

Final Report

July 8, 2011

2010 Discovery Pool Grant

Multi-Spectral Imaging Project, Canyonlands National Park

National Park Service, Southeast Utah Group

by:

Bud F. Turner, Principal Investigator

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Research Need and Questions Addressed:

The Primary Research Need for the Multi-Spectral Imaging (MSI) Project in calendar year 2010 was to create a baseline photographic record in the visible and infrared spectrums for each Barrier Canyon Style pictograph panel in the Salt Creek Archeological District. These images can then be used for research, management, and interpretive programs including an ongoing effort to monitor any changes to the panels through time.

While not part of the Discovery Pool Grant request, Phase Two of the MSI Project focused on the analysis of the pigments used to create the pictograph panels in Canyonlands. In order to better understand how these panels were made, it was necessary to determine what minerals the original artists used, how they were mixed to create the various pigment colors, and what binders were used to make the ground and mixed minerals into a form that could be applied to the rock surface. In addition, if organic materials were utilized as binders, there may be trace amounts left in the pigments that can be dated using Radio Carbon Accelerator Mass Spectrometry.

Methodology and Personnel:

The original 2010 Discovery Pool Grant request was for funds to hire a helicopter to fly the Principal Investigator, Bud F. Turner, and a National Park Service archaeologist into Upper Salt Creek to document the remaining panels in that area.

However, with only a few sites remaining to be photographed, and the high cost of the helicopter rental, it was decided to use the Discovery Pool Grant funds to complete the editing of digital images already taken during the MSI project. With concurrence from CNHA, the funds were used to pay for six months of image editing fees. This process was completed at the end of November 2010 and the image editing is complete.

What remains to be done is to complete the documentation for Phase One of the Multi-Spectral Imaging Project, organize and catalog the edited images on park service servers, and make Resource Monitoring Image prints of all panels to be filed in their respective site information folders at park headquarters.

To perform non-destructive remote sensing and analysis of the pigments in the pictograph panels, a FieldSpec3 portable spectroradiometer was used to sample pigments in a number of selected pictograph panels in several locations in the Maze and Needles districts of Canyonlands National Park. The spectrometer samples from those field locations have been made and are currently being analyzed at the U.S.G.S. Spectroscopy Laboratory in Denver, Colorado. When that analysis is complete, the MSI project team will publish their findings in one or more peer review scholarly journals.

Number and Names of Staff Utilized Throughout the Project:

A total of five personnel were utilized during the MSI Project this past year. They were:

- Bud F. Turner, Principal Investigator
- Chris Goetze, National Park Service, Southeast Utah Group, Cultural Resource Program Manager
- Pat Flanigan, Canyonlands National Park Exhibit Specialist
- Gary Cox, Canyonlands National Park Archeological Technician
- Dr. Roger Clark, Research Scientist, U.S. Geological Survey

Projected Results:

The primary objective for Phase One of the Multi-Spectral Imaging Project in Canyonlands National Park is to provide a baseline photographic survey of all pictograph panels in Canyonlands National Park in visible and infrared wavelengths, as well as in 35mm black and white film for archival purposes. These baseline survey images, plus the Resource Monitoring Images, will help determine the amount and rate of change to the panels and aid in prioritizing any future preservation and restoration efforts.

Phase Two of the MSI Project provides analysis of the pigments used to create the pictograph panels in Canyonlands. In order to better understand how these panels were made, it is necessary to determine what minerals the original artists used, how they were mixed to create the various pigment colors, and what binders were used to make the ground and mixed minerals into a form that could be applied to the rock surface. In addition, if organic materials were utilized as binders, there may be trace amounts left in the pigments that can be dated using Radio Carbon Accelerator Mass Spectrometry.

Actual Results:

Phase One of the Multi-Spectral Imaging project is complete. A baseline photographic record of the pictograph panels in Canyonlands in visible and infrared wavelengths is available. This record is an invaluable tool to better understand how these panels were created, how they are changing over time, and how best to manage their conservation/preservation.

Many of the pictograph panels are located in remote and difficult to access regions of the parks, requiring extended treks carrying heavy equipment to photograph them. The project team could not have completed this task without the support of the National Park Service, Southeast Utah Group, who provided housing, guides and personnel to carry photographic equipment and supplies to these remote locations.

Between March 20, 2007 and October 14, 2010, 121 individual photography sessions were conducted on 90 archaeological sites in Arches and Canyonlands National Parks. 85 of these sites contained pictograph panels, some of which had multiple panels with a minimum of 151 separate panels containing thousands of individual Elements (figures or graphics) and Element Groups (groups of figures).

These panels and their Elements were photographed at Visible and Near Infrared (NIR) wavelengths, between 400 and 1,100 nanometers, using high-resolution (21 megapixel) digital cameras. The individual images were then edited, aligned and stacked in layers in Adobe Photoshop so differences in the images at selected wavelengths could be detected.

Advanced capabilities in Adobe Photoshop, which allow the image layers to be mathematically combined, added, or subtracted from each other, have provided the project team additional details and increased information about how these panels were created and modified over time. Making these layered images available to qualified researchers, using even more advanced imaging tools and techniques, will add to the data already gathered. (See Figure 1A-D)

Resource Monitoring Images (RMI) are now being taken by National Park Service staff of selected panels on regular Resource Monitoring patrols. These images will then be stacked on top of the original, visible baseline images so the amount and rate of change to them can be determined. From this information, appropriate conservation and/or preservation techniques may be developed for those panels with significant deterioration.

Phase Two of the MSI Project, Dr. Roger Clark's spectroscopic analysis of the pictograph pigments sampled in the 2009-2010 field season, was delayed by the disastrous BP oil spill in the Gulf of Mexico. All of Dr. Clark's team was tied up for months analyzing the extent of the spill. When completed, this analysis will provide additional insight on how these pigments were made and the results will be published in a final, peer-reviewed report. (See Figure 2)

Future Research Needs:

Without organic components in the pigments, direct dating of the rock art cannot be done. Fortunately, the 1930 Claflin-Emerson Expedition to Southeastern Utah collected an ocher crayon on what is today part of Glen Canyon National Recreation Area. That ocher crayon, listed as a "paint stick," is in the Peabody Museum of Archaeology and Ethnology at Harvard University.

There is also a Barrier Canyon Style (BCS) pictograph panel adjacent to the cave where the crayon was found. Recently, Dr. Clark used the ASD FieldSpec3 NIR spectrometer to passively sample the pigments from this pictograph panel. He is in the process of analyzing the sample data at the U.S.G.S. Spectroscopy Laboratory in Denver, Colorado.

As the ocher crayon, or paint stick, was found in a small cave out of direct sunlight, and not exposed to ultra violet radiation, it may still contain traces of the original organic binder material used to make it. Dr. Clark would like to perform non-destructive reflectance spectroscopy on the crayon in the U.S.G.S. laboratory to determine: one, the chemical composition of the crayon to see if it matches the pigment in the adjacent BCS pictograph panel, or other pictograph panels in the area; two, if the crayon contains any of the original organic binder materials, submit a 500 microgram sample of the binder to AMS RC-14 dating.

This ocher crayon, or paint stick, in the Peabody Museum collection is the only known potentially datable artifact that was found adjacent to a pictograph panel associated with the Barrier Canyon Style of rock art in the region. It was found a few miles from the BCS panels at the Great Gallery in Horseshoe Canyon in Canyonlands National Park.

Canyonlands National Park, along with Glen Canyon National Recreation Area, is submitting a "Request to Conduct Analytical Sampling" asking the Peabody Museum to allow Dr. Roger Clark to analyze the ocher crayon at the U.S.G.S. Spectroscopy Laboratory in Denver, Colorado. Additional research funds might be needed to further support Dr. Roger Clark's analysis and findings. If necessary, a Discovery Pool Grant request for 2012 would be forthcoming.

Attachments:

Copies of all invoices for the Discovery Pool Grant are attached. These include:

- Image Editing for June, July & August 2010	\$ 7,500.00
- Image Editing for September, October & November 2010	<u>7,500.00</u>
Total Expenses	\$15,000.00