

APPENDIX 5: PROMOTING INCLUSIVE AND EQUITABLE RESEARCH (PIER) PLAN

Our PIER plan details the activities and strategies we will incorporate to enhance the scientific and technical merit of the proposed research by promoting a culture of inclusion and equity. This includes increasing the diversity of the composition of the project team, ensuring the research environment is safe and fair, and enabling scholarly and professional growth of project personnel. These core concepts are discussed in greater detail below.

1. Composition of the Project Team

Student Recruiting and Retention: NAU is a R2 institution and accredited by the U.S. Department of Education as a minority-serving institution. It obtained Hispanic-Serving Institution (HSI) status in 2021; Hispanic enrollment makes up > 25% percent of NAU's total enrollment. NAU also strives to become the leading university serving Native Americans, and is accredited as an American Indian / Alaska Native-serving institution. NAU has over 1,200 Native American students enrolled, representing more than 90 tribes. NAU is located close to tribal lands of Hopi, Navajo, Hualapai, Havasupai, Paiute, and Apache peoples. We will make strong efforts to recruit diverse graduate and undergraduate students locally from NAU to participate in our research, receive graduate degrees, and increase representation from historically underrepresented groups in the research community.

In addition to local recruitment, graduate student recruitment and mentoring support will be also conducted through the AGU Bridge Program. The Center for Ecosystem Science and Society (Ecos; a research center in which Co-PIs Carbone and Richardson are based) was awarded a Bridge Partner in 2022 and PI Carbone is the Bridge liaison for this program. The AGU Bridge program increases opportunities for students from historically marginalized populations to obtain graduate degrees in the geosciences and create a network of peers, mentors, and advisers to support and serve them before, during and after grad school. This program required a Memorandum of Understanding that outlines our approved mentoring program for students of the Bridge Program, developed in collaboration with the AGU Bridge Program directors.

Undergraduate recruitment and mentoring will occur through the NAU Louis Stokes Alliance for Minority Participation (LSAMP) program which supports underrepresented minority students pursuing degrees in Science, Technology, Engineering and Mathematics (STEM). This program takes a comprehensive approach to student development, community building and career readiness programs that connect first and second year undergraduates to research opportunities with the goals of improving college experiences and increasing both academic and professional success. In addition to connecting students to research opportunities and mentoring, this program provides the financial support (salary) for research involvement of these students.

Co-PIs Carbone and Richardson have a proven track record of successful mentoring of undergraduate students and REUs. They mentored an NAU senior capstone project in computer science, which led to the FluxPuppy Android app and portable CO₂ flux measurement system published (with undergraduate coauthors) by Carbone *et al.* (2019). More recently, together they mentored two URMs participating in an NSF-funded REU program at NAU in 2021, which led to a peer-reviewed publication with both REUs included as coauthors. Richardson also previously served as Co-PI on two Harvard Forest REU Site grants from NSF as well as additional funding for the Harvard Forest REU program from NASA. He and his lab group mentored over 15 REUs at Harvard Forest between 2009 and 2018. Two-thirds of these students have been female, and more than half have been from groups traditionally underrepresented in the sciences. Two-thirds of these REUs were coauthors on peer-reviewed publications, and two REUs were first authors.

Involvement of Early Stage Investigators: The project involves two early stage PIs: Co-PI Ben Lucas and Co-PI Adrianna Foster. In addition, this project will continue to support Austin Simonpietri a second year PhD student, a PhD student TBD, and an REU undergraduate student at NAU.

2. Safe Research Environment

DEI training and Workshops: Ecosystem takes pride in its strong commitment to issues related to Diversity, Equity, and Inclusion (DEI). Co-PI Richardson was a founding member of the Center's DEI Committee in 2018, and co-wrote the Center's DEI Statement:

"The Center for Ecosystem Science and Society (Ecosystem) at NAU is committed to fostering an inclusive environment where all members feel valued and inspired to contribute to the Center's success. We believe that a diverse and inclusive workplace leads to greater innovation and is essential to our excellence in science. At Ecosystem, we value diversity of thought and respect all persons regardless of ability, age, ethnicity, gender expression and identity, language, marital or caretaker status, nationality, race, religion, sex, sexual orientation, and socioeconomic status. We recognize that this list is not exhaustive. In order to create a workplace where all members cooperate and collaborate to advance ecosystem science, we are committed to upholding the following principles: 1) We strive toward a work environment that is free from bullying, discrimination, harassment, and prejudice. 2) We acknowledge, respect, and appreciate individual differences and encourage the free expression of ideas. 3) We believe in providing opportunities for everyone to grow as individuals and to participate in our community. This statement was developed through active engagement of students, post-docs, staff, and faculty in the Ecosystem community. It is a statement of how we view our role on campus and in the world, and it guides how we act individually and as a Center. Our community embraces these principles, within and beyond Ecosystem."

In 2022, Co-PIs Carbone and Richardson pledged that they, and their respective lab groups, would together participate in one half-day DEI training event each semester going forward, reflecting a long-term commitment to improving awareness and understanding of DEI issues. Leveraging opportunities offered through NAU's Office of Inclusion, this training will contribute to establishing a safe and welcoming environment for all team members.

Strategies for Inclusive Communication: Communication is key to achieving the goals of this interdisciplinary team project. To ensure communication, all team members will meet twice monthly via Zoom, and more often as needed. The graduate students will meet with their NAU mentors on a weekly basis to facilitate regular mentoring and to promptly address more detailed research questions/challenges. In addition to these twice monthly and weekly meetings, we will hold three in person meetings, one in each year of the proposed project. In Year 1, we will meet at the RMBL in Gothic, Colorado, where all team members can tour the field sites, view the study sites and instrumentation, and work together to plan targeted field measurements. In Year 2, we will meet at NCAR in Boulder, Colorado, to plan modelling and data analyses, and anticipated publications. In Year 3, we will meet at NAU in Flagstaff, Arizona to synthesize the findings and work on publications. The graduate students on this project will take a lead role in planning and setting the agenda both for the twice monthly Zoom meetings and for the annual in-person project meeting.

Field Safety: We will implement recommendations identified in the Report of the Workshop to Promote Safety in Field Sciences (2021). Field work in the East River watershed entails risks that require substantial safety precautions and advance planning. These risks include high altitude, unpredictable and dangerous weather (including lightning, snow, and avalanches), wildlife, and an isolated field station (~20 minutes from the RMBL to Crested Butte by car, and an additional half hour to the nearest hospital in Gunnison). In addition to these logistics, the work we will be required to conduct is challenging and physically demanding. All members of the field team will be expected to carry two-way radios and a first aid kit, as well as extra clothing, food, and water whenever field work is being conducted. All members of the field team will also be required to have up-to-date Red Cross first aid certifications at the start of each field season. To ensure maximum safety precautions are taken in the field, all team members will be required to complete field work contracts and safety plans prior to going in the field. These contracts/plans will follow best practices in Blonder (2022), specifically the section "Actions to improve field safety." We will ensure the opportunity for open communication before, during and after every trip between all supervisors and field workers about the potential hazards (physical, emotional and identity-based), and protocols to operate within them. At the conclusion of each field day, the entire team will discuss progress towards objectives, the plans for the following day, and any issues that may have arisen

during the day. In addition to field work contracts, all field workers will be made aware of, and abide by NAU (<https://in.nau.edu/environmental-health-and-safety/safety-programs/field-safety/>) and RMBL (<https://www.rmbll.org/safety-in-gothic/>) safety resources and code of conduct (https://rmbll.org/wp-content/uploads/2016/03/SC_Research_Code_2016.pdf). The Carbone and Richardson Lab Members will also have annual field safety workshops in the lab, using the resources available from AmeriFlux (<https://ameriflux.lbl.gov/fieldwork/>) and virtual training opportunities offered through AGU (<https://connect.agu.org/biogeosciences/bgsci-announcements445/bgsci-announcements>).

3. Scholarly and Professional Growth

Training Mentoring and Professional Development Opportunities: This project will support two PhD students at NAU. NAU graduate students are expected to participate in a variety of professional development activities, including training in science communication through the weekly Ecos and Ecological Informatics seminars (BIO 698 and INF 623), as well as coursework that includes proposal and grant preparation and team science (INF 605, BIO 587, INF 690) and writing scientific papers (INF 604). Graduate students will carry out all research objectives with oversight from Co-PIs, will lead publications, and will present the work at international conferences. We have specifically requested travel funding for each student to support professional development experiences (including training courses and conferences such as ESA or AGU) ensuring access to opportunities that can advance each individual's needs. These training opportunities include, but are not limited to, the Radiocarbon Short Course, Fluxcourse, and the New Advances in Land Carbon Cycling Modelling Course. Carbone and Richardson have been involved in organizing or contributed to teaching at these courses in the past. All students affiliated with this project will interact regularly with our interdisciplinary team of scientists, and have opportunities to engage and collaborate with federally-funded research scientists (DOE LBNL, NCAR).

Graduate students will gain mentoring experience by collaborating with co-PIs and through supervising the undergraduate researcher. The project will support one undergraduate researcher who will receive training in terrestrial biogeochemical field and laboratory techniques, and participate in the RMBL REU program. We anticipate that graduate students will serve as lead or co-authors on publications resulting from this research. The undergraduate student will be given the opportunity to lead or co-author conference presentations or journal publications they contributed to; this may also include senior thesis or capstone projects.

Co-PIs Carbone and Richardson have established mentoring plans for students and postdocs that focus on training and skills development to ensure an upwards trajectory towards becoming an independent but collaborative scientist. Key elements of this mentoring plan are an emphasis on: research and project development; conference and workshop attendance, and networking; effective oral and poster presentations; manuscript submission and review; mentoring and teaching; and career counseling. Mentoring contracts ensure that the expectations that the bi-directional expectations and responsibilities are understood and agreed to by both parties.

4. Metrics of Success

We will evaluate the success of our PIER plan annually throughout the project, using the following metrics of success: (1) Recruitment of LSAMP, REUs and PhD students who contribute to a more diverse project team; (2) Field seasons without safety incidents; (3) Conference presentations and peer-reviewed publications led by students and early career members of the team; and (4) Inclusion of undergraduates as coauthors on peer-reviewed publications.

References

- Blonder, B. W. 2022. Carrying the Moral Burden of Safe Fieldwork. *The Bulletin of the Ecological Society of America* 104.
- Consortium for Ocean Leadership and California State University Desert Studies. 2021. *Report of the Workshop to Promote Safety in Field Sciences*, March 24-26, 2021. DOI: 10.5281/zenodo.5841983.