, but on the Arizona side of the river. See more examples at http://www.rupestrian.com/intaglios.html

Figure 4. Photograph of Sky Rock, a large horizontal petroglyph panel near Bishop, California; note 20 cm scale in upper right.

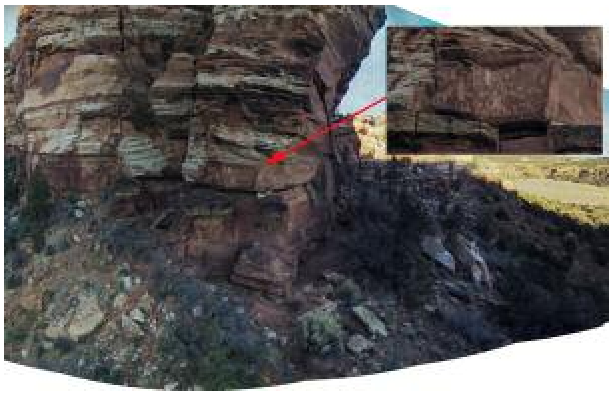

Figure 5. An inaccessible northern Arizona cliff-side petroglyph panel. Location panorama is stitched from several images taken with a GoPro camera mounted on a Phantom quadcopter.

ciated with the Yuman Creation story. This imagery from above allows updates to previously published drawings and photographs, such as the Ripley Geoglyph Complex Feature B in Johnson (2006:56), the plan view of geoglyph group 2 in Holmlund (1993:33–34), and the annotated aerial photograph in von Werlhof (2004:11). We note that each of these examples vary in detail. All photographs show the enclosed cross pattern clearly without the double lines shown by Johnson in his drawings, but confirm some other trails he shows that are not on other renditions.

Our low-altitude unmanned aerial photography system has also been useful in photographing horizontal rock art panels that cover the tops of very large boulders. Documenting panels like this with traditional methods would have required walking on the actual petroglyphs to photograph very oblique portions to stitch together. Not only could this damage the resource, it does not give the accurate perspective one gets from directly above that is shown in Figure 4. This system provides another advantage when photographing rock art that is on high cliff panels that are not otherwise accessible (Figure 5). The quadcopter camera captures the entire panel whereas images shot from ground level cannot document the lower glyphs as they are blocked from view. In addition to overhead photographs, we have used the quadcopter to take overlapping images of an outcrop on top of one of the Sears Point mesas that has petroglyphs and cupules. Photos were assembled with PhotoScan software into a 3D model. Free iOS software, Pix4D Capture, automates a flight path for photogrammetry photography. To take full advantage of these images in order to create digital elevation models or orthophotos requires the purchase (or renting) of expensive photogrammetry software, such as PhotoScan Pro or Pix4Dmapper.

Our use of inexpensive drones has demonstrated its great potential for rock art documentation; however, we are still waiting for FAA rules that permit uses beyond recreation. These regulations are in review, but the final adoption date is unknown and unpredictable. In the interim, we have applied for a Section 333 Exemption, which would allow us to start offering this technology to government agencies and other land managers who have a need to document archaeological sites from the air.

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