



REPORTS FROM ESA WORKSHOPS

Scaling Up: Concurrent Workshops on Continental-scale Population and Community Ecology and the Future of Environmental Decisions: An ESA Workshop Report

Jill Petraglia Parsons, Andrea McMillen, Clifford S. Duke, Teresa Mourad, Ecological Society of America; Deborah Goldberg, University of Michigan

I. Introduction

Over the past decade, opportunities to address new scientific questions at the continental scale have grown immensely. The demand for professionals and research scientists trained to analyze large volumes of data in the context of increasing pressures on environmental and social systems is increasing, as is the demand for scientists with training on how large data sets can inform environmental decision-making. Some ecologists, such as those working in population and community ecology, and students may have limited experience working at this spatial scale. In response to these trends, and as part of the Ecological Society of America's (ESA) efforts to promote the continued development of ecological science, ESA hosted two concurrent Scaling Up workshops in early June, 2013, both funded by the National Science Foundation.

“Scaling Up: Population and Community Ecology, A Workshop for Early-Career Scientists” was held 3–7 June 2013 in Linthicum Heights, Maryland, at the Maritime Institute's Conference Center. The workshop included three and a half days of presentations, discussions, working group sessions, and joint meetings with the concurrent student workshop on the Future of Environmental Decisions. “Scaling Up: Future of Environmental Decisions, A Workshop for Students” was held on 2–7 June 2013 at the same location. The student workshop included four and a half days of lectures, group work, joint sessions with the early-career workshop, and a field trip to the Chesapeake Bay and Jefferson Patterson Park in Solomon, Maryland. The concurrent workshops provided valuable opportunities for early-career scientists and students to interact and provide feedback on each other's research ideas and presentations.

II. Structure and objectives of the concurrent workshops

The Early-Career Workshop on Population and Community Ecology reflects a broad movement in ecology towards the use of networks, global knowledge bases, and public data. The workshop brought together young scientists so they could consider how to address the scope and scale of today's ecological and environmental challenges. The primary objectives of the early-career workshop were to:

- Identify key questions in population and community ecology that can or should be addressed at continental scales;
- Assess the status of existing analytical, physical, and software tools needed to address these questions; and
- Identify needs and capabilities for developing new tools to address continental-scale questions.

The early-career workshop included a series of “tool talks” given by members of the organizing committee. These helped provide participants with some common background information on resources and tools for continental-scale ecology that reached across the many disciplines represented by the participants.

- “The New Vast Machine: Map of Life and challenges and solutions to documenting global biodiversity and its change” (Robert Guralnick)
- “Geospatial data for large-area ecology: lessons learned” (Janet Franklin)
- “Interactions and traits: trying to scale up from community assembly” (Katharine Suding)
- “What do we do with all these data? Modeling strategies for continental-scale ecology” (Matthew Fitzpatrick)

In large and small group discussions, participants identified a number of important questions to be addressed at the continental scale and identified existing or new analytical, physical, and software tools needed to address these questions. By the second full day of the workshop, participants and the organizing committee worked together to refine this list to five key questions. Participants self-selected into working groups around these questions, and spent much of the remainder of the workshop developing research plans, including identifying data sets and available or needed analytical tools that address their selected question, and presenting those ideas to participants in the Student Workshop on the Future of Environmental Decisions.

The Scaling Up: Future of Environmental Decisions (FED) student workshop was a continuation of a program which began in 2008 to promote the future of continental-scale science and education to primarily undergraduate institutions and underrepresented audiences in ecology. The student Scaling Up workshop is the second FED workshop that ESA has organized. During this workshop student participants learned about the role of continental-scale science in helping citizens and decision-makers better understand the interaction of local and regional issues and the complexity of environmental decision-making, using a case study of the Chesapeake Bay.

This FED workshop introduced undergraduate and graduate students from diverse backgrounds to the National Ecological Observatory Network (NEON) infrastructure and provided opportunities for students to:

- Develop insights into environmental decision-making using environmental and social science data;
- Gain 21st century skills in working with large-scale data, mapping, and public communications technologies;
- Build skills to communicate science to land and resource managers and the general public; and
- Explore potential ecology and environmental science careers.

To achieve these goals, participants worked in small groups to address environmental challenges within the Chesapeake Bay watershed. At the beginning of the workshop the participants were introduced to some of the major concepts they would be addressing throughout the week: ecology, social-economic dimensions, spatial analysis, QGIS, and science communication. Talks and activities on these subjects were led by a multidisciplinary faculty.

At the beginning of the workshop, students presented mini-posters using the Integration and Application Network (IAN) Conceptual Diagramming Tool developed by the University of Maryland Center for Environmental Science (UMCES).

Participants engaged in a large-scale participatory simulation called The UVA Bay Game, a simulation based on the Chesapeake Bay watershed. The game allowed participants to take on the roles of stakeholders, such as farmers, developers, watermen, and local policy-makers; make decisions about their livelihoods or regulatory authority; and see the impacts of their decisions on their own personal finances, the regional economy, and watershed health.

Workshop participants were then organized into small groups to identify and research a topic of their choice related to environmental issues within the Chesapeake Bay watershed. To provide additional context about the watershed and spatial analysis, a field trip was organized by UMCES to the Chesapeake Biological Laboratory and Jefferson Patterson Park. During the field trip, participants explored chemical and biological indicators of the Bay's health aboard the Research Vessel *Rachel Carson*, out on the Chesapeake Bay. UMCES faculty also led exercises in understanding error in spatial analysis data. A rich discussion about how data is used for local policy implementation was hosted by Greg Sandi from the Maryland Department of the Environment and Alex Reed, Division of Environmental Management Watershed Specialist for Washington County, Maryland.

Student workshop participants worked tirelessly to present 5-minute preliminary presentations mid-week to the early career workshop participants, and then final 20-minute presentations on Friday to a panel of invited guests.

III. Outcomes from the Early Career Workshop on Population and Community Ecology

The early career workshop's relatively unstructured approach encouraged participants to work together to develop new ideas and research teams. The workshop organizing committee deliberately assembled an interdisciplinary group of scientists with diverse experience and backgrounds. A selection of the varied disciplines represented at the workshop (beyond community and population ecology)

include: theoretical ecology, landscape ecology, urban ecology, ecological modeling, macroecology, biogeography, remote sensing, ecoinformatics, entomology, botany, quantitative ecology, computational ecology, molecular and microbial ecology, and conservation ecology.

Five key questions to be addressed at the continental scale in population and community ecology.

On the first full day of the workshop, participants focused on identifying key questions in population and community ecology that can or should be addressed at continental scales. Participants were encouraged to consider questions that involved integrating across scales (incorporating local-scale ecological processes such as species interactions into continental scale patterns, and vice-versa), integrating observational data and mechanistic experiments, and relating static (such as occurrence data) and dynamic data (such as demography) over space. The final list of the most important key questions identified by workshop participants is as follows:

- What is the relative importance of different processes for population/community responses at different scales? How do the role and magnitude of dispersal change as a function of scale, and at what scales do biotic interactions matter to distributions of species in time and space?
- What is the role of intraspecific variation (local adaptations, traits, function, etc.) on continental-scale patterns? Do models need to account for this variation or are species-level attributes sufficient for prediction?
- When and how can experiments (and observations) at a small extent (but potentially fine grain) be used to extrapolate to larger extents or predict trends? In other words, how do we integrate small-scale observations/experiments into macro-scale assessments or trends over space and time?
- How do models of species–environment relationships and macroecological models that ignore species differences differ in predictions of community attributes? Do differences in predictions change from local to global scales, and for different community attributes?
- Does environmental heterogeneity or functional diversity influence ecosystem resilience, and are these relationships similar across systems?

A paper summarizing these questions and many others that arose during the workshop is in progress.

On the final day of the workshop, participants took time to reflect on some of the broader questions they were not able to address or discuss. Some of these issues and questions include:

- How are we actually going to incorporate biotic interactions into community ecology, and how do biotic interactions change across space?
- If we do see different patterns, what tools can help us classify these patterns?
- What mechanisms exist for spatially explicit biotic feedback?
- Many questions and issues concerning data arose, including:
 - Do we need data sets that scale?
 - Do we need a framework for how data sets should fit together in terms of scaling, or a standard protocol for how to scale data?

- What are the missing components we need to stitch existing data together at different scales?
- How do we progress from scaling up populations and begin to assess aspects like ecosystem function?
- How does human impact affect the inferences we make in our research, and how do continental-scale data help with decision making?
- It appears we may need some additional analytical tools to answer these questions; what are they, and what would they look like?

Since the workshop, participants have been in touch with their working groups frequently, and many groups are working on research publications and review papers that they hope to publish in the near future. In post-workshop surveys, participants felt they gained the most from the small group breakout and brainstorming time, and felt they gained a lot of knowledge and furthered their understanding of how to use continental-scale data by interacting with a diverse and interdisciplinary group of peers.

IV. Outcomes from the Student Workshop on the Future of Environmental Decisions

The final output from the student workshop was a 20-minute presentation given by each working group. ESA members in the Baltimore area were invited to attend the presentation and meet with students. Three ESA members and ESA Executive Director, Katherine McCarter attended. A brief description of each presentation is provided below:

- Group 1: Threat of urbanization on water quality.
Utilizing data on brook trout populations, water quality, and human population density, the group did an analysis to determine if changes in water quality and human population density were correlated with changes in brook trout populations.
- Group 2: A comparison of socioeconomic and Bay health trajectories in two Chesapeake sub-watersheds.
Utilizing data about population density, median household income, and water quality, this group compared different watersheds to create a framework for understanding water quality and human population dynamics as a model for the Chesapeake Bay.
- Group 3: Health and wealth in Maryland: Do economic indicators correlate spatially with water quality?
Utilizing the Social Vulnerability Index and water quality data, four counties in Maryland were compared to determine if there is a correlation between areas with low socio-economic indicators and poor ambient water quality.
- Group 4: Constructing Artificial Wetlands in the Patuxent River Watershed.
This group utilized QGIS technology to identify key locations for wetlands within the Patuxent River Watershed as a means to improving water quality in the Chesapeake Bay. Their criteria for suggested locations for additional wetlands included the percentage of impervious surface,

current land use, and proximity to streams.

- Group 5: Suburbia's Influence on Water Quality in the Chesapeake Bay.
This group addressed questions regarding the relationships between suburban areas and water quality, and which related environmental issues should be addressed with policy.

The student workshop participants responded very positively to the workshop. More than 80% felt that it helped increase or reinforce their interest in learning about how data informs decision-making and the principles of science communication to a great extent. Further, 85% or more indicated the workshop helped them gain a better understanding of how social, economic, and political dimensions affect environmental decision-making.

Both faculty and participants greatly appreciated the diversity of workshop participants in terms of their perspectives, disciplines, cultures, skills, and experience. Participants welcomed the opportunity to collaborate on a multidisciplinary team and recognized that this will be increasingly important in their careers.

Strikingly, nearly 96% of all participants indicated they learned how NEON data will be able to help address environmental management solutions. This is encouraging, as a principal motivation for this workshop is to help the field understand ways to utilize NEON data once available, and to help NEON gain insight on data products that will be useful for education and to society.

V. Next Steps

ESA's Office of Science Programs hopes to replicate the Scaling Up workshop for early-career scientists while focusing on a different sub-discipline within ecology. Ideas and suggestions for a future workshop of this type focused on continental-scale data are welcome. Please contact Cliff Duke, Director of Science Programs, at csduke@esa.org with recommendations.

The ESA Education and Diversity Office plans to continue the FED program with similar workshops that take place in other regions of the United States. Workshop faculty from minority-serving institutions recruited for this workshop are assuming leadership for subsequent opportunities. The office also has plans to convert some of the workshop activities into teaching modules for classroom use. When ready, these teaching modules will be cataloged in ESA's [EcoEd Digital Library](#). Please contact Director of Education and Diversity Programs, Teresa Mourad at teresa@esa.org for further information.

VI. Appendix A: Participants in the Early Career
Workshop on Population and Community Ecology

Margaret Andrew
Murdoch University
School of Veterinary and Life Sciences

Shawn Leroux
Memorial University of Newfoundland
Biology

Christie Bahlai
Michigan State University
Entomology

Sean Maher
University of California, Berkeley
Museum of Vertebrate Zoology

Benjamin Baiser
Harvard University
Harvard Forest

Stephen Mayor
University of Alberta
Biological Sciences

Lydia Beaudrot
University of California, Davis
Graduate Group in Ecology

Daniel McGlenn
Utah State University
Biology

David Bell
University of Wyoming
Department of Botany

David Miller
Pennsylvania State University
Ecosystem Science and Management

Jonathan (Yoni) Belmaker
Tel Aviv University
Zoology

Emily Minor
University of Illinois at Chicago
Biological Sciences

Bethany Bradley
University of Massachusetts, Amherst
Environmental Conservation

Emily Moran
ETH Zurich
Biology

Brad Butterfield
Northern Arizona University
Department of Biological Sciences

James O'Dwyer
University of Illinois
Plant Biology

Sarah Elmendorf
National Ecological Observatory Network
Plant Ecology

Ian Pearse
Cornell Lab of Ornithology
Bird Population Studies

Florian Hartig
University of Freiburg
Biometry and Environmental System Analysis

Kabir Peay
Stanford University
Biology

Sydne Record
Michigan State University
Departments of Forestry and Geography

Seeta Sistla
University of California, Santa Barbara
Ecology, Evolution, and Marine Biology

Marko Spasojevic
University of California, Davis
Environmental Science and Policy

Angela Strecker
Portland State University
Environmental Science and Management

Katherine Thibault
National Ecological Observatory Network
Terrestrial Ecology Group

Morgan Tingley
Princeton University
Woodrow Wilson School

Mao-Ning Tuanmu
Yale University
Ecology and Evolutionary Biology

Ruscena Wiederholt
University of Arizona
School of Natural Resources and the Environment

John Withey
Florida International University
Biological Sciences

Phoebe Zarnetske
Yale University
Yale School of Forestry & Environmental Studies

ESA Staff and Workshop Organizing Committee:

Clifford S. Duke
ESA Director of Science Programs

Matthew Fitzpatrick
University of Maryland
Center for Environmental Science

Janet Franklin
Arizona State University
School of Geographical Sciences and Urban Planning

Deborah Goldberg
Organizing Committee Chair
University of Michigan

Robert Guralnick
University of Colorado at Boulder
Ecology and Evolutionary Biology

Jill Petraglia Parsons
ESA Science Programs Manager

Katharine Suding
University of California, Berkeley
Environmental Science, Policy, and Management

VII. Appendix B: Participants in the Student Workshop on the Future of Environmental Decisions

Laura Bartock
University of Maryland, Baltimore County
Major(s): Environmental Science, Media and Communication Studies

Juan Botero
The City College of New York
Major(s): Economics

Wanda Briscoe
University of the District of Columbia
Major(s): Architecture

John Brito
University of Missouri- Columbia
Major(s): Civil/ Environmental Engineering

Rory Carroll
SUNY Plattsburgh
Major(s): Biology

Brenda Castro-Voltaggio
University of Puerto Rico—Medical Sciences Campus
Major(s): Demography

Yvan Delgado de la Flor
Humboldt State University
Major(s): Wildlife Conservation and Management

Jessica Flondro
Augustana College
Major(s): Geography and Environmental Studies

James Haggar
West Virginia University
Major(s): Landscape Architecture

Aubrie James
Iowa State University
Major(s): Animal Ecology

Tiona Johnson
Virginia Commonwealth University
Major(s): Urban and Regional Planning with a concentration in Regional Analysis and Development; Environmental Studies

Rugiyatu Kane
Spelman College
Major(s): Environmental Science and Studies

Bonnie Keeler
The University of Minnesota
Major(s): Natural Resources Science and Management

Laina Lockett
University of Pittsburgh
Major(s): Ecology and Evolution

Maria Cristina Martinez
Chapman University
Major(s): Environmental Science and Policy

Greg Patton
Augustana College
Major(s): Accounting and Political Science

Mariana Quiñones Rosado
University of Puerto Rico, Rio Piedras Campus
Major(s): Environmental Science

Mark Rogers
Virginia Tech
Major(s): Biological Systems Engineering

Daniel Schall
University of Maryland, Baltimore County
Major(s): Geography and Environmental Systems

Joy Semien
Dillard University
Major(s): Biology

Sumnima Sharma
ESA Education Intern
Christ University, Bangalore, India.
Major: Business Management

Kelsey Stockert
Augustana College - Rock Island, Illinois
Major(s): Biology, Environmental Studies,
Spanish for Professional Use

Tracy Wendt
University of Montana
Major(s): Resource Conservation - Aquatic
Ecology emphasis

Becky Wood
University of Oklahoma
Major(s): B.A. Environmental Sustainability
(Planning and Management); B.A.
Interdisciplinary Perspectives on the
Environment (Natural Resource Policy)

Stephanie Wilson
The University of Pennsylvania
Major(s): Biology (The College of William
and Mary)

Andrew Elmore
University of Maryland Center for
Environmental Science

Steve Guinn
University of Maryland Center for
Environmental Science

Andrea McMillen
Ecological Society of America

Teresa Mourad
Ecological Society of America

Carla Restrepo
University of Puerto Rico at Rio Piedras

Allen Roberts
Tennessee State University

Jane Thomas
University of Maryland Center for
Environmental Science

Leah Wasser
National Ecological Observatory Network

Brian Wee
National Ecological Observatory Network

ESA Staff and Workshop Organizing Committee:

Fred Abbott
Ecological Society of America

Alan Collins
West Virginia University

Bill Dennison
University of Maryland Center for
Environmental Science