

## Smithsonian Institution

# OUR SHARED FUTURE: RESEARCH HIGHLIGHTS JUNE 2023

The following stories highlight Smithsonian research that has helped to shape and champion our strategic pan-Institutional initiatives, including **Life on a Sustainable Planet** and **Solving the Mysteries of the Universe**. These highlights also show the collaborative nature of the Institution's research and dedication to equity, not only across Smithsonian units but in connection with leading universities and national and international research organizations aimed at mitigating climate change and other human impacts on nature.

## ASTRONOMERS FIND POTENTIALLY VOLCANO-COVERED EARTH-SIZED WORLD



LP 791-18 d, illustrated here, is an Earth-size world about 90 light-years away. The gravitational tug from a more massive planet in the system, shown as a blue disk in the background, may result in internal heating and volcanic eruptions—as much as Jupiter's moon Io, the most geologically active body in the solar system. Astronomers discovered and studied the planet using data from NASA's Spitzer Space Telescope and Transiting Exoplanet Survey Satellite along with many other observatories.

Astronomers have discovered an Earth-size exoplanet, a world beyond the solar system, that may be carpeted with volcanoes and could potentially support life. Called LP 791-18 d, the planet could undergo volcanic outbursts as often as Jupiter's moon Io, the most volcanically active body in the solar system. The planet was <u>first reported in Nature</u> and the discovery was made possible in part due to ground-based observations made by the <u>Center for Astrophysics | Harvard & Smithsonian</u>.

LP 791-18 d orbits a small red dwarf star about 90 light-years away in a southern constellation called Crater. The team behind the discovery estimates it is only slightly larger and more massive than Earth. It is tidally locked, which means the same side constantly faces its star. The side facing the star would probably be too hot for liquid water to exist on the surface, but the team suspects that the amount of volcanic activity potentially taking place all over the planet could sustain an atmosphere. These conditions may allow water to condense on the planet's dark side.

"Only a small proportion of the exoplanets discovered so far are thought to be able to support life," said Karen Collins, an astronomer at the **Center for Astrophysics**. "Our discovery of LP 791-18 d gives us more hope that we might one day find signs of life on another planet."

Discovery of the planet was made possible through a combination of space-based and ground-based observations. The researchers discovered and studied the planet using data from <u>NASA's Transiting Exoplanet</u> <u>Survey Satellite (TESS) and retired Spitzer Space Telescope</u>, as well as a suite of ground-based observatories organized by Collins.

The team initially estimated the planet's mass by measuring tiny differences in the time it takes the planet to orbit its host star from one orbit to the next, which are caused by the gravitational tug of the other planets in the system.

"This discovery is just a first step," Collins said. "With the potential to continue studying this planet with the James Webb Space Telescope, we will be able to fine-tune our observations and learn more about the planet's likely volcanically fueled atmosphere. Future discoveries will help us understand how the ingredients of life might have come to be on worlds other than our own."

## LET THE RECORDS SHOW: ATTRIBUTION OF SCIENTIFIC CREDIT IN NATURAL HISTORY COLLECTIONS



World map showing geographic distributions of specimen attributions binned into world regions by botanists Mary Agnes Chase, Velva Rudd, Cleofé Elsa Calderón, and Vicki Funk. For each researcher, the darker shade indicates collections, and the lighter shade indicates identifications. Photo of Funk taken by M. Bonifacino and published in Susanna et al. (2020). Other photos are from the Smithsonian Institution.

The largest collection of Smithsonian specimens and artifacts can be found at the **National Museum of Natural History** (NMNH). There, the Smithsonian stewards 148 million specimens and artifacts. These collections are essential resources for taxonomy, systematics, and ecological and climate change research. The specimen metadata can also be used to study the contributions of the people that collected and identified these specimens. A proper accounting of these contributions impacts our understanding of the history of these collections and all who contributed to their growth.

The work to document and highlight the contributions of women across Smithsonian history requires a multidisciplinary approach. In "Let the Records Show: Attribution of Scientific Credit in Natural History Collections," published in a special issue of the *International Journal of Plant Sciences* dedicated to late NMNH Senior Research Botanist Vicki Funk, researchers from the **Office of the Chief Information Officer**, **National Museum of Natural History**, **Smithsonian Tropical Research Institute**, and **Smithsonian Libraries and Archives** used a combination of data science tools such as artificial intelligence (AI) and old-fashioned detective work to document the scientific contributions of historical Smithsonian women in science. Lead author Rebecca Dikow, and a team that included four former Smithsonian undergraduate interns, used the *Funk List*, a list of

Smithsonian women in science (named for Vicki Funk), to attribute natural history specimens to 40 women, who collectively collected and identified more than 120,000 specimens.

These attributions were published in Bionomia (https://bionomia.net), which allows users to link the collections to the Wikidata ID number for these scientists. This type of work is crucial because, in many cases, women with Smithsonian spouses have been misidentified in the collections when they were listed as "Mrs. <spouse's name>." For example, the work of Mary Vaux Walcott was misattributed to her husband because the title 'Mrs.' had not been included in the transcription of the digitized record.

This work is still incomplete. We are aware of hundreds of other Smithsonian women in science, both living and deceased, who have contributed to NMNH collections. There are many reasons why proper attribution is challenging: collections may not yet be digitized, their names may not appear in full on labels (first initial only or "Mrs. <spouse's name>"), or they may not appear in the collection's metadata if they prepared or mounted specimens. In these cases, scholars can use text processing from digitized documents from SLA, such as the annual reports, to identify women who worked in collections.

The authors are now building additional AI models to accurately extract women's names from historical documents so that even more previously unknown stories can be highlighted. This study honors the legacies of two beloved Smithsonian colleagues, Vicki Funk (-2019) and Effie Kapsalis (-2022). Vicki was a champion of inclusive, collaborative science, and Effie was a tireless advocate for digitization and documenting women's contributions.

## **CENTER FOR ENVIRONMENTAL JUSTICE LAUNCHES ON EARTH DAY**



The Smithsonian's **Center for Environmental Justice** at the **Anacostia Community Museum** launched on Earth Day, April 22. The center seeks to create a future in which environmentalism is a cornerstone of civic engagement through which residents contribute to the development of healthy, equitable communities. The center encourages a humanities-led framework that places traditional scientific research and data in the context of daily life. The Center staff will organize symposiums, panels, fellowships, and an Environmental Justice Academy that will engage young people living in the region and continue the work of well-known programs like "Growing Community," the long-standing community gardening program.

"One of the Anacostia Community Museum's first exhibitions, 'Rat: Man's Invited Affliction,' not only changed the course and mission of the museum in 1969, but it began the trajectory of environmental justice work at the Smithsonian," said Ellen Stofan, the Smithsonian's **Under Secretary for Science and Research**. "From the Urban Waterways program that began in 2010 to the onsite community garden programming, this work has been at the center of this Smithsonian museum for over five decades."

To celebrate the opening of the center this year, the museum's theme for 2023 is "Our Environment, Our Future," in which the museum is examining the topic of environmental justice in the Washington metropolitan area using the lens of race and gender. This theme deepens the museum's existing work in pioneering community-centered practices and critical environmental justice conversations.

"The Center for Environmental Justice is the culmination of over 55 years of the museum's work in and with the Anacostia community," said Melanie Adams, the Roger Ferguson and Annette Nazareth Director of the Anacostia Community Museum. "The conversations we've had, and research that we've done have shown through in our exhibits, public programs, panel discussions, and summits. This Center is the next step in the work that our museum is doing to ensure environmental justice not just for our community, but we hope it can serve as a guide for other communities as well."

The new center is also a part of **Life on a Sustainable Planet**, the Smithsonian's initiative to collect new data about the changing planet, implement holistic approaches to environmental conservation, and educate the world about why and how sustainable solutions to climate change can benefit people and nature. Life on a Sustainable Planet uses the Institution's vast scientific resources across its global network of research centers to produce, curate and communicate strategies for adapting to and mitigating the impacts of climate change. The Institution will also pioneer new technologies to collect environmental data, develop new platforms to analyze and share data and work with partners and communities to inform conservation action. Life on a Sustainable Planet is part of the Smithsonian's commitment to working with communities to promote equitable, sustainable, and resilient ecosystem solutions to build a more sustainable future for all.

### TREE SPECIES DIVERSITY INCREASES LIKELIHOOD OF PLANTING SUCCESS



The team of scientists and interns who planted BiodiversiTREE in 2013, along with roughly 100 volunteers. From left: Susan Cook-Patton, Whitney Hoot, Caitlyn Cecil, Jess Shue, John Parker, Kim Holzer, and Lada Klimesova. (Credit: Susan Cook-Patton)

Planting forests with diverse species can help ensure their success, according to a new study published May 18 from the **Smithsonian Environmental Research Center** (SERC) and The Nature Conservancy. The discovery is the result of a decade of research from <u>BiodiversiTREE</u>, a large-scale reforestation project at SERC designed to run 100 years, testing the effects of different tree planting strategies on sapling survival and other ecosystem functions.

Forests are naturally diverse, and this diversity of plant species brings an array of benefits: pest and disease resistance, resilience to climate change and increased wildlife habitat. However, nearly all forest plantations, and some restoration projects, are planted as monocultures—where a single plant species is grown on the land. This practice leaves both managed and unmanaged forests ecologically and economically vulnerable to changing conditions. Another disadvantage of monocultures is the risk of planting failure—where a sapling fails to thrive—and early mortality.

Hundreds of scientific studies have shown that biodiversity enhances ecosystem function, suggesting that diversity in tree plantings could improve their survival outcomes. Yet there have been few tests of this hypothesis on trees. Scientists designed BiodiversiTREE to test whether tree diversity impacts ecosystem function—the largest experiment of its kind in North America.

In 2013, scientists and 100 volunteers created BiodiversiTREE by planting 20,000 saplings on former agricultural land near the Chesapeake Bay. In some sections the scientists and volunteers planted a single species, and in others four or 12 species. Around 8,000 trees planted in the project were monitored yearly for the first three years, and then every two to three years thereafter. Ten years in, the results showed that reforestation projects with diverse species are more likely to include species that thrive at the planting site, lowering the risk of planting failure.

"Even planting four species instead of just one significantly reduced variation in survival in our plots, showing that small increases in diversity could have large impacts on the success of tree planting efforts," said Rachel King, forest ecologist at SERC and lead author of the study, published in the journal Restoration Ecology. The results echo previous tree diversity experiments showing that monocultures can both thrive and utterly fail, making it risky to plant only one species. Single-species plots in BiodiversiTREE were prone to "boom or bust," with species like sycamore seeing 99% survival rates while hickory plots struggled around 21%. However, diverse plots were much more stable. Overall, the variability of survival in single-species plots was roughly double the variability in 4- and 12-species plots.

Forest ecosystems cover almost a third of the land on Earth, supporting most of its terrestrial species and the livelihoods of millions of people around the world. Forests are also critical in the fight against climate change. In the United States alone, there are up to <u>148 million acres</u> of opportunity to restore forest cover, which could capture 535 million tons of carbon dioxide per year, or the equivalent of removing 116 million cars from the road.

"Tree planting alone will not solve climate change, but done right, has significant potential as a natural climate solution," said Susan Cook-Patton, senior forest restoration scientist at The Nature Conservancy and co-author of the paper. "If we are going to invest in tree planting, it is important to make sure those new forests are set up for success by employing a diverse set of native species."

#### SUMMER BEGINS FELLOWSHIPS AND INTERNSHIPS SEASON AT THE SMITHSONIAN

Hundreds of graduate students and holders of doctorates come to the Smithsonian to do independent research under the guidance of our world-class research staff members. Fellows have the opportunity to study and work intensively with Smithsonian collections and experts in their fields and beyond. In addition, more than 1,500 students pursue internships across the organization, most focused during the summer months. The **Office of Academic Appointments and Internships** (OAAI) has the central management and administrative responsibility for the Institution's internships, fellowships, and other academic appointments.

Opportunities are offered at all of the Smithsonian's museums and research centers. Some, such as the **Smithsonian American Art Museum**, have already announced the appointment of <u>26 fellows</u> for the 2023–2024 academic year. Stephanie Stebich, the Margaret and Terry Stent Director of the Smithsonian American Art Museum, said, "We are pleased to be able to support such groundbreaking studies through our premier fellowship program—the oldest and largest program for the study of American art." Other opportunities, such as the <u>Climate Change, Environmental Justice, and Resilience Fellowships</u> offered in support of **Life on a Sustainable Planet**, will soon open the call for new fellowship applications.

The Climate Change Fellowship program is dedicated to creating sustainable, equitable environmental solutions that provide resilience to climate change and conserve the Earth's ecosystems for all living beings. The Smithsonian awarded the first of these fellowships to three dedicated environmental scientists—Emily Pappo (University of Florida), Ingrid Romero (Morehead State University), and Lucy Morreale (Boston University)—all will begin this summer. Over two years, the fellows will conduct independent research that utilizes Smithsonian data, facilities, and expertise to advance scientific understanding of our global ecosystems and develop sustainable and equitable solutions to climate change.