Title

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Checking in on fossil sites: Advancing monitoring protocols and techniques for paleontological localities in National Park Service units

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ABSTRACT
Paleontological site monitoring in National Park Service units can deviate from the recommended cyclical protocol because of unique challenges each unit may face. These challenges include staffing limitations or turnover, difficulty accessing remote sites, and high work volume. Insufficient monitoring of fossil sites might result in the loss of knowledge or data due to degradation or loss of resources. New monitoring protocols were tested at the Copper Canyon ichnofossil locality in Death Valley National Park (DEVA) to address the highlighted management challenges. The monitoring protocol presented here was designed to be streamlined and simple, to be utilized by paleontologists and non-paleontologists alike, and to overcome challenges, thereby, improving undermanaged sites. The monitoring protocol included baseline evaluation and imaging of the 78 track localities within Copper Canyon. Each site was assigned a sensitivity status; identifying its recommended monitoring cyclicity of high, moderate, or low. It was determined that monitors could take as few as two field trips to Copper Canyon per year and monitor between five to ten sites each trip. This could be accomplished by DEVA's resources management, interpretation, or law enforcement staff, or a volunteer. Monitors use a portable device, pre-loaded with site-specific paleontological data, to interactively record changes at a site and complete a short seven question form with their observations. Data are stored on the device and later transferred to a central paleontological database. Through this protocol, DEVA can utilize a community-based approach to better manage fossil resources, one which could be replicated by other National Park Service units that grapple with similar monitoring challenges.

MONITORING PALEONTOLOGICAL RESOURCES IN NATIONAL PARK SERVICE UNITS

Monitoring is an integral aspect of the National Park Service (NPS) mission of preserving in situ natural and cultural resources for this generation and the future. The results of monitoring programs help resource managers track preservation of and changes to fossil localities and drive resource decision making. Monitoring of paleontological localities is also a stipulation of the Paleontological Resources Preservation Act of 2009 (PRPA), which requires the use of scientific principles and expertise in federal paleontological resource management (16 USC § 470aaa 1-11).

Because of the importance of monitoring and other management practices to paleontological resources, there are numerous publications and regular federal meetings on the topic. Attention is focused on identifying the breadth of resources on federal lands, the appropriate course of action for surveying and preserving fossil sites, sustaining

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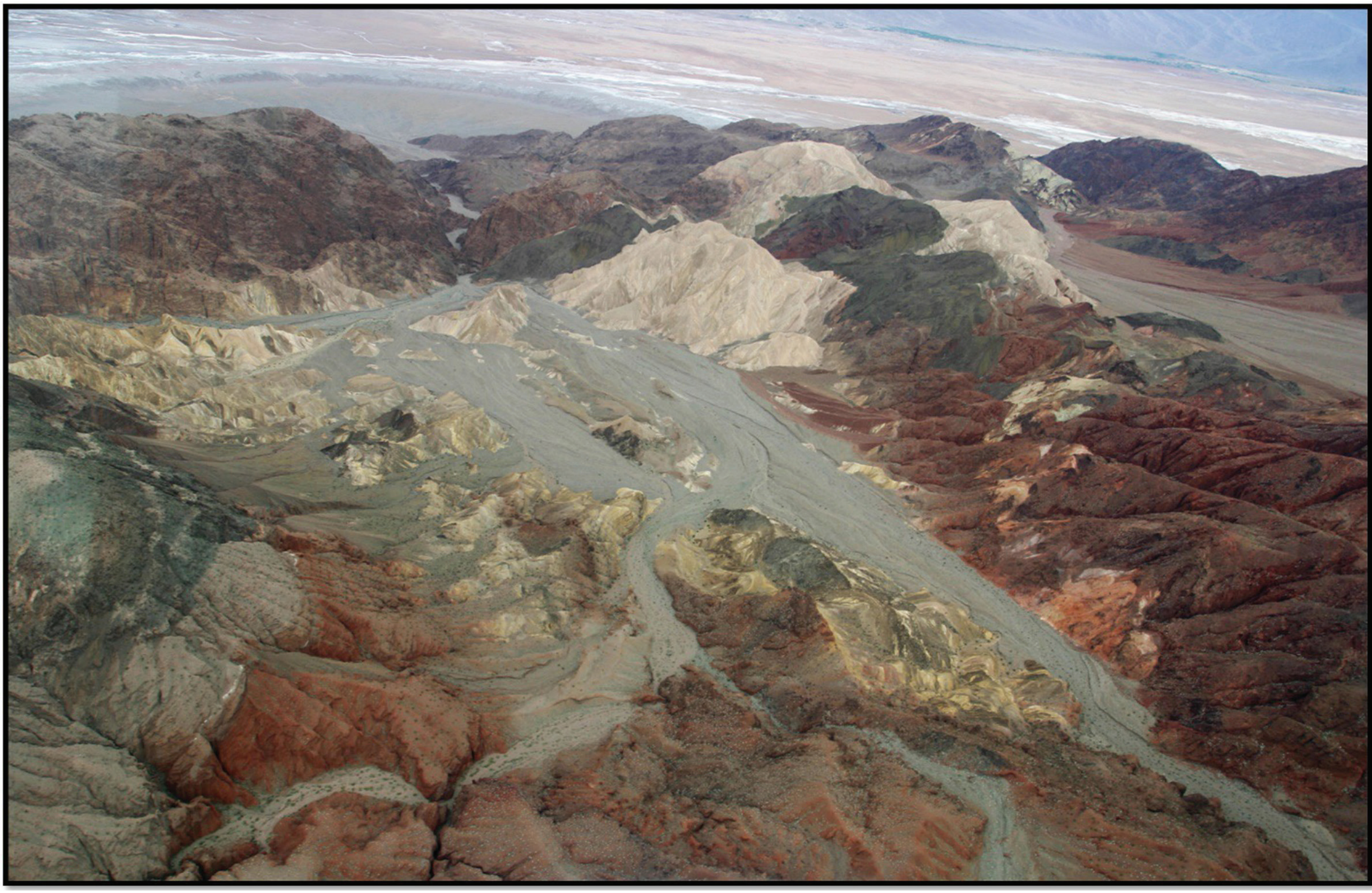


FIGURE 1. Aerial view of Copper Canyon, Death Valley National Park. TORREY NYBORG

monitoring practices, and curating fossil collections. Many novel ideas have been suggested for managing these parameters and will continue to be presented as progress is made. When it comes to monitoring in situ fossil sites in NPS units a basic approach is recommended, which is to collect baseline data (e.g., geospatial coordinates, site description, photographs, geological context, and description of fossils), weathering and erosional data, climatic data (temperature and precipitation), and data on any geohazards or anthropological hazards (Santucci et al. 2009). In addition, documentation of fossil sites using 3-D digitization, including photogrammetry and laser scanning, is also becoming more of a standard practice (Falkingham et al. 2018).

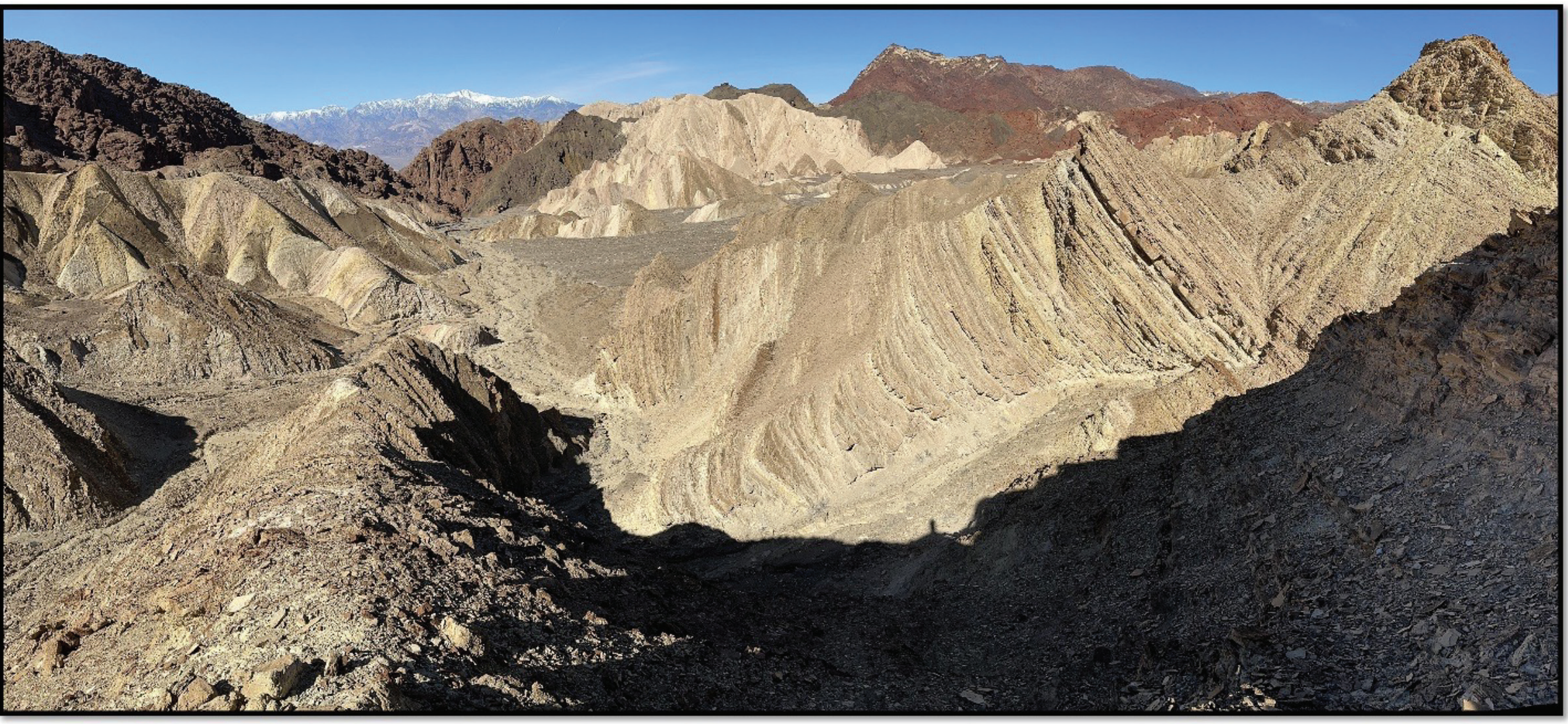
While monitoring is required, each NPS unit with paleontological resources is unique and presents its own specific set of challenges to fulfilling recommended monitoring protocols. Hence, there is no "one size fits all" approach to paleontological monitoring of fossil sites. Each unit must identify how best to complete monitoring given its own unique circumstances. A common challenge that NPS units face is funding qualified, permanent paleontologists to manage fossil resources. Oftentimes, temporary seasonal paleontologists, or even geologists or archeologists, may be hired, based on available funding. An additional challenge associated with seasonal positions is that rotating temporary staff requires time for orientation to the park and resources, as well as training on how to carry out the proposed workload in the field from data capture through to data management and archival. If these conditions are not met, then a backlog of data processing may occur which may or may not be accomplished by the next rotation of a seasonal position. Another consideration is the loss of institutional memory that becomes degraded by frequent staff turnover. Regular monitoring of fossil sites may also suffer from physical challenges, particularly spatial location (e.g., how far apart sites are, how accessible they are, or how abundant they are). Efforts to address paleontological monitoring in a variety of NPS units have been undertaken, in which authors outline a somewhat congruent baseline data approach to monitoring, examples include: Glen Canyon National Recreation Area (Kirkland et al. 2011), Zion National Park (Clites and Santucci 2012), Point Reyes National Seashore (Pearson et al. 2016), and George Washington Birthplace National Monument (Tweet and Santucci 2017). These studies are invaluable to show management progress and highlight proper monitoring practices. This protocol envelops these same sorts of monitoring techniques, and also supplies suggestions for overcoming various monitoring challenges.

The NPS unit of focus here is Death Valley National Park (DEVA), which is faced with all the monitoring challenges discussed above. DEVA, known for its spectacular geology, biology, and dark skies, is also rich in fossil resources. The DEVA fossil record spans more than a billion years, going as far back as the Mesoproterozoic Crystal Spring Formation (Gregory et al. 1988). One exceptional fossil locality at DEVA that requires special attention is Copper Canyon (Figure 1, previous page). This general area covers 13 square kilometers (5 square miles) and preserves fossiliferous strata more than 1,200 meters (3,900 feet) thick (Figure 2). At this time, there are 78 documented ichnofossil localities that preserve thousands of tracks and trackways of Pliocene-age fauna (approximately 4 Ma) (Nyborg 2011). Preserved there are tracks of birds, camelids, equids, proboscideans, felids, and canids. Regarding the sheer volume of fossils at Copper Canyon, Santucci and Nyborg (1999) state "Copper Canyon represents one of the richest and most diverse Late Cenozoic vertebrate trace fossil assemblages in North America." All of these ichnofossils were formed in a savannah-like setting where a Pliocene biota roamed around a large intra-basinal playa lake system (Nyborg 2011). The sheer abundance of fossil resources, remote location of the site, lack of a paleontologist on staff, and limited availability of existing staff all have prevented consistent and regular monitoring of Copper Canyon since its discovery in 1938. This paper will present options to help streamline a monitoring protocol to meet these challenges.

COPPER CANYON IN THE PAST

Death Valley National Monument was established on February 11, 1933, by presidential proclamation under the Antiquities Act of 1906; the monument was subsequently enlarged and its name changed to Death Valley National

FIGURE 2. (A) Overview of Copper Canyon showing the general thickness of exposures of the track-bearing Copper Canyon Formation (light colored beds of finely laminated mudstones and siltstones).
TORREY NYBORG



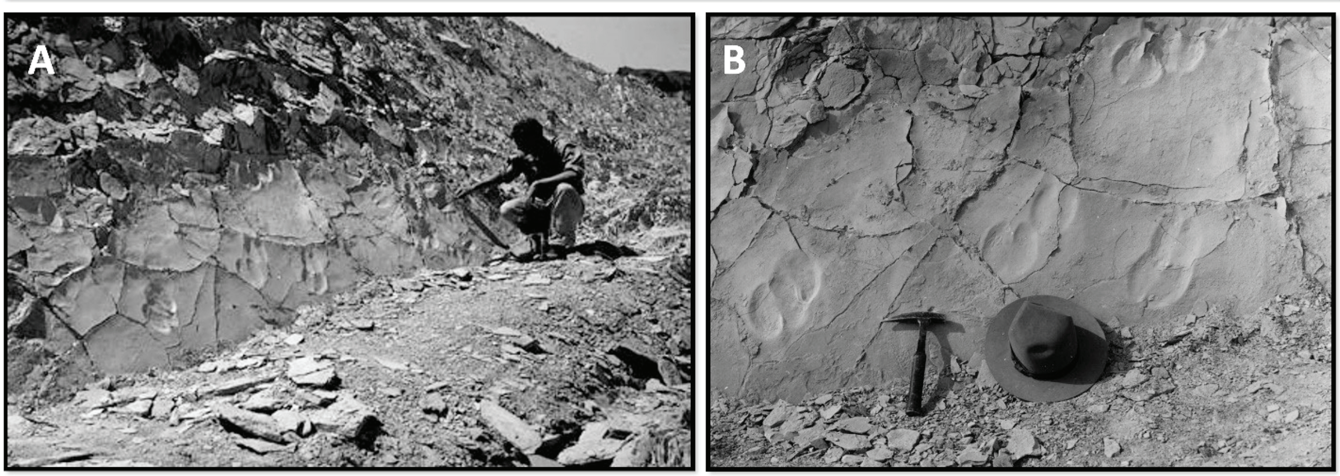
Park by congressional action on October 31, 1994. Copper Canyon is situated in a remote area of DEVA, roughly 5 kilometers (3 miles) from the nearest road. Its fossils were first discovered by Junior Park Naturalist H. Don Curry in January 1938. Recalling his discovery of the fossils at Copper Canyon, Curry stated:

> That night, when I finally turned in and closed my eyes, I could see hundreds of tracks of all kinds, a whole menagerie, millions of years old.… As it turns out, my dreams were no more vivid than the real thing. The Copper Canyon area proved to be a veritable prehistoric barnyard (Curry 1942; he went on to name a very prominent location within Copper Canyon “The Barnyard”—Figure 3).

Curry collected more than 50 slabs containing various ichnotaxa that are now housed in the DEVA museum collections, including numerous specimens of bird tracks, felid tracks, equid tracks, and camelid tracks (Figure 4), as well as excellent examples of sedimentary structures such as ripple marks and rain drop impressions. On March 21, 1938, the Department of Interior issued a press release about the discovery of fossil tracks at Copper Canyon in Death Valley. In reference to the tracks, Curry stated “Their unusual nature and educational value makes them an interesting and important addition to the ever growing list of geological phenomena that helps make Death Valley such a fascinating place to visit” (Curry 1938). The press release garnered immediate and sizeable attention from the

▼ **FIGURE 3.** A very large track panel known as “The Barnyard,” named by H. Don Curry in 1938 upon the discovery of ichnofossils in Copper Canyon. Nearly all the dimples that can be seen in this image are hundreds of tracks made by camelids, equids, and birds. TORREY NYBORG

▼▼ **FIGURE 4.** Some of the earliest known pictures taken from Copper Canyon. (A) DEVA Park Naturalist H. Don Curry at a panel of mostly camelid tracks. (B) Curry’s hat and rock hammer at the same track site as pictured in A. The exact dates of these images are unknown, but presumably sometime between 1938–1940. COURTESY OF NATIONAL PARK SERVICE



public that extended beyond sheer observation and scientific appreciation; so much so, that it soon became apparent that the resources preserved at Copper Canyon were at risk of being rapidly degraded. Vehicular traffic into the canyon and foot traffic led to pilfering of the tracks (Figure 5).

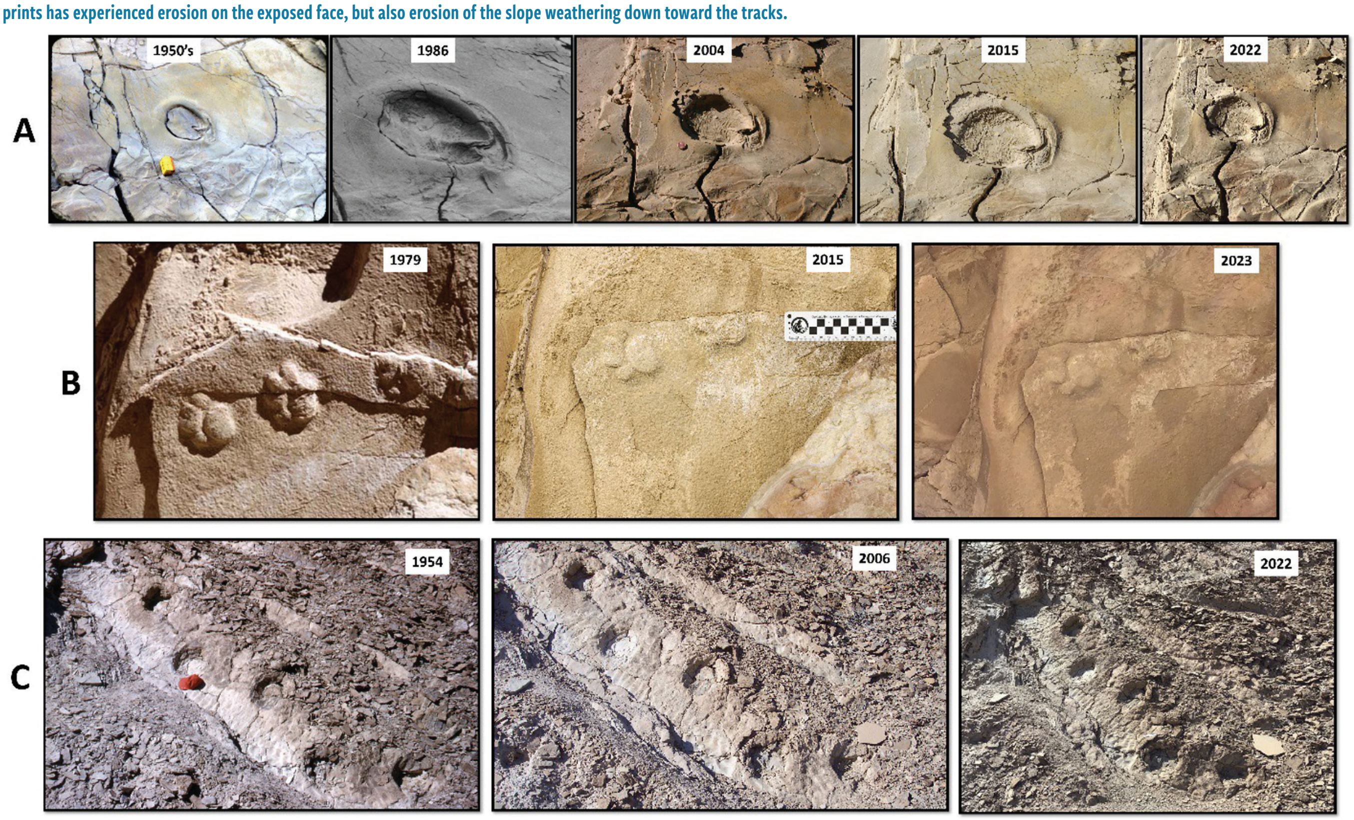
In January 1942, NPS Senior Archeologist Jesse L. Nusbaum recommended that NPS recognize the concern for resource protection by closing Copper Canyon to the public. This was carried out under proclamation by DEVA superintendent according to 36 CFR [Code of Federal Regulations] §2.1. A chain gate was installed at the entrance to Copper Canyon to prohibit wheeled access, while signage going into the canyon was posted to prohibit access by foot. The public closure was formalized in 1998, under federal policy and agency guidelines (NPS-9). To this day, Copper Canyon has remained closed to the public in order to protect the fossil resources, with two exceptions. The first is that ranger guided hikes have been and still are permitted. For example, a guided hike in 1968 advertised "Repeat of a great privilege: A visit to the ancient stamping ground of prehistoric animals which has been preserved from vandalism by the Park Service, for only The Invited to see and then only by special arrangement and under the guidance (and instruction) of authorized personnel." The approach today is quite modernized, where now roughly six reservation-only ranger guided hikes are offered each year with tour slots reserved through Recreation.gov. The second exception is that paleontological investigations and research may be permitted to qualified individuals who have applied and been issued a DEVA paleontology research permit.

From the 1940s to 2010s, several major research projects were undertaken to better identify the breadth of fossil resources and place them into a geological context. Four major projects (five including the present project) and several smaller ones have been carried out.

FIGURE 5. Historical photos showing concerns for protection of paleontological resources at Copper Canyon. (A–B) Vehicle traffic had once been allowed into Copper Canyon, which made the remote site much easier to access, but also resulted in the easy disappearance of fossils. (C–D) An example of a vandalism case that took place at Copper Canyon. 4C shows a felid trackway with seven prints. 4D shows where the felid track panel had been chiseled out. COURTESY OF NATIONAL PARK SERVICE

- **1942:** NPS Rangers Bauer and Grunigen undertook a project to geologically map and create a cross-section of the Copper Canyon area. In doing so, they mapped fossil sites covering roughly 2.6 square kilometers (1 square mile). Bauer and Grunigen documented 20 track localities, including many of the sites referenced by Don Curry during initial explorations in the area (Bauer 1942). Bauer (1942) provided general notes for each locality, including taxonomy at the Order to Family level, condition of the tracks, and recommendations for protection. Bauer (1942) also created a general fossil locality map. There is reference in the literature to photographs having been taken during Bauer and Grunigen's work; despite attempts to locate these historic photographs, as of this time, none have been found.
- **1979:** Reuben Scolnik, a volunteer at Death Valley, attempted to relocate Bauer and Grunigen's 20 track sites and in the process documented an additional 21 sites, for a total of 41 officially documented track sites (Scolnik 1983). Scolnik provided general condition notes for each of the sites, including identifications at the Family level. He also created an updated fossil locality map and completed photodocumentation for each locality (Scolnik 1983). Photographing each site was an important first step for providing a baseline to measure changes or disturbances to resources throughout the years. However, most of Scolnik's original color photos have not been located and the report he provided to DEVA included site photos in black and white, which are impossible to distinguish. The few color photos that have been recovered provide a captivating view of roughly 45 years of erosional change that has taken place at Copper Canyon since Scolnik's work there (Figure 6).
- **1981:** Paul Scrivner completed a master's thesis on the stratigraphy, sedimentology, depositional settings, and vertebrate ichnology of the Copper Canyon Formation. Scrivner (1984) provided a systematic description of the different members and facies of the Copper Canyon Formation and created stratigraphic sections to which the tracks could be correlated. Scrivner also was the first author to provide detailed descriptions, photographs, illustrations, and identifications of the different morphologies of ichnotaxa down to lower taxonomic rank, including four ichnogenera of mammals containing 13 ichnospecies of camelids, equids, and felids, and six ichnospecies of birds (Scrivner 1984; Scrivner and Bottjer 1986). Unfortunately, Scrivner did not fully connect the two subject areas and his ichnotaxa identifications were not linked to any site data. It has been an arduous

FIGURE 6. Historical to modern photographic comparisons of several important fossil localities at Copper Canyon. (A) A single camelid track, well preserved with infill cast taken in the photo taken in the 1950s, has conspicuously degraded over time from erosional factors. (B) A set of three felid tracks has fractured and now only one and a half are left in-situ. (C) A proboscidean trackway with five prints has experienced erosion on the exposed face, but also erosion of the slope weathering down toward the tracks.



undertaking to match his photographs to the track sites they represent. Only a few of Scrivner's original photographs have been procured, although his thesis does include color photographs that are useful. As with the photographs from Scolnik thus far recovered, these provide an important comparison for long-term changes to the tracks at Copper Canyon (Figure 6).

- **1998:** Torrey Nyborg initiated his dissertation research at Copper Canyon. Nyborg's research included radiometric dating of the Copper Canyon Formation, as well as new stratigraphic sections and updated interpretations of depositional environments (Nyborg 2011). Nyborg identified that the Copper Canyon Formation preserves more than 1,200 vertical meters (3,900 feet) of Pliocene lake-bed and shoreline deposits. He observed tracks present through most of the formation but more prominent in the middle- to upper-beds, which correlate with the transition from a highly saline to a more freshwater lacustrine system (Nyborg 2011). Through his studies of the area, Nyborg increased the number of officially documented track sites from 41 to 68. Nyborg completed photodocumentation for each site, which enhanced the work done by Scolnik (1983), and made recommendations to evaluate erosional and disturbance changes to the ichnofossils (Nyborg 2009). Nyborg provided a large number of photographs from his work at Copper Canyon which have been vital to the present project for identifying changes at the sites. Nyborg also identified new ichnospecies to add to the taxonomic list developed by Scrivner (1984). Thousands of fossil tracks are now known from Copper Canyon representing: 12 forms of *Avipeda*, including the holotype specimen *Alaripeda lofgreni* (Sarjeant and Reynolds 2001); five forms of *Ovipeda*, including the holotype specimen *Lamaichnum etoromorphum* (Sarjeant and Reynolds 1999); three forms of *Hippipeda*, including two holotype specimens *Hippipeda absidata* and *Hippipeda gyripeza* (Sarjeant and Reynolds 1999); five forms of *Felipeda*, including the holotype specimen *Felipeda scrivneri* (Sarjeant et al. 2002); one form of Canipeda; and one form of Proboscipeda (Scrivner 1984; Nyborg 2011; Nyborg et al. 2012).

Each of these projects are invaluable for having discovered more about the geology and paleontology of Copper Canyon, and today we have a holistic view of how the Pliocene trackmakers were utilizing environmental resources along the shoreline of an ancient playa lake. Some of the projects even made bridged efforts to update the condition of the track localities and preservation of the fossils. However, even with the best intentions to carry out a consistent monitoring program at Copper Canyon it still has not been accomplished, for the several challenging reasons that have been presented in this paper. The present project has compiled all known historical data and photographs, including from the projects outlined above, and developed a comprehensive database of this information, which had not been done before for Copper Canyon.

COPPER CANYON IN THE PRESENT

The objectives of the present project can be categorized into three areas: (1) compile all previous data collected from Copper Canyon, as just described; (2) complete site visits and gather baseline data for each track locality; and 3) construct a monitoring protocol that can transcend resource management challenges. Each objective is explained below in detail.

1. Compile all the historical data and photographs and sort into site-specific folders so that there is data continuity for each fossil locality at Copper Canyon.

It is imperative to capture the extent of natural loss of resources from erosion. However, there was no quantitative way to identify changes to the track sites at Copper Canyon because site-specific baseline data or photographs had not been gathered and organized. Record searches were carried out to locate previous Copper Canyon data and photographs in the DEVA museum and archives. Although accession records existed for historic photographs, many of the accessioned files could not be located, or else several of the accession numbers were repurposed with no further trace of the original files. Only a small number of photographs from between 1938 to 1998 were recovered. Resolution and volume are improved since that time because of the switch to digital photography and the ease of transfer and retention of digital files. All recovered data and photographs from previous Copper Canyon mapping and research projects were then identified by locality and curated into a site-specific folder. Not all of the fossil localities have historical records, but certainly the more prominent ones do, and those provide comparison intervals of between 10-30 years. Historic photo comparisons can identify valuable information, such as fracturing of tracks, spalling of the track surfaces, and sloughing of steeply tilted beds, as well as indication of the rate at which these erosional changes occur. We now have a more complete view of the rates of change as we peer into the 80-year montage of photographs that have been compiled and matched to site.

2. Field work to conduct site visits and collect comprehensive baseline data for each locality.

Previous projects had created maps of fossil localities, some which included brief descriptions of the resources present (Bauer 1942; Scolnik 1983; Nyborg 2011). However, recording comprehensive baseline data, which is proper NPS protocol, was not completed before the present project. Baseline data are just as imperative as photographs to understanding the health of and change to a fossil site. Each track locality was formally documented to evaluate a variety of anthropogenic and environmental impacts, and photographs were taken of the current conditions at each site. Anthropogenic threats to fossils include theft and vandalism, which have an unfortunate history of taking place at Copper Canyon. Natural threats include erosional and climatic factors, such as spalling, abrasion, active wash damage, dissolution, thermal expansion, wet/dry and freeze/thaw cycles, and increased rain and storm intensity. The lithology of the track beds are primarily calcareous fine-grained and finely laminated mudstones and siltstones, so environmental variables can cause erosion to take place rather quickly. Inarguably, many tracks have already been lost to erosion, while many more have yet to surface from underlying layers.

Field work during this project increased the total number of sites from 68 to 78, and undoubtedly more will be discovered with continued visits. Each locality was evaluated for its fragility in order to assign each site a monitoring status of “high”, “medium”, or “low”; rankings were assigned based on volume of resources present, accessibility of the resources, susceptibility to erosional factors, and estimated frequency of resource loss. This monitoring status then determines the frequency that each site should be monitored: “high” is every 1–2 years, “medium” is every 3–4 years, and “low” is every 5–10 years.

Photographs were taken of each site, and photogrammetry was used for most sites where the area exceeded 4 square meters (43 square feet); some track panels are as large as 60 square meters (650 square feet). Precise, non-destructive photogrammetry and LiDAR analysis were completed by Jack Wood, NPS Geologic Resources Division, for high resolution models of sites. The author used an iPhone Pro and the Scaniverse photogrammetry app to generate portable hand-held 3-D models that can be used in the field for easy on-site comparisons. Examples of models are viewable here: https://sketchfab.com/aubrey.bonde/models. Using 3-D models of the panels allows a monitor to view the sites on a portable device and interactively determine if any changes have taken place since the last monitoring visit. Baseline data, photo comparisons, models, and monitoring recommendations have all been completed, and now a formal monitoring program can be carried out.

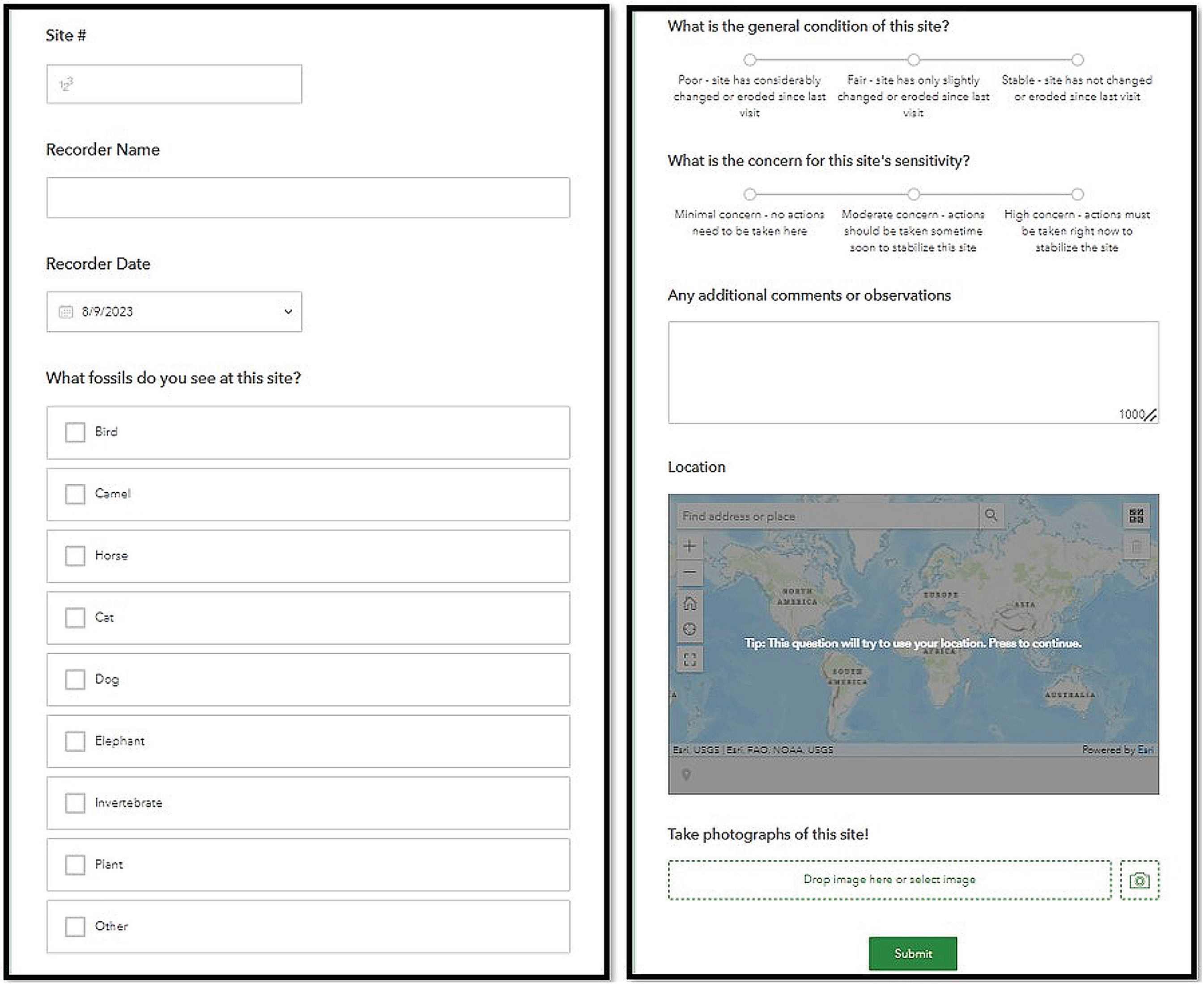
3. Construct a monitoring protocol that can carry forward and transcend resource management challenges.

With the recommended monitoring schedule in place, the foremost challenge to success is ability to follow through with the program. Past efforts have proposed regular monitoring of ichnofossils at Copper Canyon (Santucci 1998; Nyborg 2009), yet consistent monitoring efforts have not resulted. The challenges that DEVA faces are those that many other NPS units also face: staffing limitations, staffing turnover, or rotating seasonal staff; remote location or dispersed spatial distribution of paleontological sites, which can make field work very difficult; a large number of fossil sites and annual monitoring obligations that can be onerous and lead to the incapacity to keep up or result in backlogged data. Now that the foundational monitoring program has been established, the easiest way to maintain it is to offer a protocol that is streamlined and straightforward, yet can obtain annual to decadal interval monitoring data and complies with best practices outlined by the PRPA for managing fossil sites.

This monitoring protocol meets these challenges by providing the opportunity for an interdisciplinary, community-based approach to monitoring sites, made possible by slimming down technical data capture and transfer. At DEVA, this can be accomplished using available staff, as the park does not have a permanent paleontologist and has had just two paleontology seasonal staff throughout the years. DEVA interdisciplinary monitors could be from the resource management or interpretation divisions, or by the volunteer base. For example, paleontological monitoring could piggy-back on resource management work, such as hydrological, biological, geological, or cultural, that would be taking place in the same area, or piggy-back on any of the six tours that interpretation staff guide into Copper Canyon each year. This approach utilizes staff to provide monitoring coverage at a pace that can meet the recommended monitoring schedule. Most important of all, this monitoring design is simple enough that it does not unduly burden staff with other obligations. For example, interpreters are tasked with tours, not paleontological monitoring, but completing just three simple monitoring forms per tour would chip away at obligatory monitoring, while not pulling attention away from the main focus of the tour. This is just one example that could be integrated at DEVA; the monitoring protocol was designed to be simple enough to be utilized by practically any qualified staff member or volunteer available.

This protocol places paleontological site data on a single device, such as a tablet or phone. Monitors can easily see the location of the documented fossil sites (using Avenza, TouchGIS, FieldMaps, Google Earth, or whichever geospatial platform is easiest for that NPS unit to work with; the present project uses Avenza and FieldMaps). Site-specific data are loaded onto the device including data forms, photographs and historical comparisons, and 3-D models. This way, in the field, when monitors are on-site, they have access to past data and all they have to do is complete a simple offline Survey123 form recording their observations (Figure 7). When back from the field and connected to Internet service, the form automatically uploads the monitoring data and stores it without the need for post-field data transfer, which can be time-intensive and overlooked. Options for the offline form can be at the choice of the NPS unit as well. Google Forms and Microsoft Forms, while free, convenient, and easy to work with, are not currently configured to work offline. Various user-friendly offline form apps that may be considered include Jotform, Fastform, and MobileForms, although these are not NPS-approved at this time. If these options become available it may streamline the process even more. Until then, the author has tested out two options; creating forms in Excel and in Survey123, either of which may be used on an NPS device. A fillable form in Excel, while it may not have the user interface seen in Figure 7, is easy to set up and easy for a monitor to use offline, it also has the additional convenience for data being compiled in an easily transferrable format that can be later imported into a permanent database, such as Access. Alternatively, a better option in terms of user interface and data capture and storage would be Survey123, used in the present project. However, with Survey123 the monitor would need to access the form while connected to the NPS internet before going into the field.

Data capture on a single device digitizes records and reduces paperwork, stores all photographs and site data in one location, and reduces the time-intensive burden on the monitor to prepare before field work and transfer data afterward. It is imperative that the device be backed up to the network regularly. Then, when a qualified paleontologist becomes available (either on staff or perhaps in a position shared with another NPS unit or partner agency), that person can access the data and evaluate recorded changes. If sites are observed to be deteriorating then they can determine a course of action for intervention from loss of resources, such as site stabilization



Site #

Recorder Name

Recorder Date

8/9/2023

What fossils do you see at this site?

- Bird
- Camel
- Horse
- Cat
- Dog
- Elephant
- Invertebrate
- Plant
- Other

What is the general condition of this site?

Poor - site has considerably changed or eroded since last visit | Fair - site has only slightly changed or eroded since last visit | Stable - site has not changed or eroded since last visit

What is the concern for this site's sensitivity?

Minimal concern - no actions need to be taken here | Moderate concern - actions should be taken sometime soon to stabilize this site | High concern - actions must be taken right now to stabilize the site

Any additional comments or observations

1000

Location

Find address or place

Tip: This question will try to use your location. Press to continue.

Take photographs of this site!

Drop image here or select image

Submit

FIGURE 7. An example of the simple Survey123 monitoring form that can be used offline while DEVA monitors are in the field, and can be transferred to the central paleontology database.

or collection of fossils. If sites are observed to be faring well then they can also make adjustments to the monitoring recommendations, accordingly. The paleontologist can also ensure all data have been transferred to a central database as a permanent record.

In the absence of a permanent paleontologist on staff, or to augment monitoring efforts when a paleontology program is understaffed, this monitoring protocol provides an achievable approach to consistent management and monitoring of fossil sites by utilizing the available staff and simplifying data capture and processing.

COPPER CANYON IN THE FUTURE

Before having a monitoring program in place at Copper Canyon, the degradation and loss of fossil resources over time was unquantifiable. Past reports attest to the loss, by observing that entire fossil sites could not be relocated or had eroded away (Bauer 1942; Scolnik 1983). However, with a proper monitoring program in place, loss of non-renewable fossil resources can be better managed, including those at Copper Canyon. In addition, it is an absolute certainty that more tracks will erode *into* view at Copper Canyon, and they must be recorded as new sites and entered into the monitoring protocol.

Bauer (1942) noted that many more layers contain tracks. He also stated that "quarrying for fresh rock does not produce satisfactory results, only proper weathering brings out the track details and presents the spectacular characteristics needed for good display material." This is a compelling statement to emphasize the potential for more tracks to make their appearance in future years. Hence, the crucial need to continue to monitor the resources at Copper Canyon and to carry out monitoring at the recommended intervals. The monitoring protocol described in this paper is designed for park units with staffing issues, and fills a need for a shared, community-based monitoring approach. Baseline data have now been compiled and this protocol presents ways to collaboratively ensure that paleontological resources are managed properly and monitored regularly. This program is simple enough to allow cross-disciplinary teams to complete monitoring of paleontological localities by relying upon easily accessible site-based data and imagery for on-site comparisons of changes to fossil sites.

ACKNOWLEDGMENTS

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