Learning and leading with our land: Using ESF's Forest Properties as an Experimental Laboratory for Adaptive Management in a Changing World

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(1) Description of the discovery opportunity. Our forests are a vital asset that are under threat in a rapidly changing world. Managing forests in a future of climate change and invasive species requires that we synthesize the information we have generated in the past, design experiments to address current, new, and emerging challenges, and apply a "learn as we go" Adaptive Management (AM) approach. One of ESF's unique strengths is our extensive College Forest Properties (CFP; ~25,000 acres), combined with our history of management, observations, experimentation, and education on these properties. ESF is uniquely positioned to use our CFP to inform a pathway to produce healthy and resilient forests in the Northeastern region. **The vision of this Discovery proposal is to transform the ESF properties into a living laboratory that leads land management decisions at the state and regional scales for the next 50 years.**

We established an interdisciplinary team of faculty from five departments, the two major remote campuses and staff from the Forest Properties, Moon Library, the Sustainability Division, and the Communications office. This represents a new collaboration for integrating history, cutting-edge science, environmental communication, and digital storytelling. We expect this team to grow into a major new initiative involving the entire College and outside partners.

Program goals:
Legacies. We will evaluate and synthesize the legacy of prior management and experimentation on the CFP, and develop mechanisms to disseminate this information. This includes the history of ESF land, including Native Peoples, early farmers, and ESF land management (sensu "cultural landscapes"). Previous work on the CFP remains underutilized despite its high scientific value, including the oldest forest fertilization study in the US, some of the oldest thinning trials, a harvesting experiment from the 1950s, and an extensive Continuous Forest Inventory (CFI) dataset. In Year 1, we will organize and digitize the extensive paper records, incorporate long-term data (e.g., CFI, monitoring at AEC), and create geo-referenced data products that will be made available via ESF Dataverse. These activities will have high science value for short-term publications, facilitate preparation of competitive proposals for extramural funding, and will increase the visibility of ESF as a national leader in environmental systems and management.
Experimentation. We will build a new network of experimental manipulations on the CFP as a platform for research, teaching, outreach, and extramural funding. We will use a framework of

managing systems to be (1) resistant to change, (2) resilient to change, or instead (3) choose to facilitate a change to a new state. The facilitating transition treatments may include assisted migration of alternate species and planting blight-resistant American chestnut. We will partner with the Center for Native Peoples and the Environment and the Onondaga Nation to develop and implement an indigenous stewardship forest at Heiberg as a component of this experimental platform. Planning these treatments will occur in Years 1 and 2, with implementation by Year 3. External grant applications that capitalize on these treatments will begin in Years 2 and 3. Manipulations and AM will inform NY and regional agency efforts and policy targets in biodiversity conservation, climate mitigation, resource protection, invasive mitigation, and forest restoration. All management applications will be evaluated for operability and financial viability.

Communication. We will communicate past and future land stewardship to build pride in ESF while also offering practical tech-transfer. The CFP can provide excellent experiential learning opportunities for students and the general public, but the CFP are not being used to their potential. We will engage ESF students in the inventory of the cultural, natural, and historic resources currently on ESF's forest properties, and task students with designing trails, informational kiosks, and web tools to communicate this information to the public in a manner that is coherent with the ESF communications strategy. We will interview emeriti and alumni and help them tell their stories of transformational experiences on our properties. Via the Center for Cultural Landscape Preservation, we will collaborate on biocultural surveys of sites and prepare guidelines for preservation of sites' most significant historic features to ensure their continuing stewardship while maintaining AM. We will populate the CFP with videographers and storytellers who will produce media that describe what we are doing and why it is important.

(2) Impact on undergraduate and graduate programs. Integration will include the following:
• **New** 298 and 498 sections for student experiential learning on CFP-AM projects.
• **New** experimental ESF 296 course on Climate Change Mitigation and Adaptation.
• **New** 400/600 summer field course in Adaptive Forest Management taught on the CFP.
• **New** 797 Experimental Design & Monitoring for AM graduate seminar
• **New** proposed Minor in Forest Ecosystem Management
• **New** synthesis topics for FOR 490 capstone course (FES, FRM) and ESF Honor's theses
• Contributions to existing courses in environmental data science, micrometeorology, water resources, wildlife management, forest health, communications etc.

This will affect undergraduate students across the FNRM, EFB, ES, LA, and ERE departments and the Division of Environmental Science. Many existing classes will explicitly use the experiments for field teaching activities, such as FOR232, FOR333/533, SRE 441/641, and SRE 479/679. All departments will consider how to integrate a portion of this project into their first-year seminar courses. At the graduate scale, we will pursue external funding to grow Ph.D enrollments into the Coupled Natural and Human Systems GPES area from 7 to 11+.

(3) A list of agencies, partners, and funding entities. NYS DEC, NYSERDA, NYS EPF, CAFRI, USDA NIFA, USGS, US Forest Service, FEMC, NSF, NASA-ROSES, DOD, US

Army, TNC, American Forests, Northern Forest Center. We are uniquely situated to be "SUNY's Field Station" that draws students and faculty across the SUNY system and private colleges in the region; this already occurs at the AEC where it demonstrates value beyond ESF and generates revenue for local campus operations. Communicating a compelling narrative of our CFP (Year 1), as well as demonstrating active *in-situ* experimentation (Years 3 and beyond), will directly contribute to greater CFP utilization by partners in secondary and higher education.

(4) Partnerships with other academic, government, and private organizations. Our CFP provide a unique opportunity to inform policy initiatives such as the US Climate Alliance of 17 states and NGOs that recently committed to the creation of resilient carbon sinks on natural and working lands. The NY Governor's Office, DEC, Ag & Markets and NYSERDA established the Climate & Applied Forestry Research Institute (CAFRI) and funded ESF initially (2019-2022) to evaluate forest carbon sequestration pathways to meet policy targets. This project will directly inform CAFRI modeling on achieving forest-based climate solutions. Enhancing the use and value of CFP is closely aligned with ESF sustainability targets and specific initiatives such as the NYSERDA-funded Clean Energy Master Plan. Showcasing the CFP will enhance our ability to seek external funding to upgrade CFP facilities with clean energy and efficiency retrofits that are consistent with the principles of environmental stewardship being applied on the land. This project will also strengthen our partnership with SU, via a Global Change Ecology working group of six faculty. Jason Fridley is named on this proposal and represents the SU side. This connection to highly productive researchers will bolster our ability to attract funding for research, particularly on invasive species and climate change.

(5) Increase the use of ESF properties beyond the Syracuse main campus.
The ESF properties are the central focus of the proposed work. Simply put, we can do things with our land that very few other peer institutions can do, and we need to make this our competitive advantage. State leaders are realizing the value of the land base for climate adaptation and mitigation, and in NY where nearly two-thirds of the land is forested, ESF is well-positioned to play a leading role in guiding policy and decision-making. The communications proposed here will increase the integration between CFP and main campus.

(6) Inform policy decisions, enhance ESF's reputation, and have a global impact.
Policy: NY pathways to carbon neutrality via the 50% renewable electricity target and the 40% reduction to greenhouse gas emissions targets, US Forest Service S&PF, US Climate Alliance. Our experiments will combine basic and applied objectives that can be translated into actionable information. Reputation: Become the leading institution on practice of AM in Eastern forests. Global Impact: Sustaining forests and their multiple benefits for society in the Anthropocene.

(7) New investments required to achieve financial sustainability by Year 4.
The search in Forest Ecosystem Management (FNRM) is set and essential for this project. No other major investments have been identified as essential.

Learning and Leading from the Land

<u>Project feasibility statement</u>: (1) *initial startup.* This project would require an initial investment in year 1 to organize the digitization of existing paper records and datasets from the properties, the curation and publication of datasets on the ESF Dataverse, and the organization of a 2-day workshop with faculty, staff, and partners to plan new silvicultural treatments. This work will be made possible by our large and diverse team with expertise in all of the relevant areas. We expect the costs in year 1 to be modest to cover record digitization by an outside consultant already organized via Moon Library, plus some summer salary. The work will transition in year 2 with a more substantial investment to cover treatment implementation (mostly inkind via Forest Properties) and early data collection. We expect to hire an additional full-time Post-Doctoral Associate to oversee these activities.

       (2) *Growth into substantial and self-sustaining program.* This proposal focuses on establishing **platforms** for the basis of future external grant applications. The forest properties have served as platforms in the past, with large extramural grants to support new research on existing or historical resources on ESF properties. However, the forest properties are not being used to their full potential, and digitization and dissemination of the history of research on ESF properties is specifically intended to increase the use of the properties to support extramural grant applications. We have specific applications planned, including forest C storage proposals for a series of upcoming NYSERDA funding announcements, NSF, DOE, USDA, and NASA ROSES applications. We also expect new ideas to develop as the ESF community learns of the resources available on the properties. In addition, the historical and digital storytelling aspects of the proposed work are intended to increase funding income from philanthropic gifts from alumni.

<u>Transformational statement</u>: Establishing an experimental platform for forest management in a changing world is a new idea that would put ESF at the cutting edge of the science in this field. We will consider three potential management strategies: one option is to value the ecosystems that currently exist and put in place management strategies that enhance the stability of these systems. This approach would emphasize making systems *resistant* to outside pressures from invasive species and climate change (e.g., decreasing competition under increasingly stressful conditions). On the other end of the spectrum, we could choose to accept that our ecosystems will change, and put in place strategies to facilitate a *transition* in these systems to a new and useful state. As an example, the Adirondacks are expected to have prime growing conditions for American Chestnut in 50-100 years. Our project will include *transitional* management to establish Chestnut in the Adirondacks. The third concept is managing systems to be *resilient*, in which some major traits of a system are maintained while facilitating some change (e.g., by promoting diversity in structure and species composition). This work is specifically designed to transform the research **platform** of the forest properties to support a new era of ecological research on the properties. The proposed work is also transformational to ESF. The historical aspects of this work will provide substantial capacity building to maximize the use of the properties in teaching and research, including groups that have not utilized the properties in the recent past. We also propose substantial curriculum development focusing on the integration of field-based experiential learning on the southern and northern properties.