COOPERATIVE ECOSYSTEM STUDIES UNITS
NATIONAL NETWORK

PR Number: 0020051940
Award Number: P14AC01069
Project Number: **NAU-449**
CFDA #: 15.945
Park/NPS Unit: WUPA (FLAG)
Title of Project: Wupatki Earthcrack Survey – Phase 2

Administered through the: Colorado Plateau Cooperative Ecosystem Studies Unit Cooperative Agreement Number P14AC00921

CESU Partner: Northern Arizona University

PROJECT CONTACTS:
Principal Investigator: Dr. Stefan Sommer, Director, Colorado Plateau Biodiversity Center, NAU Campus Box 5640, Flagstaff, AZ, 86011, (928) 523-4463, (928) 523-7500, Stefan.Sommer@nau.edu
Co-Investigator: Dr. J. Judson Wynne, Colorado Plateau Biodiversity Center, Northern Arizona University, Box 5614, Building 56, Suite 150, Flagstaff, Arizona 86011, Ph: (928) 523-7757, jut.wynne@nau.edu
Partner Administrative Contact: Cindy Judge, Grants & Contracts Admin. P.O. Box 4130, Flagstaff, AZ 86011-4130, (928) 523-6197, Fax (928) 523-1075, Cindy.Judge@nau.edu
NPS Certified ATR: Paul Whitefield, Natural Resource Specialist, Flagstaff Area National Monuments, 6400 N. Highway 89, Flagstaff, AZ 86004, Ph: (928) 526-1157 ext. 235; Paul_Whitefield@nps.gov

FUNDING INFORMATION:
Amount Funded: $40,000
NPS Account Numbers (amounts in parentheses): 144P103601.PPIMFLAG7R.PPMRSNR1N.00000 ($40,000.00)
Fund Source (e.g., ONPS, FLREA, CRPP, CESU, etc.): WUPA ONPS (WASO NRSS WNS FY14 add-on)
☒NPS Funding
☐ Is this funded using a reimbursable account number? If yes, IMR contracting needs a copy of the Interagency Agreement.

PROJECT DATES:
Start Date: July 1, 2014

NOTE: This Task Agreement will become effective on the date of final signature or the effective date of the Award document, whichever is later.

End Date: September 30, 2015

NPS Administrative Contacts
Interim CESU Coordinator (May 18 – September 13, 2014): Todd Chaudhry, National Park Service/CPCESU, NAU P.O. Box 5765, Flagstaff, AZ 86011, 928-523-6638, Fax: 928-523-2014; todd_chaudhry@nps.gov

Intermountain Region Administrative Contact: Kelly Adams, Grants and Agreements Specialist, National Park Service, 12795 West Alameda Pkwy, Lakewood, CO 80228. Phone: 303-969-2303 Fax: 303-969-2992 Email: Kelly_adams@nps.gov

FEDERAL FINANCIAL REPORTS:

Federal Financial Reports {X} Quarterly { } Semi-annually { } Annually
Final (required): September 30, 2015

PROJECT SCHEDULE AND TECHNICAL REPORT DEADLINES:

List all technical reports and products in sequential order as required in the scope (more lines and milestones can be added as needed):

Project Start Date – July 1, 2014

Technical progress reports – { } Quarterly { } Semi-annually { } Annually
(Check as needed from PI to monitor progress of specific project. Content should be addressed in the scope.)

Investigator's Annual Report (IAR) – Due in NPS Research Permit & Reporting System by March 30 each calendar year project is active: https://irma.nps.gov/rprs/Home

Pertinent Replicate Datasets, Arthropod Collection Information, Field Notes, and Maps provided to the NPS ATR– September 30, 2015

Draft Final Report – August 31, 2015

Final Report – September 30, 2015

Project End Date – September 30, 2015

Final SF425 FFR must be submitted within 90 days of project end date

PAYMENTS

2 CFR PART 215.22*:* Cash advance (drawdown) to recipient organization shall be limited to the minimum amounts needed and be timed to be in accordance with the actual immediate cash requirements of the recipient organization in carrying out the purpose of the approved program or project. The timing and amount of cash advances shall be as close as is administratively feasible to the actual disbursements by the recipient organization for direct program or project costs and the proportionate share of any allowable indirect costs.

2 CFR PART 215.25 (8)(e)(1): Incur pre-award costs 90 calendar days prior to award or more than 90 calendar days with the prior approval of the Federal awarding agency. All pre-award costs are incurred at the recipient's risk. (i.e. the Federal awarding agency is under no obligation to reimburse such costs if for any reason the recipient does not receive an award or if the award is less than anticipated and inadequate to cover such costs.)

CESU REQUIRED PRODUCTS (may be different from those products required by the ATR – See Statement of Work for Products required by the NPS unit):

The Principal Investigator will prepare a brief report abstract suitable for public distribution and two hard copies and an electronic version (in PDF file format) of the final report and mail all to Todd Chaudhry, National Park Service, CPCESU, NAU P.O. Box 5765, Flagstaff, AZ 86011. Please be sure to include the project number (e.g.; NAU-###, UMT-###, UAZDS-###) and the P number on the cover page of the final report.

PROJECT ABSTRACT:

A network of unique subterranean "earthcrack" fissures is located at Wupatki National Monument (WUPA). Six of them are large enough for human access and thus exploration. Cave surveys documented the occurrence of two endemic pseudoscorpions in 1976 and one bat species of conservation concern in 1982. No biological surveys or cave monitoring had occurred since 1982, until a cooperative survey by the Investigators was initiated on two of the earthcracks Investigators in 2011 Malmquist Fissure and Lomaki Fissure. Current NPS management issues include: (1) Improving

information on safe cave entry rigging and access routes; (2) Confirming the presence of rare species; (3) Developing planning information and recommendations for managing caves with blocked entrances in proximity to high visitor use areas; (4) Assessing risk of White Nose Syndrome contamination and spread to the bat fauna; and, (5) Understanding cave microclimate and surface air mixing zones, and potential changes due to global climate warming. Under this Task Agreement, the Investigators and NPS ATR will expand the survey to two additional earthcracks. The primary objectives are: (1) Develop detailed subsurface and cave entrance maps; (2) Systematically inventory the cave arthropod and bat fauna; (3) Acquire baseline microclimate data; and (4) Analyze cave sediment for presence of White Nose Syndrome. The Investigators will document the results of the study in a report to the National Park Service.

SCOPE OF WORK:

Introduction. Because of regional geologic processes, a network of unique subterranean "earthcrack" fissures is located at Wupatki National Monument (WUPA) (Pearce 1998). Thirty-six earth crack openings have been documented (Persons and Drost 2001), and six of them are known to be large enough for human exploration (Cave Research Foundation 1976). Air currents move within the interconnected fissure system, driven by atmospheric pressure fluctuations, and "breath" at "blowhole" openings within WUPA. The blowholes are also associated with the unique archeological sites for which the monument was established to protect. During the 1970's, cave survey and biological inventory of the largest earthcracks resulted in the discovery of two endemic pseudoscorpion species (Muchmore 1981). These features are also used by bats, including the Townsend's big-eared bat (Bain 1982), listed as a "wildlife species of conservation concern" by the Arizona Heritage Data Management System. Two of the largest earthcracks occur in the Lomaki-Box Canyon visitor use area. Because they have deep drops beneath obscure entrances, at some time in the past they were partially sealed for public safety purposes, using boulders, used fence T-posts, and used rolls of barbed-wire. Lastly, the recent introduction of the White Nose Syndrome (WNS) fungus (*Pseudogymnoascus destructans*) from European to North American caves, and near extirpation of bat populations in caves in eastern North America is causing great concern for conserving the entire North American bat fauna, including within all NPS areas with cave habitat.

At WUPA, the cave arthropod fauna has not been re-examined in the last 38 years to confirm the presence of endemic pseudoscorpions, nor have thorough inventories been conducted to characterize cave-dwelling arthropod communities. The bat fauna has not been re-surveyed in the last 32 years to confirm continued use of these earthcracks by Townsend's big-eared bats. The NPS is considering partially restoring the entrances to more natural conditions by installing gates or other means. The opening of another of the large earthcracks lies on adjacent Coconino National Forest lands, but most of the cave is beneath WUPA. This earthcrack is known to local cavers and remains open to public access. Interagency coordination between the NPS and USFS is crucial to protecting this cave. Because the regional earthcrack fissure system in and around WUPA is responsive to surface weather systems and essentially "breaths" surface air, cave microenvironments may be altered by global climate warming. Pilot microclimate data is desired for understanding cave temperature zonation, potential surface air-mix zones, and establishing a baseline for monitoring potential climate warming effects. Soil fungal spore assay data and microclimate data is also needed to assess the risk of WNS spreading to the WUPA earthcracks, and for advance planning to prevent or deter WNS infection.

Scope of Work. Under this Task Agreement, NPS funding is allocated to expand the ongoing cooperative study of the WUPA earthcrack caves to survey two more of the six earthcracks. The Investigators and NPS ATR will review existing technical information on the earthcracks, and utilize experience gained from the last two years of cave survey work (CPCESU Task Agreement NAU-407) to select the two earthcracks for this survey. The Investigators will organize qualified technical caving personnel into teams to enter the caves to prepare detailed maps, systematically inventory the cave arthropods and bats, and collect cave sediment samples for laboratory analysis for the presence of WNS spores. A network of temperature/humidity data loggers will be strategically deployed to document the cave microclimate at selected stations. The Investigators will document the results of the survey in a study report, and provide pertinent supporting documentation described below. Under this Task Agreement, the NPS ATR will: Coordinate NPS research

permit and environmental compliance record updates; Organize field trips for reconnaissance of cave entrances; Assist with preparing cave entry plans; Coordinate the cave entry schedule with NPS staff at WUPA; Participate in safety and resource protection briefings with cave entry teams; Either serve as primary safety check-in/check-out contact or designate another NPS contact for all cave-entry activities; Review and comment on the final project report; and, Coordinate delivery of the final report, other products, and specimen collections to the Natural Resource Program files, staff library, GIS, and museum/archive collection for the Flagstaff Area National Monuments.

Sub-Tasks and Schedule.

Maintain Valid NPS Research and Specimen Collection Permit (July 2014 – July 2015): The Cooperator will meet the requirements for maintaining a valid and current NPS Research Permit in the on-line Research Permit and Reporting System, including adhering to annual reporting requirement, permit stipulations, and additional requirements under the NPS environmental review and project record (PEPC Record #43621).

Prepare Cave Operations & Safety Plans for Each Cave Entry Activity (June 2014 – July 2015): The Investigators and NPS ATR will review the 2012 Cave Entry Risk Assessment and Job Hazard Analysis, and update as needed. A cave operations and safety plan will be prepared for all cave entry field days, and circulated to key NPS field staff and a back-up technical search-and-rescue incident coordinator. WNS Prevention Measures developed for the U.S. Fish and Wildlife Service for western U.S. caves, adopted for the surveys under NAU-407, will also be adhered to for all cave entry activity at WUPA.

Cave Reconnaissance and Mapping (July 2014): The Cooperator and ATR will evaluate existing technical documentation and NPS file information, and conduct field reconnaissance of cave entrances as needed to select two caves, and then plan the survey of both caves. A team of experienced cave mapping personnel will be assembled by the Investigators to travel to the Wupatki area, utilizing temporary lodging and rental car while completing this task. All accessible features of both earthcrack caves will be mapped using standard sub-surface cartographic mapping techniques. The resulting maps will be of sufficient detail to accurately document bat and arthropod observation locations, and ensure precision in the placement of arthropod sample stations and microclimate data recorders. Maps will be prepared prior to conducting biological inventory work.

Collect Soil Samples for White Nose Syndrome Testing (July - August 2014): During cave entry for mapping or arthropod sampling in the earthcrack caves, soil samples will be collected according to protocol for WNS testing. If possible, additional samples will be acquired from as many earthcracks as possible. The Investigator and ATR will determine together how best to allocate the WNS assay funding among the six earthcracks, along with the number of desired replicate samples for statistical reliability.

Analyze Soil Samples for White Nose Syndrome Spores (September – November 2014): Cave sediment samples will be submitted to NAU laboratory facilities capable of WNS soil assays, or a comparable laboratory. The results of the analysis will be incorporated into the Final Survey Report.

Arthropod Inventory (July – August 2014): The Investigators will sample arthropods during July-August, during the late monsoonal season, using leaf-litter traps, time-constrained searches, and opportunistic searches. A strategic number of leaf-litter traps will be deployed within each cave and recovered within 7-10 days with specimens. These traps will be designed and deployed to minimize surface disturbance within the earthcracks. Time-constrained searches will be conducted at each trap station; this will involve searching for arthropods, for one to three minutes, within a 1 meter radius of each station. If no arthropods are detected, the search will be discontinued at one minute; if arthropods are detected, the search will be extended to three minutes. This will be repeated twice – once prior to trap deployment, and again prior to checking and collecting traps. Opportunistic searches will involve collecting arthropods as they are encountered throughout the cave. A set of arthropod voucher specimens will be prepared, along with NPS museum catalog records.

Bat Survey (July 2014 – March 2015): Field work to inventory the bat fauna will be completed during periods when resident bats are most likely to be detected, including winter months when bats may be in hibernation. Each cave will be searched for roosting or hibernating bats, including documenting any bat guano locations. For winter hibernacula counts, the Co-Investigator will travel to the Wupatki area and utilize temporary lodging and rental car.

Other Wildlife Observations (July – August 2014): All direct observations or identifiable sign of other vertebrates will be documented, including targeted searches around cave entrances, beneath rocks, along cave walls, etc.. Vertebrates which are recently deceased may be considered for collection, but only if the NPS ATR has been consulted and approves removal from the cave.

Cave Microclimate Monitoring (July 2014 – July 2015): Remote temperature and relative humidity data loggers will be deployed in each cave. The loggers will be strategically stationed by cave depth, near arthropod collection stations, bat roosts, and other stations which facilitate repeat measurements and/or yield useful data to understand microclimatic stability/variability within the earthcracks. They will be programmed to store hourly temperature and relative humidity measurements. Data will be collected over a one-year period to determine if cave temperatures are near constant in some locations or if all stations fluctuate with seasonal temperature patterns and/or the passage of weather systems over the surface. For cave entry field work to recover the data loggers, the Co-Investigator will travel to the Wupatki area and utilize temporary lodging and rental car.

Specimen Identification and Preparation (September 2014 – September 2015). The Investigators will sort and preserve the collected arthropods, identify them using taxonomic keys, and/or submit to taxonomic subject-matter-experts for identification.

Report Preparation (June – September 2015): The Investigators will prepare a study report for the NPS. The report content will be organized according to accepted scientific report format and style, and clearly document or adequately reference the following:

(1) Literature review.

(2) Rigging techniques and access routes.

(3) Cave mapping methods.

(4) Arthropod and bat survey methods.

(5) Temperature and humidity data acquisition methods.

(6) Documentation of arthropod collection sites, bat observation locations, and data logger deployment stations.

(7) Summary statistics for microclimate temperature/humidity measurements.

(8) Notable observations and/or management recommendations.

(9) Two-dimensional, scaled maps of two earthcracks, including their entrances.

(10) Bat species list, counts, and activity summary for each earthcrack.

(11) Arthropod species lists. Note: Because specimens must be submitted to taxonomists with expertise in insect identification, additional time may be required before these results are available. The NPS will accept a supplemental cave arthropod report when this information becomes available, which will include species lists and summary information for each earthcrack.

COOPERATIVE AGREEMENTS OR TASK AGREEMENTS INVOLVING COOPERATORS WORKING ON-SITE

Background

In cooperative agreements or task agreements with universities where the university utilizes interns, student employees, research associates (RAs) or cooperators on-site (hereafter called "cooperator personnel"), these cooperator personnel sometimes work on government sites in close proximity to federal employees. It is illegal (without specific statutory authority) for federal employees to directly supervise the cooperator personnel or any university employees or for the students or other university employees to supervise federal employees. When cooperator personnel are working on an NPS site, it is important that there is a clear distinction between students and federal employees.

Office Environment and Vehicles

- The office space of the cooperator personnel and NPS personnel should be clearly labeled (Name and NPS or University affiliation on office or cubicle space).
- Cooperator personnel should be listed separately from NPS personnel in telephone lists, other identification or organizational rosters, and publication credits.
- Cooperator personnel should not receive "all-employee" e-mail or other communications intended for NPS personnel (unless it relates directly to the work the cooperator is doing for the NPS). When the e-mail does relate to the work being done, a copy of the same e-mail message should be sent to the University or cooperator's supervisor.
- Cooperator personnel may use NPS e-mail systems when the communication relates directly to the work the cooperator is doing for the NPS. The e-mail addresses of the cooperator personnel must include a label associated with their NPS e-mail address that identifies the cooperator's status (i.e., "Linda Webb, Cooperator" would be the label associated with the e-mail address, linda_webb@contractor.nps.gov). Doing so clearly identifies this individual each time they send an e-mail message using the NPS system, and it identifies their status as a research associate, student intern or student employee in the e-mail directory.
- Unless stipulated in the agreement, cooperator personnel should not drive government vehicles.
- Unless stipulated in the agreement, cooperator personnel should not ride as a passenger in a government vehicle. When this is planned as part of the agreement, an appropriate amount of liability insurance should be negotiated.
- Prior written approval by the Park Superintendent or Center Manager must be obtained in order for a task to allow cooperator personnel to drive or ride in government vehicles.

Supervision and Scheduling

- Each task must specify the university's/cooperator's supervisor for the cooperator personnel.
- Unless stipulated in the agreement, NPS staff should not set hours for cooperator personnel, specify where the work should be done, or conduct performance appraisals. National Park Service staff may give performance feedback to the cooperator personnel supervisor.
- Cooperator personnel should report leave, scheduling, and other related issues to the university or cooperator's supervisor, not to NPS employees. The supervisor of the cooperator personnel should then communicate with the NPS. National Park Service employees cannot directly supervise cooperator personnel on a day-to-day basis. Work should be given to the cooperator personnel (via the cooperator's supervisor) on a "task basis." Cooperators should work without NPS supervision to accomplish each task, although technical consultations and cooperation is permissible.
- The Cooperator will be responsible for any disciplinary action needed to correct student employee conduct or performance problems. The NPS agreements technical representative will inform the university/cooperator's supervisor of any conduct or performance problems.

- The Cooperator will remove student employees from their positions if they fail to improve performance or address conduct issues.
- The NPS will review and provide feedback to students or interns regarding work assignments.
- The NPS will inform the cooperator of conduct or performance problems with cooperator personnel so that the university can counsel employees and correct the performance problems.
- The NPS will recommend to the cooperator dismissal of cooperator personnel based on conduct or performance issues.
- The Cooperator will hire students, interns or RAs to work on NPS tasks identified in the agreement. Hiring will be conducted in consultation with the NPS Agreements Technical Representative (ATR).
- The Cooperator will: pay students, interns or RAs for hours they have worked in support of the agreement.

Representation and Communication

- Cooperator personnel cannot in any way represent themselves to the public as NPS employees.
- Cooperator personnel are required to wear visible identification at all times.

Other Issues

- Cooperator personnel should not list an NPS affiliation on publications, but rather should list the cooperative agreement under which the work was performed.
- Cooperator personnel should not be invited to official NPS "social" events.
- Cooperator personnel will follow the local policy of the facility when federal facilities are closed due to early release for holidays, snow days, etc.

PRODUCTS:

At the conclusion of Phase 2 of the WUPA Earthcrack Survey, the NAU Investigators will provide the following products to the NPS:

Draft Study Report: A draft Study Report will be submitted to the NPS ATR for review at least 30 days before the final report is due. The Investigators will consider the NPA ATR's review comments and suggested edits while preparing the final report.

Final Study Report: An unbound hardcopy of the Final Study Report and electronic copy in Adobe Acrobat format will be provided to the NPS ATR.

CESU Required Products: The Principal Investigator will also provide a brief report abstract suitable for public distribution, along with two hard copies and an electronic version (in PDF file format) of the final report to the CPCESU Coordinator.

Publications: The NPS requests digital or reprint copies of scientific journal papers or other publications resulting from the WUPA earthcrack surveys.

Supporting Data: At the conclusion of the study, the NPS requests sufficient archival documentation so that the cave surveys may be repeated at periodic intervals to monitor the earthcrack fauna and cave microenvironment. Useful documentation to be provided to the NPS ATR includes:

- Large-format hardcopy cave maps, or digital files with scaled profiles and cross sections.
- Site descriptions, photographs, and/or or hardcopy diagrams for all technical rigging and access routes, mapping datum stations, bat observations, arthropod collection sites, environmental sensor sites, and other notable features.
- Photographic documentation.

- Legible copy of field notes.
- Blank field data recording form(s).
- Temperature/humidity datasets, either as computer database files or printed tabular reports.

Voucher Specimens: A full set of arthropod voucher specimens will be prepared, and delivered along with pertinent label data to the Curation Specialist for the Flagstaff Area National Monuments, based at the Museum of Northern Arizona. All resulting specimens shall remain public property of the NPS, and the NPS shall remain legally responsible for their indefinite curation.

BUDGET: *A separate budget spreadsheet is attached.*