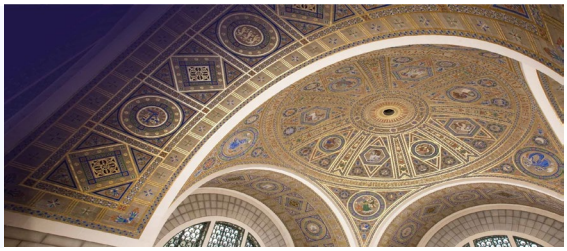
NATIONAL ACADEMIES Sciences Engineering Medicine

Board on Environmental Studies and Toxicology | Board on Life Sciences

# Paving the Way for Continental Scale Biology: Technology, Techniques, and Teamwork for Connecting Research Across Scales (*A Webinar Series*)



## MEETING GOAL AND OBJECTIVES

This is the third of three public information-gathering sessions exploring how biological research at multiple scales can inform the development of a continental-scale biology. This session will focus on data collection, collective engagement and involvement, and innovative tools and techniques to aid in the advancement and understanding of continental-scale biology. This event will provide a platform for creative collaboration among experts from multiple fields, organizations, and sectors.

## MONDAY, AUGUST 21, 2023

**9:00-9:05 am ET** — **Welcome & Opening Remarks**
Jianguo (Jack) Liu, Michigan State University (Chair)

**9:05-10:05 am** — **Panel 1: Coordinated Data Collection & Theory**

Moderator: Brian Enquist, University of Arizona/Santa Fe Institute

Panelists:
Gillian Bowser, Colorado State University
Theresa Crimmins, National Phenology Network
Christopher Lepczyk, Auburn University
Daniel Park, Purdue University

**10:05-11:05 am** — **Panel 2: Indigenous Perspectives: Collaborative Approaches to Continental Scale Biology**

Moderator: Phoebe Zarnetske, Michigan State University

Panelists:
Stephanie Russo Carroll, University of Arizona
Cristina Eisenberg, Oregon State University
Danielle Ignace, The University of British Columbia

**11:05-11:15 am** — **Break**

**11:15-12:15 pm** — **Panel 3: Inclusive Training and Workforce Development: Promoting Diversity, Equity, and Inclusion (DEI)**

Moderator: Bala Chaudhary, Dartmouth College

Panelists:
John Matsui, University of California-Berkeley
Bonnie McGill, American Farmland Trust
Milton Newberry III, Bucknell University
Sara Bombaci, Colorado State University

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| **12:15-1:15 pm** | **Break** |
| **1:15-2:15 pm** | **Panel 4 – Tools, Technology, and Research Techniques: Top-down Approaches**<br><br>Moderator: Inés Ibáñez, University of Michigan<br><br>Panelists:<br>Charuleka Varadharajan, Lawrence Berkeley National Laboratory<br>John Bargar, Pacific Northwest National Laboratory<br>Rachel Buxton, Carelton University<br>Sarah Huebner, University of Minnesota |
| **2:15-3:15 pm** | **Panel 5 – Tools, Technology, and Research Techniques: Bottom-up Approaches**<br><br>Moderator: N. Louise Glass, University of California-Berkeley/Lawrence Berkeley National Laboratory<br><br>Panelists:<br>Nico Franz, Arizona State University<br>Jesús Pinto-Ledezma, University of Minnesota<br>Christine Wilkinson, University of California-Berkeley<br>Elise Zipkin, Michigan State University |
| **3:15-3:25 pm** | **Break** |
| **3:25-4:25 pm** | **Panel 6 – Across Sectors: Interdisciplinary Tools and Theories**<br><br>Moderator: Jack Gilbert, University of California-San Diego<br><br>Panelists:<br>Brook Nunn, University of Washington<br>Andrew Farnsworth, Cornell University<br>Patrick Meyfroidt, Université catholique de Louvain |
| **4:25-4:30 pm** | **Closing Remarks**<br>Jianguo (Jack) Liu, Michigan State University (Chair) |

**MEETING ADJOURNS**

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## SPEAKER BIOS

### JOHN BARGAR, PACIFIC NORTHWEST NATIONAL LABORATORY

Dr. John Bargar is the Environmental Transformations and Interactions Science Area leader. His research interest focuses on molecular processes across molecular to pore to field scales that provide new insights into building new tools and models to better understand and simulate Earth system behavior. For more than 25 years, Bargar has led projects pertaining to both molecular structure and system-scale research with respect to the behavior of essential metal micronutrients and metal contaminants in soils and natural waters. At the molecular level, his research has contributed important findings and models of metal behavior in soils and groundwater. Coordinated laboratory and field work conducted by Bargar and his team discovered that uranium behavior in contaminated soils at legacy DOE sites is controlled by short seasonal “hot moments” when water tables and dissolved oxygen are elevated. At the larger systems scale, his research has focused on understanding how, where, and when

molecular reactions occur and interact across larger distances, from floodplains to regions. For example, laboratory model studies coordinated with field sampling performed by Bargar's team showed that soil organic matter interactions control uranium accumulation and release in soils across the entire upper Colorado River Basin, where these interactions moderate persistent uranium groundwater contamination.

**SARA BOMBACI, COLORADO STATE UNIVERSITY**

Dr. Bombaci is an Assistant Professor in the Department of Fish, Wildlife, and Conservation Biology at Colorado State University. Dr. Bombaci's multidisciplinary research blends conservation science and social science to explore how ecological systems interact with social and environmental gradients in pursuit of innovative solutions to conserve biodiversity while meeting diverse human needs. Dr. Bombaci also prioritizes advancing diversity and inclusion in STEM education, and has over a decade of experience conducting research, teaching, and outreach to foster greater equity and inclusion in academia. Dr. Bombaci received her B.S. in environmental biology at Fort Lewis College in Durango, Colorado, and received both her master's and PhD degrees at Colorado State University.

**GILLIAN BOWSER, COLORADO STATE UNIVERSITY**

Bowser focuses on ecological indicators of climate change, such as pollinator insects, and linkages between changing ecological conditions, local community livelihoods and climate. She places special emphasis on sustainability, citizen-scientist engagement, and encouraging more students from underrepresented backgrounds to study science. Her current interdisciplinary work looks at biodiversity indicators in high elevations around the world. Bowser has worked as a wildlife biologist and ecologist for the U.S. National Park Service in Yellowstone, Grand Tetons, Joshua Tree and Wrangell St. Elias, and was an AAAS Science and Diplomacy Fellow in 2011. She serves on the board for the Rocky Mountain Sustainability and Science Network, and participated in the U.N. Framework on Climate Change Convention and U.N. Global Environmental Outlook. Bowser earned her B.S. from Northwestern University, her M.S. from the University of Vermont, and her Ph.D. in Biology at the University of Missouri-St. Louis.

**RACHEL BUXTON, CARLETON UNIVERSITY**

Rachel is an Assistant Professor at the Institute of Environmental and Interdisciplinary Science and Department of Biology at Carleton University. She leads a team that aims to generate knowledge to support and mobilize equitable conservation solutions. Her main research interests include soundscapes, seabird ecology, ecological restoration, and systematic conservation planning. She works with groups of practitioners, decision-makers, Indigenous peoples, and stakeholders to ensure her research is applicable for mobilizing effective conservation solutions. In drawing from her experiences as a research scientist, mom, life-long learner, teacher, mentor, and community member, she is committed to making a difference for biodiversity conservation and environmental justice.

**STEPHANIE CARROLL, UNIVERSITY OF ARIZONA**

Dr. Stephanie Carroll is a citizen of the Native Village of Kluti-Kaah in Alaska and of Sicilian-descent. At the University of Arizona, she is Associate Professor of Public Health, Associate Director for the Native Nations Institute, and Associate Research Professor at the Udall Center. Her research group, the Collaboratory for Indigenous Data Governance, develops research, policy, and practice innovations for Indigenous data sovereignty. Her research, teaching, and engagement seek to transform institutional governance and ethics for Indigenous control of Indigenous data, particularly within open science, open data, and big data contexts. Stephanie co-edited the book Indigenous Data Sovereignty and Policy and led the publication of the CARE Principles for Indigenous Data Governance. Stephanie co-founded the US Indigenous Data Sovereignty Network and co-founded and chairs the Global Indigenous Data Alliance (GIDA), the International Indigenous Data Sovereignty Interest Group at the Research Data Alliance, and the Indigenous Data Working Group for the IEEE P2890 Recommended Practice for Provenance of Indigenous Peoples' Data.

**THERESA CRIMMINS, NATIONAL PHENOLOGY NETWORK**

Theresa is Director of the USA National Phenology Network and Associate Professor in the School of Natural Resources and the Environment at the University of Arizona. In her role with the Network, Theresa supports an amazing team and works enthusiastically to support the growth and use of phenology data and resources curated by the USA-NPN, involvement in Nature's Notebook, and a broader appreciation of phenology among scientists and non-scientists alike. Theresa's research investigates changes in plant phenology at local to continental scales. Theresa also communicates widely on the topics of phenology and climate change; she has published in Scientific American, The Hill, and the Arizona Daily Star and has appeared in the PBS productions SciGirls and American Spring Live as well as on NPR, The Weather Channel, and Fox Weather.

**CRISTINA EISENBERG, OREGON STATE UNIVERSITY**

Cristina is the Associate Dean for Inclusive Excellence and the Maybelle Clark Macdonald Director of Tribal Initiatives in Natural Resources at Oregon State University (OSU) in the College of Forestry, is a Professor of Practice who specializes in Indigenous Knowledge, and has a PhD in Forestry and Wildlife. As a Native American (Raramuri and Western Apache) and Latinx ecologist, she is the lead principal investigator on several long-term, federally-funded projects with Native American (Montana and Oregon, USA) communities that incorporate Indigenous Knowledge and best Western science in ecocultural restoration of forests and grasslands in North America. At OSU she is leads the Indigenous Natural Resource Office and the Traditional Ecological Knowledge (TEK) Lab. From 2014 until 2019 Cristina was the Chief Scientist at Earthwatch Institute, where she oversaw a global research program focusing on ecological restoration, sustaining human communities (particularly Indigenous Peoples), and increasing ecological resiliency. Cristina is the author of numerous books, journal articles, and book chapters. She serves on the Board of the Society for Ecological Restoration (SER) as Director at Large and leads the SER TEK Working Group.

**ANDREW FARNSWORTH, CORNELL UNIVERSITY**

Andrew Farnsworth is a Visiting Scientist in the Center for Avian Population Studies at the Cornell Lab of Ornithology. Andrew began birding at age 5 and quickly developed his long-standing fascinations with bird migration. His research advances the use and application of rapidly expanding remote and direct sensing technologies to study bird movements across scales, including weather surveillance radar, audio and video recording and monitoring tools, citizen science datasets, and machine learning. He mentors young researchers, from elementary to postdoctoral stages and engages frequently with the media in communication about science, with regular appearances in print, internet, television, radio, and cinematic media. Andrew received his BS in Natural Resources from Cornell, MS in Zoology from Clemson University, and PhD in Ecology and Evolutionary Biology from Cornell University. He directs a family foundation that among other efforts promotes land conservation, climate change education, women's rights and children's education. Andrew is also a performing musician, and he lives with his wife Patricia and daughters Aja and Elle in Manhattan.

**NICO FRANZ, ARIZONA STATE UNIVERSITY**

Nico Franz is the Virginia M. Ullman Professor of Ecology and Biocollections Director at the School of Life Sciences, Arizona State University. He is an evolutionary biologist and insect systematist who specializes in the megadiverse plant-feeding lineage of weevils, estimated to include 220,000 species globally. His research program also focuses on developing innovative biocollections infrastructure and biodiversity data science services; including AI - and logic -enabled tools to integrate evolving systematic knowledge robustly, equitably, and at scale. At Arizona State University, he is the principal investigator of the National Ecological Observatory Network, NEON Biorepository, and the iDigBio Symbiota Support Hub, which sustains more than 1,900 collections and 90 million global occurrence records. He serves as curator of insects and directs the Biodiversity Knowledge Integration Center (BioKIC).

**SARAH HUEBNER, UNIVERSITY OF MINNESOTA**

Dr. Huebner is a postdoctoral Researcher with the University of Minnesota College of Science and Engineering and Zooniverse, a crowdsourcing platform that connects volunteers with professional scientists to quickly and accurately process Big Data across a wide range of domains. Her research focuses on the practical aspects of

conserving and restoring wild mammal populations, including long-term continuous monitoring to safeguard biodiversity and assess trends in wildlife demographics and distributions in response to anthropogenic disturbances. She is also an active proponent of employing citizen science and machine learning for conservation and ecological research and democratizing access to artificial intelligence. She created and manages 'Snapshot Safari', a multinational distributed network of ecologists, wildlife managers, data scientists, citizen scientists, and local community members working together to protect and restore African mammals. Snapshot Safari has deployed camera trap grids at more than 50 sites in Botswana, Kenya, Mozambique, South Africa, Tanzania, and Zimbabwe using standardized data collection protocols to allow for cross-site comparisons of wildlife populations and conservation programs. She is a co-founder of the Labeled Image Library of Alexandria, a public repository of labeled images for use in training new machine algorithms. Huebner received a PhD in Wildlife Ecology and Management from the University of Minnesota.

**DANIELLE IGNACE, UNIVERSITY OF BRITISH COLUMBIA**

Dr. Danielle Ignace is an Assistant Professor in the Faculty of Forestry at the University of British Columbia and a Research Associate at Harvard Forest. As an enrolled member of the Coeur d'Alene tribe, Dr. Ignace studies how global change (climate change, fire, and introduced species) impacts ecosystem function and Indigenous communities. She currently serves as an elected Officer for the Traditional Ecological Knowledge Section of the Ecological Society of America, Chair of the Equity, Diversity, and Inclusion Committee for the American Society of Plant Biologists, and is a member of the Resurgent Indigenous Scholars for the Environment (RISE) collective at UBC. Dr. Ignace was a Wall Scholar for the 2022-2023 Catalyst Program at the Peter Wall Institute for Advanced Studies at UBC and a Science for Society Equity Fellow at Fair Count Inc. She is an Associate Editor for the journal Elementa: Science of the Anthropocene, which is a trans-disciplinary, open-access journal committed to the facilitation of collaborative research. Fostering unique collaborations to understand and communicate pressing global change problems is the hallmark of her research, teaching, YouTube channel, and ArtSci projects. Dr. Ignace is deeply committed to developing Indigenous curriculum and her perspective bridges Indigenous communities, people of color, and scientists.

**CHRISTOPHER LEPCZYK, AUBURN UNIVERSITY**

Dr. Lepczyk is an ecologist whose background focuses on questions related to conserving nature and biodiversity. Originally from the Great Lakes region, he received his BS in Biology and Geology from Hope College, his MS in Wildlife Ecology from the University of Wisconsin-Madison, and his PhD in both Fisheries and Wildlife, and Ecology, Evolutionary Biology, and Behavior from Michigan State University. Prior to joining Auburn University, he was an Associate Professor at the University of Hawai'i at Mānoa in Honolulu. He and his lab work on topics including invasive and endangered species, conservation planning, urban ecology, landscape ecology, citizen science, wildlife and avian ecology, human-wildlife conflict, and socioecological systems.

**JOHN MATSUI, UNIVERSITY OF CALIFORNIA-BERKELEY**

John Matsui is the Assistant Dean of Biology and Director/Co-Founder of UC Berkeley's Biology Scholars Program (BSP). He is an evolutionary biologist and science educator trained in the California Community College and University of California school systems. Dr. Matsui's dedication to make STEM more diverse, equitable, and inclusive comes from his passion for science and his experience growing up Japanese American in post-World War II California. For 30 years, he has worked with 4000 Cal undergraduates in BSP, of which 60% have been URMs (African American, Latine, and American Indian), 70% women, and 60% from low-income and/or first-to-college backgrounds. Dr. Matsui's goal is to 'level the playing field' for those not fitting the historical profile of success, so they become leaders in their future science-related careers. He has served on STEM-equity panels and national committees for NIH, NSF, and HHMI. His awards and honors include, Distinguished Mentor Award (SACNAS), Mentoring Keynote Award (ASCB), Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM) (NSF). Dr. Matsui sees BSP as a scalable model to make STEM education more equitable, one that nurtures and values the talent of all individuals, and not just those who fit the traditional profile of success.

**BONNIE MCGILL, AMERICAN FARMLAND TRUST**

Bonnie McGill (she/her) is an ecosystem ecologist and a Senior Climate and Soil Health Scientist at American Farmland Trust (AFT), a national non-profit organization working to protect farmland, promote environmentally sound farming practices, and keep farmers on the land. McGill serves on the AFT DEIJ committee and was on a

similar committee in her previous role at Carnegie Museum of Natural History. She has authored and co-authored several peer-reviewed papers on promoting DEIJ in academia and on decolonizing conservation. McGill believes ecologists and conservation biologists have a particularly important role in a) transforming the relationship between western science and the land and b) making space for traditional ecological knowledge and knowledge-keepers. In the coming years she will be working with a team as part of a USDA Partnership for Climate Smart Commodities to co-develop and implement anti-racist strategies for delivering technical and financial assistance to BIPOC farmers across the US.

**PATRICK MEYFROIDT, UNIVERSITÉ CATHOLIQUE DE LOUVAIN**

Patrick Meyfroidt holds a PhD in geography (2009) and a degree in sociology from Université catholique de Louvain (UCLouvain) in Belgium. Since 2016 he is Research Associate at the F.R.S-FNRS (the Belgian Research Funds) and Professor at UCLouvain. His research focuses on how land use and more broadly land systems can contribute to sustainability. His main research interests are land use transitions, i.e. non-linear land use dynamics at broad scale such as forest transitions and emergence of land use frontiers; linkages between globalization and land use including supply chain interventions to halt deforestation; theories of land system change; and social-ecological feedbacks. His recent projects include the MIDLAND project https://erc-midland.earth/ (ERC Starting Grant) investigating emerging agricultural and forestry frontiers in Mozambique and Southern Africa; the SUSTAIN-COCOA project https://epl.ethz.ch/research/SUSTAIN-COCOA.html researching cocoa supply chains, deforestation and sustainability in West Africa; the COUPLED project https://coupled-itn.eu/ investigating telecouplings and sustainability issues; and participations to the Trase initiative https://www.trase.earth/ .

**MILTON NEWBERRY III, BUCKNELL UNIVERSITY**

Milton Newberry, Ph.D. serves as the Director of the Sustainable Technology Program at Bucknell University, where he guides the development and implementation of research and outreach projects on renewable energy, environmental conservation, and community engagement with natural resources. He has extensive love for and background in informal STEM education, sustainability, and environmental conservation. Additionally, he has a research focus in environmental stewardship motivations and barriers, JEBDAI (justice, equity, belonging, diversity, accessibility, and inclusivity) in environmental conservation, human dimensions of natural resources and agriculture, and sustainability and climate change perceptions. Currently, Dr. Newberry centers his research on exploring the lived experience of BIPOC scientists and STEM professionals working in their discipline, the racist behavior endured, and pathways for success despite the encountered racism. Outside of his academic role, he serves on the advisory board of “Letters to a PreScientist”, a nonprofit building STEM identity and awareness in youth from marginalized communities through pen pal letters and connection with STEM professionals. Dr. Newberry also holds a deep passion for student mentorship and works with BIPOC students to navigate academic environments and thrive for success. When he is not working, he enjoys spending time with his family, working out, and birding.

**BROOK NUNN, UNIVERSITY OF WASHINGTON**

Brook Nunn is currently a research professor in the Department of Genome Sciences at the University of Washington. She has bachelor degrees in geology and chemistry and completed her Ph.D. in chemical oceanography at the University of Washington. In her thesis work, she pioneered mass spectrometry analysis of proteins from ocean ecosystems to understand their long-term preservation and degradation potential. Her post-doctoral work was a combination of honing her MS-based analytical skills and initiating the development of methods to bioinformatically unravel environmental microbiome metaproteomics and non-model proteomics analyses. As a research professor, she has diversified her research to include macro and microfauna in the ocean. Her lab uses peptide-based detection and quantification to track the changing functions of an ecosystem in response to perturbations over time. This allows them to use time-course data to see metabolic scheduling, understand functional redundancy, and search for protein signals that can serve as biomarkers that indicate state shifts in the ecosystem. Her explorations of proteomes from polar and hydrothermal vent extremophiles have recently led her to develop the use of MS-based peptide analysis as a means for life detection off Earth. She is

currently the Co-lead of NASA's Network for Life Detection and has been the director of the UW-Environmental Proteomics Resource Center for 15 years.

#### JESÚS PINTO-LEDEZMA, UNIVERSITY OF MINNESOTA

Jesús is an evolutionary and quantitative ecologist whose work focuses on developing a deeper understanding of species coexistence and patterns of diversity across spatial and temporal scales and the underlying processes that drive, maintain, and alter these patterns. He earned his Ph.D. in Ecology and Evolution at the Federal University of Goiás (Brazil) and holds an M.S. in Wildlife Management from the National University of Córdoba (Argentina). His work concentrates on terrestrial systems, with a focus on avifauna and vascular plants, but also encompasses other terrestrial groups. He integrates evolutionary and ecological theories of biodiversity and develops methodological advances to unveil processes acting in concert at different temporal and spatial scales. The ultimate aim of his research program is to apply insights gained from understanding the onset of biodiversity patterns to inform conservation and management responses to ongoing global change and biodiversity loss.

#### CHARULEKA VARADHARAJAN, LAWRENCE BERKELEY NATIONAL LABORATORY

Charuleka Varadharajan is a biogeochemist and data scientist at Berkeley Lab. Her interdisciplinary research spans a broad range of topics including the impacts of human and natural disturbances on water resources, methane cycling, environmental impacts of carbon sequestration and fossil fuel production, and bioremediation. She also leads the Earth AI and data program at LBNL and her research group is developing data science capabilities – from machine learning and statistical algorithms, to data management services and software for integration of diverse environmental data.

#### CHRISTINE WILKINSON, UNIVERSITY OF CALIFORNIA-BERKELEY

Christine Wilkinson is a conservation biologist, carnivore ecologist, and science communicator currently based at University of California, Berkeley and the California Academy of Sciences. Her research interests include multidisciplinary mapping, human-wildlife conflict, carnivore movement ecology, and using participatory methods for more effective and inclusive conservation outcomes. Wilkinson's research uses remote sensing and GIS analyses in conjunction with participatory mapping to understand social-ecological landscape permeability for carnivores, the dynamics of human-carnivore interactions, and the intersections between human and wildlife wellbeing in Nakuru County, Kenya and in the Bay Area and Los Angeles, California. She looks to integrate a variety of community perspectives toward lasting and socially-just environmental outcomes.

#### ELISE ZIPKIN, MICHIGAN STATE UNIVERSITY

As a quantitative ecologist, Dr. Elise Zipkin connects the complexities of natural communities with the precision of mathematics to shine light on mysteries in ecology and conservation. Elise and her team develop analytical frameworks to address grand challenges in the study of biodiversity loss and the effects of anthropogenic activities, such as climate change. She harnesses empirical data (big and small) to understand fine and subtle interactions in the natural world, revealing the causes and consequences of species' declines and biodiversity loss while charting pathways to mitigate and reverse these alarming trends. Elise has published over 85 peer-reviewed articles and delivered more than 50 invited talks nationally and internationally. Among her honors is being named an Ecological Society of America Early Career Fellow and a Fulbright U.S. Senior Scholar. Elise regularly works with management agencies to translate the results of her research for conservation. She is committed to open, accessible, and reproducible science and to supporting and mentoring the next generation of scientists, natural resource managers, policy makers, and scientific communicators.