Citizen Science 2015 Conference

Poster Presentation Abstracts
Exhibited on February 11, 2015
San Jose, California

Posters are listed in alpha order by first author
*Presenting authors' names are **bolded***
Affiliations are US-based unless otherwise indicated

Guide to Poster Themes
Bracketed letters following each abstract indicate the Theme of the Poster
[A] Best Practices for Designing, Implementing, and Managing Citizen Science Projects and Programs
[B] Broadening Engagement to Foster Diversity and Inclusion
[C] Digital Opportunities and Challenges in Citizen Science
[D] Making Education and Lifelong Learning Connections (K-12, university, informal)
[E] Research on and Evaluation of Citizen Science Experience
[F] Tackling Grand Challenges and Everyday Problems with Citizen Science
[G] Other

Guide to Groupings of Posters within the Poster Session
Numerals following each abstract indicate the Poster's position in the Poster Session
(e.g. 7.1 is Row 7, Poster 1)

GOOGLE IMAGERY AND GEO TOOLS FOR CITIZEN SCIENTISTS
Christiaan Adams, Google Earth Outreach
What if you could get updated satellite imagery of the places you are working in, or put the aerial imagery you're creating into Google Maps? What if you could see how your region has changed over the last 30 years? What if you could measure that change using remote sensing analysis in the cloud, without having to download and process massive amounts of data? Google has tools and programs that allow nonprofits, researchers, citizen scientists and others to do all of these things for free. This session will provide a brief overview of Google's Geo tools, especially the ones for imagery analysis (Google Earth Engine and Timelapse), and the potential to get software grants and request imagery updates through the Google Earth Outreach program.
[C] 7.10

CITIZEN SCIENCE, EDUCATION AND ENGAGEMENT FOR CONSERVATION
Janet Ady, US Fish and Wildlife Service
The U.S. Fish and Wildlife Service is creating a framework to guide design of citizen science projects that inform adaptive land management practices in response to climate change. The framework will assist teams of FWS educators, scientists and partners to jointly design and manage projects to meet mutual objectives, using sound protocols. Citizen science program participants would then collect crucial scientific data while developing conservation stewardship knowledge and skills, expanding reach and impact. This poster reviews research related to environmental education, experiential education, and conservation behavior change that can be applied to citizen science program design. Preliminary results from both case study research and a facilitated workshop of subject matter experts is shared. Findings regarding key criteria for citizen science, education and engagement inform the framework and help articulate measurable objectives. The framework and objectives form the basis for a planning and evaluation template that can be used to implement citizen science projects that meet integrated social

and ecological goals. Another focus is on training and support for conservation science and education professionals aiming to devise integrated citizen science projects that both contribute phenological data and achieve short- and long-term public conservation engagement.
[D] 12.6

DARK CITIZEN SCIENCE: REVIVING OLD, LOST, AND OVERLOOKED CITIZEN SCIENCE RECORDS
Emma Albee, Seth Benz, and Mark Berry, Schoodic Institute at Acadia National Park; Rebecca Cole-Will, National Park Service; Caitlin McDonough MacKenzie, Boston University; **Abe Miller-Rushing**, National Park Service; Glen Mittelhauser Maine Natural History Observatory; Hannah Webber, Schoodic Institute at Acadia National Park
Attics, libraries, museums, historical societies, and many other places are full of records of past amateur naturalists, hunters, fishermen, gardeners, and others who made valuable observations of species occurrences and behaviors, drew maps, collected specimens, and recorded weather and other phenomena. These records are invaluable to current studies of climate change and other rapid environmental changes. They can provide insights into how species, landscapes, and environmental conditions have changed over the past century or more. Too often, however, these records are left unread and unused in favor of doing new research.
In this poster, we describe our work using "dark citizen science" in Acadia National Park in Maine. Acadia's museum collection contains over one million items, including plant and animal specimens, photographs, reports, field notebooks, maps, and other documents and objects. Moreover, the libraries, historical societies, and colleges in the surrounding communities contain millions more. We have begun an ambitious project to digitize these specimens and records and make them freely available in an online database. At the same time, we are engaging volunteers to help pull key data--starting with species occurrences, abundance, and phenology--out from these records and transcribe them into databases. And we are encouraging and facilitating research that uses these records to understand changes in the park's ecosystems. One of the first of these projects has shown that the park has lost nearly 20% of its flora over the past 100 years. We are working with researchers to use these historical records and new field observations to understand why these losses occurred and to identify species that are likely vulnerable to future environmental changes. These dark citizen science records provide critical data to protect our environment and also provide compelling personal stories that can engage the public in science and conservation.
[F] 3.9

HOW DOES SNOWPACK EVOLUTION AFFECT CLIMATE?
Tristan Amaral, University of New Hampshire; Jack Dibb and Cameron Wake, Institute for the Study of Earth, Oceans, and Space, University of New Hampshire
Current uncertainties associated with climate model projections can be attributed in part to incomplete understanding of specific climate feedbacks, such as the snow albedo feedback. Fluctuations in snow albedo [reflectivity] caused by changes to the snowpack impact local, regional and global climates. Ground-based snow albedo data at high temporal and spatial resolution are needed to address gaps in model representation as well as in understanding of overall snow evolution processes. In this study, a network of 20 volunteer citizen scientists located throughout the state of New Hampshire were trained to collect daily snow albedo, snow depth and snow density measurements starting in winter 2011-2012 and continuing to the present. Volunteers in the network receive training and education, low-cost measuring equipment and access to an interactive website where data are entered, visualized and downloaded. Roughly half of the participants in the network are middle or high school teachers and students while the other half are volunteer weather observers who are already part of the CoCoRAHS (Community Collaborative Rain, Hail & Snow) Network. Unfortunately, some participants struggle to make daily albedo measurements, but overall the majority contribute consistent, high quality albedo data that are valuable for research and education purposes. Snow albedo values range from 0.78-0.99

for newly fallen snow, 0.34-0.88 for aged snow and 0.09-0.39 for snow-free conditions. Collectively, albedo values are found to decrease with increasing snow age, increasing snow density and increasing air temperature with much variability across the state and through time. These relationships inform an empirical formula that uses snow age, snow depth and air temperature to predict albedo. This research will increase understanding of snow albedo evolution processes as well as improve the simulation of snowpack evolution by regional climate models.
[F] 1.1

EPREP: ENVIRONMENTAL PREPAREDNESS AND RESILIENCE EMPOWERING PEOPLE
Kim Anderson, Diana Rohlman, Kevin Hobbie, Michael Barton, Josh Willmarth, and Laurel Kincl, Oregon State University
Oregon State University researchers were among the first to conduct environmental sampling in the wake of the Deepwater Horizon oil spill. Partnering with community groups, university researchers organized a workshop for community stakeholders, researchers and policymakers to assess the response to this environmental disaster. Impacted communities related the need for better pre-event planning and post-disaster environmental assessments that included community input, and improved communication of the results from environmental exposure sampling. In response to these community-identified needs, Environmental Preparedness and Resilience Empowering People (EPREP) was created. The goal of EPREP is to provide communities with a sampling platform that they can use. EPREP is accessed online and provides training in environmental health, passive sampling, sample collection, and quality assurance and control standards. EPREP will provide a mechanism to enhance neighborhood organization and resilience.
Pre-event planning, coupled with a trained cohort of citizen scientists allows for an immediate sampling response following a disaster. Sampling designs would be enhanced with local knowledge supported by expertise from the scientific community. Trained participants in EPREP utilize passive samplers to safely monitor their environment and contribute to a growing database of environmental sampling data. All projects will be driven by communities with an interest in evaluating their environment.
The influx of data in EPREP will contribute to a growing database offering new insights on environmental conditions pre- and post-disaster. This database will be freely available on the EPREP website, allowing citizen scientists to perform their own analysis and query the database to answer community-relevant questions. The requirement that all users obtain certificates in QA/QC will help increase traceability such that data can be used by non-governmental and regulatory agencies, resulting in better communication of environmental monitoring results.
[B] 4.3

MO DIRT—MISSOURIANS DOING IMPACT RESEARCH TOGETHER: A PROJECT TO EXAMINE THE SOIL-CLIMATE INTERFACE WITH CITIZEN SCIENTISTS
Sandra Arango-Caro and Terry Woodford-Thomas, Donald Danforth Plant Science Center
The Missouri Transect project, recently funded by the National Science Foundation EPSCoR program, uses different scientific approaches to study and predict the impact of climate change on agricultural productivity and native flora in Missouri, and how stakeholder communities are likely to be affected by and respond to the challenges of changing climate. Important components of The Missouri Transect are public education and outreach efforts. MO DIRT - Missourians Doing Impact Research Together, is a new citizen science initiative that will crowdsource the collection of data on soil health and reciprocal soil-climate interactions across the state. Soils store vast amounts of organic carbon and the CO2 flux from soils to the atmosphere (soil respiration) is one of the largest fluxes in the global carbon cycle. Changes in climate due to an increase of CO2 in the atmosphere are expected to be influenced by changes in soil respiration. Missouri citizens, including K-12 students, equipped with training, guidelines, and soil quality test kits, will collect and electronically record relevant data to contribute to the overall research efforts. All participants can experience science-based enrichment activities to gain knowledge on the

physical, chemical and biological properties of soil and better understand that healthy soils are living, breathing entities. MO DIRT data will be analyzed, validated, and used to compliment data on climate and plant performance produced by meteorologists, plant biologists, and computer scientists at Missouri Transect institutions to provide a more complete picture of the current and future impact of climate change on the natural resources of the state of Missouri.
[A] 1.5

THE POWER OF LONG-TERM OBSERVATION: NATURE'S NOTEBOOK CULTIVATES PERSONAL GROWTH AND UNDERSTANDING

Lorianne Barnett, USA National Phenology Network

Phenology provides a lens to teach inquiry, observation, the scientific method, visualizing data, and communicating results. The USA National Phenology Network's (USA-NPN) Nature's Notebook program (http://www.nn.usanpn.org) is a long-term plant and animal phenology observation program with phenology curriculum and outreach materials for educators in formal, non-formal, and informal settings (www.usanpn.org/education). Participating in Nature's Notebook (NN) addresses Next Generation Science Standards (NGSS) for middle and high school, including Earth and Life Science Standards, as well as standards at the undergraduate level. It provides a framework for developing program and outreach resources for non-formal or informal education settings.

Long-term phenology monitoring via Nature's Notebook offers collaborative place-based, hands-on learning opportunities, promotes cross-subject engagement and can be used to identify and answer local scientific research questions. Additionally students, teachers, and adult volunteers contribute to a national citizen science research initiative. The National Phenology Database (NPDb) provides a rich data set to explore, for use in teaching basic statistical analyses, graphing and mapping techniques in excel and GIS, and information to compare and contrast what is happening nationwide.

In this presentation I will discuss the benefits of developing a long-term educational program around the Nature's Notebook observation activity at your school, nature center, museum, or park. Participants will gain an understanding of how to set goals and outcomes, and learn how doing so contributes to life-long learning and potential behavior change. I will share curriculum packages and lesson plans for audiences of all ages, including pre- and post- activity assessment and reflection. I will also discuss the time required to implement the program, concurrent activities and field exercises, how students can summarize and relay the information they have collected to others, and how to create local partnerships with community organizations around the topic of phenology. Using phenology programmatically creates a deep understanding of nature.
[D] 1. 8

ANGLER SCIENCE: MOBILIZING A NATIONWIDE GROUP OF DEVOTED ENTHUSIASTS

Matt Barney and Matt Barney, Trout Unlimited

Trout Unlimited (TU) is a national organization that works to conserve, protect and restore North America's coldwater fisheries and their watersheds. TU's 150,000 members are organized into over 400 chapters across the country and are matched by a staff of conservation professionals working to restore fisheries at the local, state and national levels.

Our members and their families, many of them fly-fishing anglers, spend a great deal of time each year enjoying our nation's streams, while keenly observing the conditions that sustain trout and salmon. Variables like water temperature, stream structure and condition, water quality, and the aquatic insects present—changing moment to moment—are all important for sensitive coldwater fishes. Likewise, these factors are of particular interest to anglers: What prey species are present and when is feeding most active? Which streams provide the best habitat? Have conditions changed since they were last in the area? As online and mobile tools have expanded, the ability of our members to share their observations—many of which they've been making for years—has increased dramatically. As a result, Trout Unlimited has a variety of citizen science efforts underway to answer such questions as: How

effective are TU's restoration efforts? Are there on-the-ground conditions or developments that may be limiting the success of trout and salmon? Where are the strongholds of our native trout? How do species and their habitats vary geographically and over the course of time?
Through Trout Unlimited's "Angler Science" program, we aim to foster a curiosity about the fish we enjoy and the environments that sustain them. Our challenge is figuring out how to leverage the expertise, enthusiasm, and insight of our members, while ensuring their efforts are scientifically useful, well-organized, and duly recognized.
[B] 3.4

STREAM SALAMANDER MONITORING IN THE SMOKIES: A MODEL FOR LIFELONG CONNECTION
Tiffany Beachy, Great Smoky Mountains Institute at Tremont
Great Smoky Mountains Institute at Tremont (Tremont Institute) is a residential environmental education center that has been connecting people and nature in the Great Smoky Mountains National Park for 45 years, and one of the ways we accomplish our mission is by facilitating deep connections through hands-on field research. We coordinate a number of citizen science research projects that contribute to our understanding of the ecosystems and animals that compose this exceedingly biodiverse national park. All of our participants, from 5th graders to retired nature enthusiasts, have opportunities to be scientists as they engage in collecting data, developing a sense of ownership for projects and subjects that previously seemed inaccessible or scary.
One such project at Tremont Institute is our long-term stream salamander monitoring study, which is among the longest-running studies of its kind in the country. Because we are located in the 'Salamander Capital of the World,' we are in the perfect position to study these endearing cold-blooded creatures. Since the inception of this project, our participants of all ages have been directly involved in data collection and maintenance of our 6 stream transects. One of our core classes brings students on a journey of science discovery as they actively participate in the scientific method by collecting data on stream salamanders. Summer campers and adult naturalist course participants learn about amphibian conservation and population dynamics as they visit our streams. Local volunteers develop life-long connections to science and nature as they visit their adopted plots year after year. Schoolteachers continue the magic their students experienced at Tremont Institute by applying data the students collected to interdisciplinary concepts in the classroom. Fifteen years later, we are still making connections and forming partnerships around our little mascots, while ensuring their health and survival for future generations of stream explorers.
[D] 5.3

ENHANCING SYNERGY ACROSS CITIZEN SCIENCE PROJECTS TO ENGAGE DIVERSE AUDIENCES AND ADDRESS GRAND SCIENCE CHALLENGES AT A SINGLE LOCATION: ACADIA NATIONAL PARK, MAINE
Seth Benz, Mark Berry, Emma Albee, and Hannah Webber, Schoodic Institute at Acadia National Park
The scientific and educational benefits of citizen science projects are often limited because they attract relatively narrow audiences or are narrowly focused. For example, a project might engage a small set of people very deeply in many aspects of an ecological restoration experiment or another project. Participants might be limited to those people who have a lot of time and energy to invest. Alternatively, a project might engage a large number of people in collecting certain types of narrowly-defined observations, such as wildlife sightings or water samples. These relatively narrowly focused projects can limit the educational and experiential opportunities for volunteers, or the amount and type of data or other scientific outputs generated.
At the Schoodic Institute and in Acadia National Park, we are integrating a number of related citizen science projects that engage different audiences—e.g., one-day visitors, year-round volunteers, and week-long intensive volunteer experiences. The projects are intertwined and synergistic, and are all aimed at helping the park understand and respond to rapid environmental changes. This diversity of citizen science volunteer opportunities provides many points of entry for new volunteers, options for

volunteers to apply skills learned in one project to a related but different project, and opportunities to learn new topics and skills. The diversity of projects also provides concrete scientific, education, and management benefits to the national park. Here we describe the rationale and initial lessons learned as we begin undertaking this strategy.
[F] 3.7

OVERVIEW OF A CITIZEN SCIENCE APPROACH TO INTEGRATING RESEARCH AND EDUCATION PRIORITIES: A PUBLIC-PRIVATE PARTNERSHIP BETWEEN SCHOODIC INSTITUTE AND ACADIA NATIONAL PARK

Mark Berry, Emma Albee, Seth Benz, and Hannah Webber, Schoodic Institute at Acadia National Park
Schoodic Institute at Acadia National Park is a nonprofit partner to the National Park Service on connecting people to nature through science research and education. Schoodic Institute and Acadia partner in management of the Schoodic Education and Research Center, one of 20 National Park Service Research Learning Centers around the nation.
Citizen science is our approach to integrating meaningful research and education experiences in support of Acadia National Park's priority of understanding and responding to rapid environmental change. Together with university researchers and many other partners, Schoodic Institute and Acadia National Park are developing a diverse portfolio of citizen science projects. While each project is unique and requires careful consideration, our public-private partnership provides room for innovation and testing of new approaches. Acadia provides a powerful opportunity to connect with a wide audience, and the National Park Service can be a vehicle for bringing successful approaches to national scale.
In a series of posters, we will present the efforts of our partnerships to 1) integrate and coordinate multiple citizen science projects and engage diverse audiences, 2) improve teaching and data literacy to support desired educational outcomes for teachers, students, or diverse volunteers in citizen science, 3) leverage historical, lost, or overlooked citizen science records to enhance current research, and 4) connect citizen science research with natural resource management in a National Park. In each poster we present the challenges faced when balancing the needs of all stakeholders, and the solutions we've developed together.
[F] 3.6

SIGNS OF THE SEASONS PROGRAM: INCREASING CLIMATE LITERACY AMONG CITIZENS AND IMPROVING PHENOLOGY DATA AVAILABLE FOR CLIMATE ADAPTATION PLANNING IN THE NORTHEAST

Beth Bisson, Maine Sea Grant Program; Esperanza Stancioff, University of Maine Cooperative Extension/Maine Sea Grant; Abe Miller-Rushing National Park Service; Elissa Koskela, University of Maine Cooperative Extension
Search for information on climate change in a region, and one is often inundated by a range of dire predictions. In the Northeast, the climate over the next hundred years is expected to become warmer and wetter. This will have significant effects on species and the people who rely on these local ecosystems. With such a broad scope of impacts, the issue of climate change can quickly overwhelm. Many people are both unfamiliar with climate change and unaware that they can have a positive role. This presentation will discuss goals and outcomes of the Signs of the Seasons program, which was created to engage people in thinking about climate change, offer a positive outlet for involvement, and improve understanding of the local effects of global climate change. Signs of the Seasons provides instruction and support for collecting climate data at a local site, often the participant's backyard. Citizen scientists observe the timing of life cycle events (phenology) for indicator species that are common to the region, and record their observations in an online database managed by the National Phenology Network. Program goals include increasing climate literacy among participants, and compiling meaningful phenology data that regional climate scientists and resource managers need to improve local, state, and regional climate adaptation planning and decision-making processes. University of Maine Cooperative Extension and the Maine Sea Grant Program launched Signs of the Seasons in 2010

in collaboration with climate change scientists, state and federal agencies, and numerous nonprofit education and conservation organizations. Signs of the Seasons participants in Maine and New Hampshire are already providing far more information that is specific to our region than scientists could collect on their own, and participants report feeling more aware of climate-related changes and more confident in their discussions with others about climate change.
[F] 1.2

UNDERSTANDING AND SUPPORTING COMMUNITY EXPLORATION OF LOCAL GREEN SPACES THROUGH TECHNOLOGY

Carol Boston, Marshini Chetty, and Jennifer Preece University of Maryland, College Park

Hyperlocal websites provide a platform for individuals to share plant and animal sightings with others in the same natural setting. Studying what members of the public spontaneously find noteworthy and how they choose to convey observations from a particular location can provide useful guidance for citizen science research into participants' motivations and technology use. Over the past three years, approximately 100 unique observers have posted about 300 sightings along a 9-mile creek in the greater Washington, DC, area. This presentation uses results from descriptive analysis, visualization, and content analysis to explore the most common classes represented among the sightings (birds, followed by mammals), the species that constitute charismatic megaflora in a mid-Atlantic greenway, the most common categories for observations (describing behaviors, making identifications, and observing quantities), and the social context in which the sightings are undertaken and their role in building community cohesion. Inductive thematic analysis of interviews with 9 habitat and park experts and technology designers provides additional insight into the observation activity, the motivations and behaviors of those who practice it--including hyperlocality, sustainability, and teaching and learning about nature--and the role that technology plays in supporting observations among non-experts. Functions of the tools and technologies reported include 1) supporting overall communications about, and involvement in, outdoor experiences; 2) capturing, viewing, and displaying specific images; 3) looking up information to validate identifications; 4) conducting citizen science activities; and 5) navigating terrain while on site. Contributions of the work include the application of a temporal model from parks and recreation research (Clawson and Knetsch, 1966; McKay, Brownlee, and Hallo, 2012) to determine when various tools and technologies can be deployed most effectively and the creation of a set of research-based design guidelines that identify logistical, content-oriented, and social features of future technologies to support hyperlocal nature observations.
[C] 9.3

COSMOQUEST: DESIGNING FOR LONGTERM ENGAGEMENT

Georgia Bracey, Pamela Gay, Nicole Gugliucci, Cory Lehan, Joseph Moore, Justine Breedon, and Houston Southard, Southern Illinois University Edwardsville

The CosmoQuest virtual research facility is designed to provide members of the public opportunities to learn and do science that parallel the facilities in real world research facilities. It is our hope that by providing a rich environment, we can promote long-term engagement, including social engagement. CosmoQuest's site can loosely be categorized into five areas: science programs, popular media, online classes, and content for educators. In this talk, we consider how community members move within the first four of these content areas, and study what site usage patterns correlate with long-term engagement.

Currently, CosmoQuest's citizen science programs focus on mapping geological features on rocky bodies in the Solar System. Initial checks into volunteers' behavior show that participants tend to focus their efforts on a favorite world, although we are going to test if volunteer behaviors can be affected through direct intervention and badges. These results will be discussed in this talk.

Just as real-world research centers provide classes, seminars, and colloquium to help students and professionals develop, CosmoQuest produces a variety of programs designed to advance the knowledge

of community members. Video content is produced using Google Hangouts-on-Air and is streamed live and archived on YouTube.com/astrospherevids. Weekly content includes: Astronomy Cast (basic astronomy), the Google Lunar XPRIZE Team Hangouts (interviews with GLXP team members), Learning Space (content for educators), the Weekly Space Hangout (space science news), and the Virtual Star Party. Additional, audio-only, content is supplied by a community of volunteers and distributed through the "365 Days of Astronomy" podcast. Small classes (limited to 8 participants) are also offered for a fee through the CosmoAcademy program. We will examine audience overlap between these learning opportunities and look to see how participation affects behavior and retention.
Finally, we will consider how forum participation relates to use of the rest of CosmoQuest.
[E] 9.10

SCIENCE CENTERS AS A CLEARINGHOUSE FOR CITIZEN SCIENCE OPPORTUNITIES
Fernando Bretos and **Chelle King**, Patricia and Phillip Frost Museum of Science
Founded in 1949, Patricia and Phillip Frost Museum of Science is a leader in educating South Florida residents about science and nature. Its Museum Volunteers for the Environment (MUVE) Program engages local residents in restoring coastal habitats and gathering scientific data to determine the success of these restoration efforts. Since 2007, over 5,000 volunteers have restored over 15 acres of urban coastal habitat. MUVE is based on the Museum's principle of Act, Learn and Engage and serves to bring the Museum's mission of learning about science directly to the populace. By participating in MUVE, South Florida residents learn about the environmental stresses we face, engage themselves and their peers in making a difference, and act by restoring native coastal habitats.
The museum is undergoing a move to a 250,000ft2 state-of-the-art museum and aquarium, scheduled to open in 2016. The three-story aquarium, called the Living Core, will feature modular, interactive exhibits to educate visitors about South Florida habitats. On the top floor of the Living Core, visitors will see a microcosm of habitats such as mangroves, sea grass and tropical forests. These exhibits will utilize video, social media and digital sign ups to direct visitors to relevant local restoration and citizen science efforts. This way they can participate firsthand in restoration and data collection efforts whether coordinated by MUVE or other local environmental/research agencies.
Our new $300 million new museum is expected to draw up to 600,000 visitors, making the museum a clearinghouse for directing visitors to relevant conservation and citizen science opportunities. Further, data collected by new citizen scientists can be displayed within these same exhibits. This presentation will explore how science centers can play a pivotal role in engaging visitors in citizen science as a way of expanding their knowledge.
[D] 15.8

DEVELOPING PARTNERSHIPS WITH LOCAL AGENCIES AND SCIENTISTS: OVERCOMING RESERVATIONS AND CHALLENGES
Emily Brown, Omaha's Henry Doorly Zoo & Aquarium
Omaha's Henry Doorly Zoo & Aquarium began the Amphibian Conservation Education Project (ACEP), a citizen science program, in 2007 to address the global decline of amphibian populations in our own backyard. This project was conceived through meetings hosted by Omaha's Zoo & Aquarium that brought together Zoo staff and herpetologists from universities and governmental agencies in the region.
Through these meetings, it was obvious that very little was known about the current state of amphibians in Nebraska and surrounding states, due to the extensive field work required. Educators at Omaha's Zoo & Aquarium quickly realized that this would be the perfect opportunity to involve educators and students in real-world research, while at the same time providing valuable data for the herpetologists and helping statewide amphibian populations. Thus, the Amphibian Conservation Education Project was born, a statewide amphibian study and educational campaign, where participants collect data on water quality and swab samples from amphibians to be tested for disease.

This project did not come without many obstacles to overcome along the way. Of those hurdles, garnering the trust from the scientists to properly implement ACEP and overcoming their reservations with regards to citizen science was a challenge. We learned valuable lessons about gaining their support, addressing concerns, and ensuring that the data collected was valued and useful for them. This presentation will aim to share some of those struggles and how we successfully partnered with local agencies and scientists to create a sustainable citizen science program.
[F] 5.1

EXPLORING THE INTERSECTIONS OF BOTANY, LEARNING, AND TECHNOLOGY

Christine Bush, Principal Software Developer, BumbleApps.com; Judith Bush, Principal Researcher, BumbleApps.com

Mobile technologies enable users to discover, explore, and engage with the natural world in amazing ways. Judith and Christine Bush are developing hybrid educational apps that explore the intersection of botany, learning, and technology. Our initial offering is a free mobile app available for iOS and Android, part of a larger project that we call BumbleApps™. This name conveys our curiosity about the natural world in a playful way while also evoking the holistic enterprise central to understanding the interconnectedness of an ecosystem as exemplified by bees and flowers. Our first tier of BumbleApps™ provide users with a gentle introduction to the history and phytology of a target plant and then invites them to casually explore a carefully curated collection of photo and video references. Some of the photos or videos are of the target plant. Others share some, but not all, of the target's characteristics. Others are dissimilar. These assets are embedded in interactive galleries in which users playfully gain experience in correctly identifying the target plant and recognizing which of its distinguishing characteristics support their claim. Unlike many apps which attempt to identify a plant for you (based on characteristics you provide), our early apps shift the focus from using mobile technology as a field appliance to turning smart phones and tablets into the field itself. Inspired by connectivist learning strategies which have shown that learning is increased through interaction with and creation of content, BumbleApps™ present users who might have only a layperson's appreciation for flora with a fun, intuitive, beautiful way to interact with the botanical key. Core development strategies include use of open software and openly licensed educational assets. Additional tiers will include a digital magazine, and a field journal which will facilitate sharing data collected from the real world with other citizen science communities.
[C] 9.2

IMPLEMENTING A VOLUNTEER-LED LONG-TERM CITIZEN-BASED INVERTEBRATE MONITORING PROGRAM AT THE URBAN ECOLOGY CENTER

Jennifer Callaghan, Anne Reis, Jennifer Callaghan, and Timothy Vargo, Urban Ecology Center

The Urban Ecology Center is a community-based environmental education Center in Milwaukee, Wisconsin with branches in three unique neighborhoods. Center Research and Citizen Science staff, along with the help of 32 dedicated volunteer invertebrate enthusiasts, developed and implemented a long-term comprehensive terrestrial invertebrate monitoring program with the generous support of the WDNR Citizen-based monitoring partnership program. The ultimate goal of this project is for the volunteers to drive the Center's goals of using invertebrates in an adaptive management plan that helps to guide and evaluate our restoration and stewardship activities. The composition and abundance of aquatic and terrestrial invertebrates at the individual, population, and community level are often used to assess ecosystem health, helping provide information on how to better manage the natural areas in which they are found. Volunteers contributed over 250 hours in the creation of the plan. Outcomes from this project include 10 working group meetings for creating a long-term monitoring plan, workshops for Odonata and Lepidoptera surveys, and a long-term invertebrate monitoring plan focusing on key taxa that includes data sheets, sampling methods, projected analyses, and means to assess the health of the natural areas the Center manages. Successes included more in-depth participation in the

scientific process and the building of an invertebrate enthusiast community for the Urban Ecology Center. A challenge was keeping enthusiasm throughout the winter months while creating the plan. In addition, this was the Research & Citizen Science team's first effort to provide a collaborative space for volunteer-driven work, requiring a great deal of time and facilitation. In the future, we hope to have volunteers take a stronger leadership role. Ten individuals responded to a post-project evaluation where 60% of respondents indicated they were novices and 100% were satisfied with their participation. Best practices include cloud-based communication plans and goal-oriented meetings.
[A] 7.6

ENGAGING CITIZEN SCIENCE: BUMBLE BEE CONSERVATION AT THE UNIVERSITY OF WISCONSIN—MADISON ARBORETUM

Susan Carpenter, Susan Carpenter, and Bradley Herrick, University of Wisconsin-Madison Arboretum

Native pollinator populations are declining in range and size, with serious implications for native plant pollination and reproduction, ecosystem function and human agricultural systems. Public awareness and concern about pollinator decline has increased. The 1200-acre University of Wisconsin-Madison Arboretum supports and fosters native pollinators, providing varied habitats, diverse native plants, nesting sites and insecticide-free areas in an urban setting. Working in the field and in collaboration with the Xerces Society and other experts, we train and mentor citizen scientists who photograph, document and observe native bumble bees throughout Arboretum gardens and restorations. Our collective findings include seasonal patterns, floral resource use, and behavioral observations for 11 bumble bee species present in the Arboretum, including *Bombus affinis*, the rare rusty-patched bumble bee. This species is now absent from most of its original geographic range and is imperiled. We describe the key role that citizen scientists play in expanding what we know about bumble bee populations, life history, habitat use and ecology. We present successes and challenges in developing and sustaining an evolving citizen science program that both increases understanding and generates new questions. Integrating native plant gardening, ecological restoration, citizen science and community engagement, photography, expert bee identification and tools for sharing regional data yields critical and immediately useful conservation and education practices to apply well beyond the Arboretum.
[A] 5.7

THE URBAN ECOLOGY ENGAGEMENT INITIATIVE - STUDENT-DRIVEN RESEARCH OF THE ANACOSTIA WATERSHED

Alison Cawood, Smithsonian Environmental Research Center; Tony Thomas, Anacostia Community Museum; Kenneth Carroll, United Planning Organization - Youth Services Division

The Urban Ecology Engagement Initiative (UEEI) is a collaborative effort by Smithsonian researchers and educators, out-of-school programs for disadvantaged youth in Washington, D.C., environmental and community-based non-profit organizations, and public schools to study the health of streams in the highly urbanized Anacostia Watershed in Washington, D.C. and Maryland. Trash, sewage, runoff, heavy metals, and toxins pollute the troubled watershed, making it largely unusable by the communities that live within it. In an effort to better understand and combat these problems, UEEI engages students who live within the watershed to monitor stream health and conduct research.

UEEI students represent groups that are traditionally underrepresented in STEM fields. The students reside in Southeast Washington, D.C., an area that is largely African-American with a median household income of less than $35,000. Additionally, UEEI students are often attempting to be the first in their families to graduate from high school. Because these students live and attend school within the Anacostia Watershed, they are directly affected by its poor health. UEEI seeks to provide students with the knowledge to actively participate in the restoration of streams as well as to become advocates for the watershed in their communities. To meet this goal, UEEI partner organizations help students learn watershed ecology through classroom activities and field trips, explore STEM career paths, collect data to contribute to non-profit and government stream health databases, develop and implement research

projects, and present their findings to community groups and leaders. Students work with scientists to develop their own research questions, enabling them to identify and pursue topics that are directly applicable to the community in which they live. The resources provided through the UEEI collaboration enable middle and high school students to conduct high-quality research and become advocates for environmental health in their neighborhoods.
[B] 7.7

TRACKING A CHANGING CLIMATE: CITIZEN SCIENCE CONTRIBUTIONS TO CLIMATE CHANGE INDICATOR SYSTEMS

Emily Therese Cloyd, US Global Change Research Program; Melissa A. Kenney University of Maryland; Ilya Fischhoff, US Global Change Research Program; Mandy Lamoureux, University of Maryland; Elizabeth Tyson, Wilson Center

Climate change indicator systems are based on measures of key physical, ecological, and societal variables related to climate change drivers, impacts, vulnerabilities, and responses. Crowd-based approaches to data gathering and analysis, including citizen science and community-based monitoring, already support some indicator systems, and there is the potential for greater use of these approaches. One example of such an indicator system is the US Global Change Research Program's National Climate Indicators System, which aims to create a system of indicators that inform and support decision making about climate change. In November 2014, the US Global Change Research Program, the Commons Lab of the Woodrow Wilson International Center for Scholars, and the Federal Community of Practice on Crowdsourcing and Citizen Science hosted a roundtable that used the National Climate Indicators System as a case study to explore a number of issues related to integrating citizen science into indicator systems. This poster reports on the results of the workshop, including identifying existing uses of citizen science in climate-related indicators; linking existing citizen science data and analysis streams to current and proposed indicators; highlighting areas where new contributions from citizen science projects might support indicators; and suggesting ways to connect indicators and citizen science efforts across geographic scales. Additional results include identifying the challenges of integrating citizen science information into climate change indicator systems and brainstorming possible solutions.
[F] 1.3

LEVERAGING SCISTARTER TO GROW AND SUSTAIN YOUR CITIZEN SCIENCE PROJECT. CASE STUDY: PROJECT MERCCURI

David Coil, MicroBEnet, University of California, Davis; **Darlene Cavalier**, University of California, Davis, SciStarter Jenna Lang Project MERCCURI, University of California, Davis; Caren Cooper, North Carolina Museum of Natural Sciences; North Carolina State University; Arvind Suresh, SciStarter

SciStarter is more than a searchable index of over 800 citizen science projects worldwide. Project leaders can work with SciStarter to promote their projects and recruit participants. In the workshop, we'll cover the basics of SciStarter's multi-media campaigns with Discover Magazine, Public Library of Science, WHYY and the National Science Teachers Association; highlight partnerships with broad and diverse audiences including national sports, culture, and hacker communities; and lead a brief "how to" session to implement free, open SciStarter APIs and other tools designed to make it easier for project owners to recruit, retain, and learn about participants, find and partner up with complementary projects, align NGSS with projects, and capitalize on opportunities to share and leverage existing citizen science data and participants, worldwide.

David Coil, coPI on Project MERCCURI, from the Eisen Lab at UC Davis, will kick off the workshop with a talk about this citizen science project to compare microbes on Earth and in space (citizen-collected samples are currently orbiting the Earth on the International Space Station!). He'll provide updates on the findings, share successes and challenges, illuminate how working together with complementary communities (including SciStarter and Science Cheerleader) helped advance the field of microbiome research and share a glimpse into the future of citizen microbiome research.

Collaborators: Dr. Jenna Lang/Eisen Lab/UC Davis , Dr. Caren Cooper, NC Museum of Natural Science, and Arvind Suresh, SciStarter
[A] 9.9

TACKLING DROUGHT IN THE GREAT PLAINS: EXPLORING THE SCALAR CHALLENGES TO THE CO-MANAGEMENT OF WATER RESOURCES
Nicole Colston and Jacqueline Vadjunec, Oklahoma State University
This poster presentation shares findings from a comparative study of governance, agricultural land-use, and water usage in a dual-state area encompassing Union County, NM, and Cimarron County, OK. While these Great Plains citizens share a common cultural and ecological landscape, agricultural economy, and similar vulnerability to drought, governance and policy boundaries generate a unique set of challenges to regional drought adaptation and resiliency. Specifically, this poster asks, what are the scalar challenges to citizen-science as a vehicle for the co-management of water resources in the Great Plains? First, we will compare and contrast the everyday challenges faced by land-users in each county within the context of governance, social, and environmental factors. Disparities in state and federal laws about land-use influence individual perceptions about drought risk and recovery, as well as limit the possibilities for organized response. Next, theoretical applications of resiliency theory and political ecology guide the identification of the relational webs and the transboundary possibilities for community collaboration through citizen-science. We argue for a dynamic model for adaptive drought communication focused on: (a) dimensions of community adaptive capacity at multiple scales, (b) the role of scientific inputs in processes of public deliberation, and (c) participatory models for community co-management meetings and interactive drought mapping (i.e. citizen-science). The project highlights a citizen-science model for engagement, which is both multi-scalar and embedded within participatory research processes. This poster presentation contributes to a broader discussion about how to address problem of scale and community-capacity in the face of competing governmental and policy boundaries.
[F] 2.8

COMMUNITY-BASED INTEGRATED WATER MONITORING: THE EXAMPLE OF "CURA H20"
Cathy Conrad Saint Mary's University, Nova Scotia, Canada
While significant amounts of valuable data are collected annually through community-based environmental monitoring, the integration and use of this data by resource managers and decision makers remains limited. One of the most prevalent challenges in integrating environmental data gathered by volunteers is the potential for inconsistent collection methods, resulting in uncertainty of data accuracy. CURA H2O (http://curah2o.com/)seeks to address this challenge by standardizing data collection processes at the community level, and has developed a water quality monitoring training and certification course and an accompanying toolkit that will provide all necessary monitoring equipment. Funded by the Community-University Research Alliance (CURA) program of the Social Sciences and Humanities Research Council of Canada, CURA H2O focuses on community-based water quality monitoring and the advancement of integrated watershed management in Nova Scotia and abroad. CURA H2O engages the public in meaningful participatory management, and will provide resource managers with a broader set of reliable data upon which to base more informed decisions. The theoretical research directing CURA H2O will generate new knowledge around issues of effective community-based resource management, improved accuracy of data collection, and the successful integration of volunteer monitoring into resource management. Potential social benefits of this research include not only the empowerment of communities to successfully assess the health and needs of their watershed, but also the development of a grassroots capacity to create solutions to environmental degradation concerns that negatively affect local water quality.
[A] 2.4

THE BOSQUE ECOSYSTEM MONITORING PROGRAM AS A MODEL K-12 CITIZEN SCIENCE INITIATIVE

Rowan Converse, Daniel Shaw, Kim Eichhorst, and May Leinhart, Bosque Ecosystem Monitoring Program-- University of New Mexico and Bosque School
Citizen science initiatives can provide an excellent avenue for engaging K-12 students in scientific practice; however, many programs make sacrifices on the axis of either student learning or the production of quality research. We present the Bosque Ecosystem Monitoring Program (BEMP), the official schoolyard outreach of the Sevilleta Long-Term Ecological Research Program, as a case study of a program successfully meeting both goals. BEMP involves K-12 students, many from underserved communities, in the collection of ecological data monthly at sites in a southwestern desert riparian forest. BEMP's success can be attributed to three main factors: 1) standardized data collection protocols, with supporting educational materials tailored to individual classrooms; 2) the participation of the University of New Mexico in data quality control and the training of university interns for field and educational support; and 3) a broad base of community partnerships, including local, state, tribal, and federal natural resource management agencies. We believe that BEMP could serve as a model in the design of other citizen science programs.
[A] 14.3

GROWING ENVIRONMENTAL DATA NEEDS IN THE ANTHROPOCENE: SCALING UP DATA FLOW FROM AMATEURS AND EXPERTS THROUGH CYBERINFRASTRUCTURE

Robert Costello, Smithsonian National Museum of Natural History, Washington DC, USA; Tavis Forrester and William J. McShea, Smithsonian Conservation Biology Institute, Front Royal, VA, USA; Zhihai “Henry” He, Electrical and Computer Engineering Department, University of Missouri, Columbia, MO, USA; Megan Baker, Smithsonian Conservation Biology Institute, Front Royal, VA, USA; Arielle Parsons and Roland Kays, North Carolina Museum of Natural Sciences, Raleigh, NC, USA
The recent period of human-driven environmental change has been so rapid and different than any other in Earth's history that we now recognize it as a new era - the Anthropocene. Managing these changes to conserve biodiversity is a priority for our planet's health, yet it requires a broad geographic and temporal context that scales from local to regional to continental to global. For many researchers, citizen science is seen as the best solution for collecting data at the temporal and spatial scale needed to address these global problems. However, managing such large data flows from volunteers challenges the technologies typically developed for local studies, especially when extra steps are needed to build in quality control of information collected by non-experts. We present the cyberinfrastructure of eMammal, a large-scale mammal population study, as a case study for data management and workflow that meets the needs of both small and large-scale research questions. eMammal recruited more than 500 volunteers to deploy remote cameras in forests across six states in the Mid-Atlantic region. Volunteers collected over 2.6 million images in a two-year period by setting motion-sensitive camera traps at more than 2,300 locations. We have implemented a cloud computing workflow to manage data, including a central website to coordinate volunteers, custom software for remote photo tagging and uploading, and storage and curation of photos and meta-data in a Smithsonian digital repository. The workflow includes an 'expert review' process to verify all data from volunteers, and we continue to develop automated image analysis to make image processing more efficient. We conclude by proposing cyberinfrastructure solutions that would allow the project to reach a global scale with 30,000 or even 100,000 camera trap deployments.
[A] 8.7

HOW THE NATIONAL PARK SERVICE IS UTILIZING CITIZEN SCIENCE TO CONTRIBUTE TO BIOLOGICAL RESOURCE CONSERVATION AND INSPIRE THE NEXT GENERATION OF STEWARDS

Kelly Coy, National Park Service
The mission of the National Park Service (NPS) mandates preservation of natural resources for the enjoyment, education, and inspiration of this and future generations. As critical reserves for North American biodiversity, the NPS must be proactive to protect at-risk species, mitigate exotic species, and

minimize spread of wildlife disease—but first, parks must know what species they have to protect. Currently, the vast majority of species in parks—primarily invertebrates, non-vascular plants, fungi, and microorganisms—remain unknown. Invasive species, climate change, and loss of habitat are the kind of unprecedented, impending threats that have the potential to wipe species out of a park, or off the face of the planet, before anyone has had a chance to discover them. The amount of resources and expertise required to conduct large scale, comprehensive biological inventories is often beyond the capacity of national park staff to take on alone. By initiating citizen science biological discovery (or BioDiscovery) efforts in national parks, the NPS has made significant progress toward identifying species in parks. As of July 2014, 114 parks have participated in citizen science biodiversity discovery, and more than 7,500 species have been identified—some previously unknown to have existed in a specific park, as well as species that are new to science.

The value of BioDiscovery in the NPS goes beyond the grand challenge of species conservation; BioDiscovery also serves to engage youth and local communities with the stewardship of their national parks. As of July 2014, 30,000 people including professional scientists, educators, students, children, families, NPS staff, and park visitors have contributed to NPS BioDiscovery. With a high emphasis on education and engaging diverse audiences and urban communities, the NPS hopes that BioDiscovery will be one of the primary mechanisms to inspire the next generation of national park and biodiversity stewards.

[F] 6.3

THE VIRGINIA MASTER NATURALISTS: A READY TEAM OF CITIZEN SCIENCE VOLUNTEERS

Alycia Crall, Michelle Prysby, and David Mellor Virginia Tech

The Virginia Master Naturalist (VMN) program is a chapter-based, statewide volunteer training and service program that engages participants in natural resource education, citizen science, and stewardship. Basic VMN volunteer training includes field science skills such as field journaling and using dichotomous keys, as well as general training on natural history and natural resource management. Our 29 chapters across Virginia, along with similar programs across the country, make excellent partners for citizen science, as they are stable pools of volunteers who are trained and ready to take part in scientific research endeavors that relate to natural resource conservation.

In 2013, VMN volunteers spent approximately 105,000 hours of VMN volunteer time on citizen science projects. A review of the citizen science activities of VMN chapters reveals a wide array of projects and levels of engagement. VMN volunteers participate in national citizen science programs, statewide projects initiated by agencies, and local projects initiated by partners or the volunteers themselves. We will use program data and case studies to examine program aspects that have been successful at engaging VMN volunteers in citizen science, and we will share lessons learned as we have grown the program over ten years.

[D] 11.8

NASA ROVER, TACKLING CITIZEN SCIENCE WITH GRAND CHALLENGES AND EVERYDAY PROBLEMS

Sarah Crecelius, Lin Chambers, and Tina Rogerson SSAI, NASA Langley Research Center

ROVER is the Citizen Science arm of the NASA Clouds and the Earth's Radiant Energy System (CERES) Students' Cloud Observations On-Line (S'COOL) Project. Since 2007, participants around the world have been making and reporting ground truth observations of clouds to assist in the validation of the NASA CERES satellite instrument.

NASA scientists are very interested in learning how clouds affect our atmosphere, weather, and climate (relating to climate change). It is the clouds, in part, that affect the overall temperature and energy balance of the Earth. The more we know about clouds, the more we will know about our Earth as a system and citizen scientists are an important piece of that puzzle!

As a ROVER cloud observer, all participants follow simple online tutorials to collect data on cloud type, height, cover and related conditions. Observations are sent to NASA to be matched to similar

information obtained from satellites and sent back to participants for comparison and analysis. The supporting ROVER website houses a searchable database archiving all participant reports and matching satellite data.
By involving Citizen Scientists in cloud observations and reporting we can gain a valuable set of data that would have been previously unavailable to science teams due to funding, manpower, and resource limitations or would have taken an unreasonable amount of time to collect. Reports from a wide range of Citizen Scientist locations are helpful to assess the satellite data under different conditions. With nothing more than their eyes and an internet connection participants provide a different perspective and analysis of clouds, adding to a more complete picture of what's happening in the atmosphere in which we live.
[F] 4.5

FOR LOVE AND MONEY: BUSINESS MODELS THAT SUPPORT, SHARE REWARDS WITH, AND BENEFIT FROM THE WORK OF CITIZEN SCIENTISTS
David Curren, OpenScientist
A principal finding of my OpenScientist poster for the 2012 Public Participation in Scientific Research Conference was that"... the strongest positive correlation for all interactive citizen science projects is the availability of a reward." While many conference-goers agreed with the finding none had a cost-effective way for providing monetary rewards, and they eagerly sought my advice. This poster addresses those questions by proposing models for monetizing citizen science to the benefit of both citizen scientists and private companies. This "Tackl[es] grand challenges and everyday problems with citizen science" by addressing a powerful method to ensure extensive data collection and public participation in scientific research—the profit motive.
The poster will survey existing practices from my own research (current uses of citizen science by companies, options for funding such as crowd-sourcing and challenge programs, etc.), analyze industry niches filled by current science-based businesses for ways they can benefit from citizen science, and identify business models from unrelated industries that can be adapted by citizen scientists. It will also demonstrate ways to ensure citizen scientists are rewarded when for-profit firms find ways to monetize citizen science research, and it will propose citizen scientist classifications based on the different routes available to monetizing their work. It will conclude with tools participants can use themselves to implement these ideas.
[F] 12.2

MAPPING INVASIVE SPECIES WITH EDUCATORS AND STUDENTS
Jennifer Dean, New York Natural Heritage Program
The New York Natural Heritage Program manages the state invasive species database and provides an online mapping and reporting tool (iMapInvasives) for natural resource professionals and citizen scientists. Contributors trained to enter data help support the state's goals to foster early detection of and strategic response to invasive species. While the natural resource professionals input the majority of data, educators, students, volunteers, and amateur naturalists are valuable eyes-on-the-ground that contribute observations regularly. To help build this team of citizen scientists across the state, we have launched invasive species mapping projects for a variety of educational audiences (e.g., secondary, college, and adult learners), with the goal of having the educators provide the necessary data entry training and yearly continuity. Many projects were met with enthusiasm, but failed to have momentum for the following year for a variety of factors. We have found our best return on investment from working with college professors, who typically have continuity and flexibility in their curriculum to design projects with students. I'll discuss some projects that worked (and didn't work) to keep educators coming back each year.
[D] 6.9

ARE FREE PRINTED EDUCATIONAL MATERIALS REALLY NEEDED IN ENGAGING UNDERSERVED COMMUNITIES?

Marta L. Del Campo, Karen Purcell, and Janis L. Dickinson, The Cornell Lab of Ornithology

We'll explore the consequences of changing the model of a successful citizen science project designed to engage underserved urban audiences. Celebrate Urban Birds (CUBs) is a citizen science project from the Cornell Lab of Ornithology that successfully engages and involves urban underserved communities in science, the appreciation of birds, and conservation. So far, CUBs has engaged over 10,000 organizations (88+% reaching underserved communities) and more than 300,000 participants across North America. The project is bilingual, delivered in Spanish and English, and has earned widespread recognition for its innovative approaches to reaching audiences not traditionally represented in science. The project was co-created with input from urban Latino communities and is based on research to develop novel models for bringing meaningful and relevant participatory science to Latino communities in placed-at-risk neighborhoods.

Until January of 2014 the project model consisted of co-creating community celebrations focused on birds, greening, and the arts; free materials for participating organizations; mini-grants; and capacity building. Since 2007 CUBs had impressive success in engaging new audiences from underserved communities. Due to temporary funding constraints, starting in January 2014 CUBs changed its model to reach underserved communities. The most radical change was to no longer provide free educational materials. As of January 2014 organizations had to request a scholarship to receive free educational kits or they could download them from the website. The impact of this modification in the outreach model transformed the number of participants and organizations registering for the project and the demographics of new registrants.

We carefully looked at the consequences of the change in implementation and will discuss the results of our study. The value of free, printed educational materials in the successful inclusion of underserved communities in citizen science may be much greater than we imagined.

[B] 14.9

ANECDATA.ORG: A VERSATILE ONLINE COMMUNITY FOR ENVIRONMENTAL CITIZEN SCIENCE

Jane Disney and **Duncan Bailey**, Mt. Desert Island Biological Laboratory

The Internet and mobile devices have opened new opportunities for citizen science, but existing citizen science websites are limited in the scope of the data they can collect. Anecdata.org, developed at MDI Biological Laboratory's Community Environmental Health Laboratory, is a new mobile-friendly web app for environmental citizen science, which addresses many of these limitations.

Anecdata allows students, teachers, researchers, regulatory agencies and community organizations to crowd-source a wide range of environmental data. While existing citizen science sites only accept reports where a species is present, Anecdata collects species presence and absence reports as well as environmental data related to habitat quality and pollution events.

Project creators can make custom datasheets with lists of locations where users can add data. Users can include their device's GPS coordinates, upload photos and videos, and add additional fields on the fly while posting. They can also run advanced searches and download custom reports in spreadsheet or Google Earth format as well as ArcGIS shapefiles for use with ArcMap and QGIS.

Anecdata will enable many groups from around the globe to get started on environmental projects without having to invent data management or mapping tools. Some anticipated uses of Anecdata include: researchers collecting data on habitat quality from volunteers; teachers and students testing their hypotheses by collecting information and comparing their data to other groups' data; and regulators collecting input from citizens who may not be able to attend public hearings.

[C] 9.7

WHY WATCH BEES? UNDERSTANDING CITIZEN SCIENTISTS' MOTIVATIONS IN ORDER TO IMPROVE RECRUITMENT, RETENTION, AND PROJECT OUTCOMES

Meg Domroese and Elizabeth Johnson, Center for Biodiversity and Conservation, American Museum of Natural History
The benefits of citizen science to science, participants, and socio-ecological systems are increasingly recognized and valued, yet what motivates volunteer participants remains little studied and poorly understood. To better understand citizen scientists' motivations and how they benefit from their participation, we surveyed volunteers in the Great Pollinator Project in New York City. We conducted pre- and post-season surveys and focus group discussions to find out who the active volunteers were, their motivations for joining, and what benefits of participation they experienced. With demographics and a range of motivators similar to those found in other projects, our findings correspond with and support those of other studies. However, while studies of motivations of environmental volunteers have indicated helping the environment as the strongest factor, helping or contributing to science was a leading motivation of our volunteers. Learning about bees and how to attract pollinators was as strong or a stronger motivator for many participants in the project. Being outdoors was also an attraction, particularly finding a meditative setting in an urban area to quietly watch bees. We discuss some of the steps we took in response to participants' feedback and recommend studies to improve understanding of volunteer motivations to benefit volunteers themselves as well as citizen science project outcomes.
[E] 5.8

INCREASING CAPACITY FOR SCIENCE: USE OF COLLABORATIVE NETWORKS FOR A WHOLE THAT IS LARGER THAN THE SUM OF ITS PARTS

Alyson Eberhardt, NH Sea Grant/UNH Cooperative Extension; Malin Ely Clyde, University of New Hampshire Cooperative Extension
Many citizen science efforts today are increasing capacity to do science through crowd-sourcing, social media, and technology innovations. We propose that citizen science programs can also increase capacity through investments in collaboration among organizations, volunteers, and program staff. Research and experience suggest that effective citizen science programs require staff time, strong communication with volunteers, and adequate funding. While collaboration can be time-intensive, we suggest that it can be a critical tool for increasing the capacity of organizations and researchers with limited resources. We describe two related collaborative networks being employed to expand research capacity, increase pools of trained volunteers, and improve science and stewardship outcomes among a diverse group of partner organizations in New Hampshire and beyond. The Coastal Research Volunteer (CRV) program is a regional network of volunteers based at the University of New Hampshire and NH Sea Grant. CRV provides an interface where volunteers are trained to work with researchers on a variety of funded coastal research projects that vary by season and year. By relying on one citizen science coordinator to support many projects, this "time-share" citizen science model allows local scientists to stretch limited time and financial resources to address local and regional environmental issues while creating a dynamic community of citizen volunteers. The Stewardship Network: New England (The Network) is a broader-scale effort, of which CRV is a collaborating partner. The Network, based at the University of New Hampshire, mobilizes volunteers to care for and study ecosystems, lands and waters in and around New Hampshire. Collaborating with over 75 different partner organizations since its launch in 2013, the Network provides a collective volunteer management system for partners, including an online calendar, registration system, citizen science hub, weekly e-bulletins, and opportunities to share student interns across organizations.
[A] 13.1

PUBLIC PARTICIPATION IN THE DIGITIZATION OF BIODIVERSITY SPECIMENS

Elizabeth Ellwood, iDigBio; Florida State University; Betty A. Dunckel, Florida Museum of Natural History Paul Flemons, Australian Museum; Robert Guralnick, University of Colorado at Boulder; Gil Nelson, Florida State University; Greg Newman, Colorado State University; Deborah Paul, iDigBio; Nelson Rios, Tulane University; Katja C. Seltmann, American Museum of Natural History

New web resources provide scientists opportunities to engage the public in ways and at scales not previously possible. Many ecological and environmental citizen science projects focus on generating present-day occurrence data on populations, species, and communities to address urgent societal challenges, such as the extinction crisis and biotic responses to climate change. Biodiversity research collections provide the opportunity to produce the important historical and present-day baseline data on distributions with which to compare the new observations and project future change. However, only ten percent of U.S. specimens have been digitized, a situation that limits the discoverability and usability of specimens. A goal of the biodiversity research community is to digitize most of the remaining specimens within a decade and public engagement can provide an important strategy to accelerate digitization. Engaging citizen scientists in digitization promises to both serve the digitizing institutions and further public understanding of biodiversity science. Here we discuss three major digitization tasks that the public can participate in online: label and ledger transcribing/cataloging from digital images, georeferencing from collection locality descriptions, and specimen tagging/categorizing from images. We present the tools that have been developed to interface between collections and citizen scientists. The field of public participation in digitization of biodiversity research specimens is clearly in a growth phase with many emerging opportunities for scientists, educators, and the public. The field will benefit from broader communication with complementary or overlapping projects in other fields, such as the digital humanities.
[C] 7.3

ENGAGING NON-SCIENTISTS IN URBAN ECOLOGY: LESSONS LEARNED FROM DESIGNING, IMPLEMENTING, AND SUSTAINING THREE PLACE-BASED CITIZEN SCIENCE PROJECTS
Monica Elser and **Marcia Nation**, Arizona State University
As the world's population becomes increasingly urban, understanding the ecology of cities is critical to ensuring the health of urban ecosystems and the people that live in them. Yet designing, implementing, and sustaining effective place-based citizen science programs requires more than just a good idea; these require dedicated human and fiscal resources and clear implementation plans.
The Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) program is an urban ecology research program that has been involved in several citizen science initiatives over its 17-year history. We examine three of these initiatives of varying durations: The Ecology Explorers program (15 years-old), which involves teachers and students in collecting and entering schoolyard ecological data in a web portal; the Urban Tree Community Science initiative (3 years-old), which engages homeowners in reporting data about shade and fruit trees planted in the Phoenix metropolitan area; and the Phoenix Phenology Trail (to be implemented with a group of project partners in spring 2015), which will involve a variety of citizen science groups in observing and understanding plant phenology in Phoenix area mountain parks.
Using various evaluation frameworks we distill key lessons learned in three areas: program design, implementation, and management toward program sustainability. In doing so, we examine issues of participant recruitment, engagement and retention; technology use in program delivery; and the challenges of channeling resources to citizen science ventures. We reflect on how our ideas about effective strategies for engaging citizen scientists have changed over time, and how we have tried to make these changes in our more recent programming. While we focus primarily on formative or process-related aspects of running citizen science programs, we touch on the challenges of defining, monitoring, and measuring learning outcomes.
[A] 6.8

PATHWAYS TO SCIENCE THROUGH NATURE: CITIZEN SCIENCE, IDENTITY, AND YOUTH DEVELOPMENT
Jody Enck, Jennifer Shirk, Rick Bonney, Nancy Trautmann, Jennifer Fee, and Ileana Betancourt, Cornell Lab of Ornithology
Pathways to Science through Nature immerses 4-H youth in nature-based, curricular activities scaffolded

with the Next Generation Science Standards and explicitly linked to several citizen science projects. The goal is to enhance scientific thinking in youth and propel them along pathways to towards developing a science identity. The need for this program is rooted in recognition that Science, Technology, Engineering, and Mathematics (STEM) fields are critical educational foundations for youth development. For example, the National 4-H Council builds many aspects of its youth development programming on the idea of contributing to a "STEM-ready workforce." With support from the Noyce Foundation, the project is working with 4-H programs in New York, Illinois, and California. Multi-day, in-person workshops prepare 4-H educators and volunteer leaders to use two curricula created by education staff from the Lab of Ornithology, and to participate in each of the linked citizen science projects. On-going, interactive support is provided through webinars, conference calls, a listserv, and interaction with the statewide, 4-H science coordinators in the three focal states. Some innovative aspects of the program include opportunities for youth to engage with the ideas and activities of "science people" to better align their own behaviors and imaginations to more fully understand the science content they may already know and new content they learn through the Pathways curriculum. The combination of fun, innovative, nature-based curricular activities and participation in citizen science offers tremendous potential for enhancing youth development and STEM education. Our formative evaluation of the program is aimed at documenting science identity and youth development outcomes attributable to these experiences.
[G] 11.9

WE CHALLENGE YOU TO CREATE: PROJECT MODELS AND APPROACHES FOR CITIZEN SCIENCE IN PUERTO RICO (CONTRIBUTORY, COLLABORATIVE, CO-CREATIVE)

Sandra Faría Dávila, Yogani Govender, and Lee Ann Rodriguez, Para la Naturaleza

Citizen Science projects of the Conservation Trust of Puerto Rico (CTPR) are aim to engage citizens in nature so they can become stewards of ecosystems. Although, the conventional model for citizen science is a participant attending training session to learn standard methodologies to measure/asses species, habitats and ecosystems from a scientist and then go off to collect data on their own and share data with the scientist is successful. The CTPR propose an alternative model that includes the scientist throughout the spatial and temporal long-term data collection. In this model, the participants are mentored by the scientist or scientific assistant to pass through the different phase of the citizen science model (contributory, collaborative, co-created). The main goal is to enable the participants to develop the skills of scientific inquiry as they participate with the scientist so as to develop their own research question and experiment to address STEM concerns within their community. This approach challenges the project team to provide opportunities such as field trips, workshops, dissemination for participants to interact with scientists in more intimate manner to stimulate dialogue about experiments or research that they would be interested in developing through this project. Based on the criteria set by scientists currently we have 16 participants that have passed the contributory phase of the model and committed to developing a community based science project. These criteria vary from the numbers of times participants contributed to data collection and analysis, skills on equipment use, ability to do data entry and analysis and confidence to disseminated information about Citizen Science project. The new proposed model of citizen science provides an alternative exciting opportunity to engage citizens to create projects that concern their environment and everyday lives.
[E] 13.4

CITIZEN SCIENCE ON THE SCHOOLYARD: MEETING THE NEEDS OF TEACHERS, STUDENTS, AND SCIENTISTS

Jennifer Fee and Nancy Trautmann, Cornell Lab of Ornithology

For K-12 teachers, citizen science offers a way to motivate and inspire students through participation in research that is relevant both locally and globally. Students build meaningful connections to the natural world as they make observations, collect data, and view their findings within the broader scope of the

project. Participating can also create opportunities for students to learn key science concepts related to topics such as life cycles, habitats, adaptation, phenology, and ecological interrelationships. During their observations, questions naturally arise, providing a jumping-off point for authentic student investigations, and furthering the opportunity to build students' science practice and reasoning skills. Through these experiences, students are not just learning science but are actually being scientists, contributing findings that collectively build to a broader study. Teachers are generally excited about doing citizen science, in part, because such activities uniquely fulfill the NGSS mandate to couple science practice with content and give students a real-world context in which to apply what they are learning. Use of citizen science in school settings offers potential rewards for everyone involved: scientists (opportunities for outreach, additional data), students (engagement, meaningful connections to the natural world, learning science in a real-world way), and teachers (motivating students through authentic investigations, meeting education standards). But successful implementation of citizen science in school settings requires attention to the potentially competing needs of these audiences. For example, scientific rigor cannot come at the sacrifice of student learning, or vice-versa.
In this session, we'll share brief case studies of citizen science projects that have been successfully used in K-12 settings, as well as lessons learned in our own work in developing educational materials and teacher training that scaffold the Cornell Lab's citizen science projects. We will illustrate that goals for these audiences—scientists, students, and teachers—can be achieved!
[D] 14.4

EXPERIENCES USING A SMARTPHONE APPLICATION TO EVALUATE WILDFIRE THREATS
Colin J. Ferster and Nicholas C. Coops, University of British Columbia
Wildfires can threaten property and life in the wildland-urban interface (WUI), where human development meets wild areas. Two priorities for mitigating these threats are collecting information about the fuel that is available to burn (i.e. forest structure, so actions can be planned to reduce the intensity and severity when wildfire occurs), and building cooperation through fostering a sense of shared responsibility and understanding by the numerous stakeholders. With limited resources and shrinking forest management budgets, creative applications of public participation in scientific research may help meet these objectives. In this work, a smartphone application was developed that utilizes a novel method of collecting rapid observations of forest vegetation structure. Participants were recruited from local communities, and questionnaires and observational notes were used to explore potential audiences for the application, motivations for volunteering, and experiences using the application. The data quality were evaluated using reference measurements and comparisons were made between participants with different levels of experience. A framework was developed to integrate the smartphone data with multispectral remote sensing and topography to make estimates over broader areas. As a result of these experiences, a range of future priorities were identified including building tools to reward the motivations for participation of different audiences and increasing the degree and quality of public participation.
[F] 9.5

TROUT UNLIMITED'S COLDWATER CONSERVATION CORPS: CITIZEN SCIENCE FOR MONITORING UNCONVENTIONAL SHALE GAS DEVELOPMENT IMPACTS TO WATER QUALITY IN CENTRAL APPALACHIAN STREAMS
Kurt Fesenmyer and Jake Lemon, Trout Unlimited
Trout Unlimited's Coldwater Conservation Corps trains and organizes volunteers for stream surveillance of water quality impacts from ongoing unconventional shale gas development in the Central Appalachian region of Pennsylvania, West Virginia, and Virginia. Unconventional shale gas wells are created using hydraulic fracturing drilling methods, or fracking, and have been associated with stream sedimentation during construction, flow impairments associated with water use, and water quality issues related to the disposal and transportation of fracking chemicals and effluents. The "angler

scientists" of the Coldwater Conservation Corps conduct routine water quality monitoring by taking water samples, measuring stream flow, and conducting visual assessments before, during, and after shale gas development in watersheds. We discuss the training and procedures of the program, the science and web-mapping tools Trout Unlimited staff developed to guide monitoring to the most vulnerable watersheds, the challenges inherent in detecting infrequent events and monitoring remote locations, and the process of integrating data-logging equipment for continuous measurements into the program.
[F] 3.5

DOES CITIZEN SCIENCE CONCEAL AN IMPORTANT DICHOTOMY BETWEEN CROWD-SOURCED AND PLACE-BASED SCIENCE?—AN OUTLOOK FROM THREE DECADES OF RAPTOR RESEARCH AT THE GOLDEN GATE

Allen Fish, Golden Gate National Parks Conservancy

The Golden Gate Raptor Observatory was founded in 1984 as a cooperative program of the National Park Service, to monitor the largest raptor migration site in California. Today, GGRO has 300 volunteers and three paid staff. We use counting, banding, radio-tracking, and GSM satellites to track raptor flights and numbers. We have produced over 100 articles and presentations for scientific audiences, and have conducted cooperative research with eight local universities. Among lessons learned at GGRO: citizen scientists are not cheap labor; they are expensive. They require interviewing, training, and clear position descriptions. They must follow methodologies, be evaluated, and can be fired. Given the work, why engage volunteers to do field research? For at least two reasons—both of which support conservation biology: they bring creativity to the scientific process, and they create outcomes that deeper embed our research into local communities.

In a 2012 textbook on citizen science, one author asserts, "Had a book like this been attempted before widespread use of the Internet, it would have been at best, bland. It is no coincidence that the first appearances of the phrase 'citizen science' in the 1990s coincided with the Internet's ascendance." However flawed, this statement points to a natural schism in citizen science, a split between (1) crowd-sourced, internet-based data collection, and (2) a more localized research wherein volunteers work closely with each other and with scientists to collect data, and to organize and present results. This latter, more place-based model of citizen science offers different benefits and challenges than the crowd-sourcing Internet model. Among them: (1) regular and personal dialogue between scientists and data collectors about the research process; (2) a local tradition of research that can support neighborhood conservation, education, and sociopolitical issues; and (3) a sense of ownership of the research among the volunteers.
[F] 12.5

EXPLORING EXPERIMENTATION IN AN INNOVATIVE CITIZEN SCIENCE PROJECT

Ria Follett, Macquarie University

Citizen science projects have been classified as contribution, collaboration and co-creation based on the roles between citizens, professionals and scientists, with the majority currently falling into the contribution group. An alternative typology divides projects into five categories: action projects initiated by volunteers, conservation projects with resource management goals, investigation projects focused on scientific research in a physical setting, virtual projects run entirely on-line, and education projects.

A new emerging category of collaborative, or co-created projects, engage citizens who conduct their own experiments at home. They gather, share and analyse the data they collect in partnership with the professionals. They also suggest and test new hypothesis devising and conducting new experiments. PatientsLikeMe is an example where patients with rare diseases record their medical data and condition, and partner with physicians in analyzing the data, suggesting and trialing new treatments.

A case study in aquaponics (the growing together of fish and plants for mutual benefit) explores this approach, involving citizens already experimenting with aquaponics. The project explores the extent

that potential benefit to themselves drives commitment to long term participation. It also explores how they analysed the collected data, proposed research questions and created new knowledge. Citizens were invited to contribute to an easy but useful survey and/or keep a detailed structured diary of their systems, requiring considerable commitment to longer term research. The diary is a rich source of data—valuable to both the contributor and the researcher—which is analysed by the contributors, who suggest hypothesis based on the data. This paper presents results showing that a significant percentage of participants are prepared to take part in the longer term research, and suggest questions based on the data. Participants who were new to aquaponics, with more to learn, were more diligent than experts in contributing.
[B] 12.4

EMAMMAL – BALANCING RIGOROUS LARGE SCALE CITIZEN SCIENCE WITH PARTICIPANT LEARNING
Tavis Forrester, Smithsonian Conservation Biology Institute, Front Royal, VA, USA; Robert Costello Smithsonian National Museum of Natural History; Stephanie Schuttler, North Carolina Museum of Natural Sciences, Raleigh, NC
Citizen science initiatives try to balance scientific data collection with education, with varying degrees of success. eMammal is a large-scale citizen science program that partners with volunteers to place wildlife cameras and collect photographs of mammals with associated meta-data. The project is also engaged in informal and formal education of both volunteers and the general public. Volunteers were trained to set wildlife cameras and used custom software to identify wildlife photos and upload data remotely. All volunteer identifications were reviewed and validated/corrected by experts before storage in a Smithsonian digital repository. Over 500 volunteers sampled 2300 sites across 6 states in the first 2 years of the project. Only 7% of volunteer cameras were rejected for poor setup, and individual volunteers improved camera setup over time. Volunteers accurately identified 15 of 20 common species 90% of the time, although there was no improvement in species identification during the project. We assessed volunteer wildlife conservation attitudes and wildlife knowledge before and after participation with validated survey instruments. We found that attitudes toward wildlife and importance of protected areas were already high and did not change (n=48, Wilcoxon rank test, p=0.67, 0.71), but knowledge of wildlife natural history slightly, but significantly, increased (n=63, paired t, p=0.01). Volunteer enthusiasm was high and 98% of surveyed volunteers wanted to return (n=126). eMammal has created a system for collecting high quality data with volunteers by using photographic data vouchers and expert review, but both outreach and education efforts have potential to grow. While we are currently reaching groups already interested in conservation, current classroom programs have higher outreach and education potential with urban and underserved youth populations. eMammal is poised to be a central platform for camera trapping projects worldwide and shows potential for balancing the collection of quality scientific data with education.
[E] 8.1

INVOLVING THE PUBLIC IN MARINE RESEARCH: CITIZEN SCIENTIST DIVERS MONITOR CALIFORNIA'S MARINE PROTECTED AREAS
Jan Freiwald, Reef Check Foundation
Ecosystem-based strategies have become an essential aspect of marine conservation in California, increasing the need for long-term environmental monitoring data to assess management outcomes and adapt accordingly. Citizen science can address these data needs while involving the public in conservation science. One pertinent example is the implementation of a California-wide network of marine protected areas (MPAs). Management agencies are mandated to monitor the performance of these MPAs with respect to meeting their goals; for example, protecting diversity and restoring marine life populations. Reef Check's California program (RCCA) trains recreational volunteer scuba divers as citizen scientists to conduct subtidal monitoring of an iconic habitat targeted for protection by MPAs: rocky reefs and kelp forests. Community members, in conjunction with staff scientists, then collect data

that are used to not only inform future MPA management but can also help understand ecosystem responses to impacts such as ocean warming and acidification. RCCA has conducted state mandated baseline monitoring since 2007 as in all regions where MPAs were implemented throughout the state. Through this program, citizen scientists have established one of the geographically largest near-shore reef datasets in California. This level of citizen scientist involvement in subtidal ecosystem monitoring is unprecedented in California and demonstrates how citizens can perform ecosystem monitoring in challenging environments. Additionally, the public's involvement in research informing marine management also builds a science-based stewardship ethic in the ocean stakeholder community.
[F] 11.3

THE CALIFORNIA NATURALIST PROGRAM

Brook Gamble, University of California Hopland Research and Extension Center; Carrie Raleigh, University of California Cooperative Extension; Sabrina Drill, University of California Cooperative Extension

University of California's California Naturalist Program seeks to create a committed corps of volunteer naturalists and citizen scientists trained and ready to take an active role in natural resource conservation, education, and stewardship. Throughout the nation, Master Naturalist programs and citizen science projects have both been shown to increase volunteers' ecological knowledge, understanding of science, and environment-related behaviors. In California, we partner with local formal and informal science organizations to offer 40+ hour certification course. Our partners use a core science curriculum called the California Naturalist Handbook (published by UC Press) that addresses basic natural history of California as well as classical and modern techniques for recording and communicating observations of nature. We are currently developing advanced peer-reviewed curricula in subjects such as the ecology of specific bioregions, near shore systems and the California Current, and urban ecology. Our highly interactive program includes experiential and classroom learning, communication training, community service, and post-certificate advanced learning opportunities to engage participants. Outcomes include increased scientific literacy and critical observational, analysis, interpretation skills, increased engagement in different types of volunteer opportunities, and a vibrant community of practice with which to keep learning and sharing skills. To date, we have partnered with 23 organizations to certify over 650 Naturalists, who have volunteered over 17,000 hours of service in the areas of program support, education and interpretation, scientific monitoring, and land stewardship.
[D] 11.7

CITIZEN AND SCIENTIST ENTHUSIASM FOR TREE HEALTH MONITORING AND SURVEILLANCE IN THE UK

Hilary Geoghegan, University of Reading, UK

Trees are culturally visible markers for environmental stress. The growth of the international plant trade, climate change, and insufficient biosecurity protocols have led to an increase in invasive pests and diseases affecting trees.

Governments and other officials have identified the public and citizen science as an important part of the response in detecting the arrival, presence, spread and absence of pests and diseases. Through the example of Chalara fraxinea, popularly known as Chalara dieback of ash, this paper examines the role of enthusiasm in tree health monitoring and surveillance in the UK, specifically revealing the strong emotional affiliations involved in tree health monitoring. The paper reveals the opportunities and challenges encountered when government scientists ask members of the public, often unaware of tree health pests and diseases, to monitor environments for health.
[F] 4.8

CITIZEN SCIENCE'S BROADER IMPACTS: DOES PARTICIPATION IN VOLUNTEER WATER QUALITY MONITORING PROVIDE MORE THAN DATA?

Brian Greene and Nancy Mesner, Utah State University

Citizen science programs are often promoted as avenues to not only increase data collection and participation in science, but to also increase people's knowledge and awareness about environmental issues. In order to make these broader educational claims about citizen science's outcomes we need to evaluate participant's knowledge and opinions to measure if there is a change due to participating in citizen science programs. In 2012 a statewide volunteer water quality monitoring program called Utah Water Watch was launched by Utah State University Extension and the UT Division of Water Quality. The goal of the program was to collect water quality data to assist in statewide monitoring efforts and increase the public's awareness of the importance of water quality. Before volunteers were trained they completed an evaluation form for baseline information about their knowledge and opinions of water quality and the professional organizations in Utah that monitor water quality. In less than three years over 150 volunteers have been trained and reported over 1,000 monitoring events on 91 sites. In 2014 we conducted a follow-up survey to see if volunteers' knowledge or attitudes about water quality changed. We used an online survey of Utah Water Watch volunteers to answer the following questions:

- Do volunteers report increase knowledge or improved attitudes about water quality?
- Does the number of times volunteers talk to people in their community about water quality increase?
- Did volunteers' opinions about professional water quality monitoring improve?
- How do these measures relate to volunteer participation (number of monitoring events; length of time in program)?

We also surveyed volunteers about their motivations for participating with Utah Water Watch, their knowledge of water quality, and perceived benefits from participating in a volunteer water quality monitoring project.

[E] 2.6

CITIZEN SCIENCE THROUGH PARTICIPATION: ENGAGING TEACHERS AND STUDENTS IN CUTTING-EDGE WATER CONSERVATION

Victoria Gutierrez, Arizona State University/ Decision Center for Desert City/ Center for Policy Informatics/ Global Institute of Sustainability; Dara Wald, Arizona State University/ Decision Center for Desert City/ Center for Policy Informatics; Monica Elser, Arizona State University/ Global Institute of Sustainability

Successful water management depends on critical, valid, and reliable water use data. In Arizona, access to water data is limited by protective, consumer legislation that prohibits the collection of individual, household data without a complex consent process. The lack of available water use data presents a grand challenge for developing water conservation strategies and forecasting future water demand. To help bridge this informational gap, our study combined aspects of citizen science and experiential education to develop an innovative citizen science water monitoring project that uses cutting-edge technology to engage high school students in the real-time tracking, analysis, and sharing of their water consumption data. The citizen science project is being developed with participatory feedback from high school teachers across the Phoenix Metropolitan area. In July, 16 middle and high school teachers participated in a formative evaluation of the proposed citizen science water unit. We presented teachers with examples of the possible web-based tools and approaches we were designing for classroom use and data collection. Teacher feedback suggested ways the exercise could be improved, including accounting for differences in single vs multifamily dwellings and more questions to encourage discussion about water. During the small group discussion, teachers highlighted the importance of engaging students in the process of collecting data, understanding the scientific method and understanding data analysis tools (e.g., graphs and charts). Teachers also expressed a great deal of interest in this type of unit and we expect this enthusiasm to contribute to increased success in recruiting and retaining future program participants. Moreover, this experience allowed us to balance scientific and educational goals and highlighted the potential mutual benefits of participatory program development and formative evaluation.

[D] 2.5

JELLYWATCH.ORG: MONITORING GLOBAL MARINE ECOSYSTEMS

Steven Haddock, Monterey Bay Research Institute, University of California Santa Cruz

JELLYWATCH.ORG - Monitoring the ocean on a global scale can be an expensive and frankly impossible undertaking. The area that has to be covered is simply too large for any ship, expedition, or research team. However thousands or millions of people experience the ocean each day in all corners of the earth. By tapping into this pool of citizen scientists, we can aspire to generate a global network of observers to monitor the state of ocean health. In particular, at jellywatch.org we are interested in the timing and distribution of blooms of jellyfish. Since launching the list a little more than a year ago, we have received nearly thousands of sightings from North and South America, Indo-Pacific, Africa, the Mideast, Asia, and Europe—from the Arctic Ocean to the Coral Triangle. The database and images that are submitted are freely available to anyone to use in their own research. So far, our jellywatchers have identified blooms across broad regions of the Gulf of Mexico, revealed interesting and unusual species, and mapped out global occurrence of "By the Wind Sailors." Future plans include developing improved visualization tools for examining temporal and spatial patterns.

[F] 10.5

COMBINING PEOPLE, PLACE AND SCIENCE: LESSONS LEARNED FROM DEVELOPING A CITIZEN SCIENCE PROGRAM AT PEPPERWOOD

Michelle Halbur and Lisa Micheli, Pepperwood Preserve

Building a successful citizen science program brings as many thrills as it does challenges in order to maintain a balance between organizational and research needs and the needs of volunteers. In just four years Pepperwood's citizen science program has grown over 600%—from a few hundred hours to over 3700 volunteer hours in 2013-14. Pepperwood's citizen science projects are part of our "watershed sentinel site," which serves as a cohesive conservation model integrating climatic, abiotic, and biological monitoring projects that directly inform our land management practices and objectives. Under this umbrella, research and management staff define a range of projects suitable for volunteers: phenological surveys, maintaining wildlife cameras, managing the Stephen J. Barnhart Herbarium, breeding bird surveys, monitoring stream flow and pond water levels, documenting species through iNaturalist and our summer teen program (TeenNat), and more.

Through our two-year Steward Program, which was foundational to the development of the California Naturalist Program, and detailed volunteer orientations, trainings, and project meetings, we have retained a strong citizen scientist volunteer base. Clearly stating our objectives, expectations, and defining volunteer roles based on volunteer skills and motivations are key to managing research volunteers. Furthermore, we have established multiple data check points in each project where staff conduct quality control and assess volunteer performance. Project results are shared with our volunteer community, keeping them engaged and informed on the progress and importance of each project. We have developed a culture of gratitude at Pepperwood; all volunteers recognize they are part of a larger team contributing to the advancement of conservation science. To assess the learning objectives of our citizen science program, we are currently developing protocols with our education team.

By bringing people and science together Pepperwood is compiling research quality data to support interdisciplinary climate change studies and further conservation science.

[A] 13.6

TEXAS PARKS AND WILDLIFE DEPARTMENT USES INATURALIST TO COLLECT HERITAGE DATA

Cullen Hanks Texas Parks and Wildlife Dept

The Wildlife Diversity Program (WDP) at the Texas Parks and Wildlife Department maintains the Texas Natural Diversity Database (TXNDD), a centralized repository for state-level data on rare, threatened, and endangered species. As part of the NatureServe Network, the TXNDD uses Biotics software and

applies NatureServe's natural heritage methodology. The TXNDD manages data on over 1,000 species of plants and animals. These data are used in environmental review, to assess conservation status, and as a tool for research efforts. Given the large number of species tracked and the immense geographical extent of Texas, obtaining data is a significant logistical challenge. To overcome this challenge, the WDP is using iNaturalist to generate photo-vouchered observations of tracked species. These observations are reviewed and validated by curators before acceptance into the TXNDD. The initial focus of the citizen science program has been a project targeting amphibians and reptiles, the Herps of Texas Project. Since its inception in 2011, this project has collected over 10,000 observations of amphibians and reptiles from over 500 participants. It has also engaged a community of naturalists that were not previously contributing to our database. To improve the quantity and quality of data, we are focusing on user experience. To instill a sense of achievement, we are promoting life lists, leaderboards, and challenges. For 2014, we also established a Big Year Challenge to see who can find the most species of amphibian and reptile species during the calendar year. In addition, we are promoting seasonal challenges that highlight data gaps and herping opportunities. The Herps of Texas Project has generated high-quality data at relatively low cost while simultaneously engaging Texas citizens. This success has encouraged us, in collaboration with our partners NatureServe and iNaturalist, to initiate new citizen science programs focusing on other taxa.
[F] 5.2

EVALUATION OF CITIZEN SCIENCE AS A LOW-COST TOOL FOR MARINE MAMMAL RESEARCH AND EDUCATION IN SOUTHEAST ALASKA

Courtney Hann and Andy Szabo, Oregon State University

This citizen science project evaluates a mobile application as a method for collecting low-cost regional-scale marine mammal data in Southeast Alaska. The project collaborates with the Alaska Whale Foundation and Smallmelo Geographic Information Services to produce a citizen science version of Whale mAPP. Whale mAPP is a GIS-based mobile application tool that allows citizen scientists to collect observations of marine mammals. Traditional methods of gathering and managing data to map marine mammal distributions require extensive time and resources. Whale mAPP allows anyone to submit and visualize observations over a broad regional-scale area. For this project, all data was collected between June and September 2014 in Southeast Alaska. The usability of these data will be determined by comparing marine mammal distribution maps based on (1) citizen science data collected via Whale mAPP and (2) standardized survey data. Furthermore, the educational benefits of participating will be assessed with user surveys. Overall, this project will assess the usability of citizen science data to understand marine mammal distribution patterns, determine the educational benefits of Whale mAPP, and provide critical feedback to revise the mobile application.
[C] 11.2

A NEW INSTRUMENT FOR MEASURING GEOGRAPHIC REASONING SKILLS IN CITIZEN SCIENCE: WHAT IS GEO-REASONING? HOW CAN WE MEASURE IT?

Ardice Hartry and Matthew Mac Cannady, University of California, Berkeley; Audrey Kremer, Mary Ford, and Jill Wertheim, National Geographic Society

This poster will describe a measure of geographic reasoning as well as seek feedback on how this instrument could be useful for evaluating citizen science programs. Geographic reasoning is a concept that is deeply relevant to many citizen science programs, such as programs that focus on issues of air or water quality, species distribution, and plant phenology. The field of citizen science would benefit greatly from having a common instrument—an instrument that is validated, reliable, and fits many different programs—to measure this common program goal.
As a way of focusing much of the previous research emerging from learning sciences, psychometrics, and studies of geographic education, researchers at the National Geographic Society and The Lawrence

Hall of Science at the University of California, Berkeley, have developed an instrument that measures geographic reasoning and is designed for use in citizen science programs.
The first purpose of this poster is to describe this new instrument by defining geographic reasoning and through providing examples of how it fits with many citizen science programs, samples of currently developed items and relevant technical information. The second purpose of the poster is to collect feedback about how this measure could be improved or expanded for use in evaluations of citizen science programs. The instrument is designed to be used in a variety of contexts, scored without specialized skills or knowledge, and interpreted without requiring statistical expertise. The poster will be used to trigger discussion with attendees about the following: 1) The types of instruments that would be useful for evaluators of citizen science programs; 2) Technological and administrative barriers that citizen science programs face in evaluation; 3) What is required of an instrument to make it useful for evaluations of citizen science experiences, such as ease of administration.
[E] 7.9

BEYOND DATA MANAGEMENT: EXPLORING NEW ROLES FOR LIBRARIANS IN CITIZEN SCIENCE PROJECTS
Katie Hassman, **Cartsen Oesterlund**, Gabriel Mugar, and Corey Jackson, Syracuse University; Kevin Crowston, National Science Foundation
No matter the size or scope, it is a challenge to provide resources and support to what are often diverse citizen science volunteer communities. While librarians have tended to play roles in citizen science projects related to managing data, their skills developing outreach and instructional initiatives, managing online resources, working as disciplinary liaisons, and collaborating with a broad range of faculty, staff, and patrons equip them to play new and creative roles that meet this challenge. In this poster we draw on empirical findings and a deep understanding of the volunteer communities engaged with the Zooniverse citizen science projects to provide examples of new roles librarians might take in citizen science projects that support volunteer engagement. In addition to describing each role, we also provide practical advice on how citizen science designers, developers, and scientists might reach out to and collaborate with librarians to fulfill these types of roles. The proposed poster is designed to start conversations and provide opportunities for conference attendees to collectively develop new ideas and strategies for successful collaborations with librarians in a variety of roles.
Take home message: Aside from their roles related to data management, librarians' skills and proficiencies make them valuable collaborators for the design, development, and support of citizen science projects.
[C] 15.10

WHAT DOES A CITIZEN SCIENCE PROJECT LOOK LIKE? THREE SIMPLE PROJECT MODELS FOR INCREASED RESEARCHER PARTICIPATION
Julie Hecht, The Graduate Center, City University of New York
While many fields have embraced citizen science to enhance and expand data acquisition and public reach, others remain cautious. This hesitancy could stem from questions about project design, setup and infrastructure. What could citizen science projects look like? Which project designs are well-suited for public participation? How can project design ensure high-quality data? As examples, the fields of ethology (animal behavior) and canine science both have the potential for substantial public involvement due to the public's interest in animals, specifically wildlife and companion animals. On the whole, these fields do not frequently incorporate traditional public participation projects. Established citizen project frameworks allow researchers to examine and incorporate effective public participation approaches into their research. Further, elucidating clear project models can aid researchers' understanding of the benefits and challenges presented by melding scientific research with public participation. Here, I discuss notable citizen science project models, clarifying potential advantages and pitfalls of each. Project models include: 1) volunteers collect and provide data, and researchers receive

volunteer-interpreted data but do not interact with the raw data; 2) volunteers collect and provide data, and researchers view and analyze the raw data; and 3) researchers provide content, and volunteers evaluate it. Some projects may incorporate multiple models. Additionally, canine science currently relies on dog owners and their dogs for passive or active study involvement, and I will discuss whether this participant-facilitated approach constitutes citizen science or traditional subject recruitment. Ultimately, discrete public participation project models can help researchers expand the scope and scale of their work while benefiting public participants.
[A] 13.3

VOLUNTEERS ARE AMAZING! HOW DOCENTS RE-VITALIZED A LONG-TERM ANT SURVEY AT JASPER RIDGE BIOLOGICAL PRESERVE, CA

Nicole Heller, Dwight Center for Conservation Science; Matthew Bahls and Merav Vonshak, Stanford University; Gary Smith, Retired; Carol Johnson, Adobe Systems; Deborah Gordon and Philippe Cohen, Stanford University

Long-term datasets of biological species distributions are highly valuable for ecological science, especially for understanding how species respond to global change. Despite the importance of long-term monitoring, support for such endeavors can be difficult. Grants for research tend to be three-year terms, rarely include monitoring, and are unlikely to be a good investment for a graduate student as the fieldwork demands are great relative to the likelihood of producing a high impact publication. On the other hand, long-term monitoring does lend itself well to citizen science. Citizen science offers the advantage of crowd-sourcing, such that many volunteers can achieve what would have been impossible for a few investigators. Here we describe the successful transition in 2009 of a long-term monitoring project of biological invasion at Jasper Ridge Biological Preserve (1994 – 2014) from a graduate student to a citizen science project. The Ant Survey serves as an example of a place-based, small-scale, collaborative participatory research that serves primarily to contribute quality long-term ecological data for scientific investigation, and secondarily an informal education experience for adults of all ages. Here, we share results on key issues in citizen science research in the context of this project: data quality, recruitment, training, retention, learning outcomes, and new methods that have emerged for collecting data as a result of volunteer input. The data obtained now, as a citizen project, are of similar quality to those obtained when graduate students conducted the survey. One advantage to the current method is that it's all done in one day, whereas it used to take one month. Volunteers report that they enjoy the work and are interested in devising additional opportunities to collect data. We describe some lessons learned from this project in hope that it will spur other researchers and biological preserves to implement similar programs.
[F] 5.10

CITIZEN SCIENCE ACADEMY: EXPLORING ONLINE PROFESSIONAL DEVELOPMENT COURSES FOR EDUCATORS AND RESEARCHERS

Sandra Henderson, Kat Bevington, and Liz Goehring, National Ecological Observatory Network, Inc.

The National Ecological Observatory Network (NEON) Citizen Science Academy (CSA) came about to address the need for online professional development (PD) resources and opportunities that explicitly focus on implementing Citizen Science (CS) in diverse educational settings. In addition, it became clear that professional field staff at government agencies and institutions would also be able to use online courses to advance their knowledge of CS programs that might be useful in their work. In the past decade, there has been more widespread acceptance of online PD courses as viable alternatives to face to face classes and workshops. This acceptance, along with the current proliferation of online ecology based citizen science programs, spurred the development of NEON's CSA (citizenscienceacademy.org) dedicated to providing online courses and resources to facilitate effective implementation of programs designed to engage the public in scientific data collection and analysis. Using NEON's Project BudBurst (budburst.org) as the pilot, an online, self paced course for informal and formal educators was

developed, piloted, and evaluated. An intended outcome of this pilot project was the development of best practices based on lessons learned that could be used for the development of future NEON online courses and shared with the citizen science community at large. The pilot clearly demonstrated the in interest in an online citizen science course. As a result the initial pilot, several more citizen science based online courses have been developed and are being offered 4 times a year. We are currently developing online courses for professional staff at USDA Forest Service and US Fish and Wildlife that will be released in 2015.
[F] 13.5

SUCCESSES AND CHALLENGES IN SOCIOECOLOGICAL EDUCATION
Solomon Henson, Kelly Hickman, and Rachel Durben, Sierra Streams Institute
Sierra Streams Institute is implementing socioecological education in our community that incorporates place-based learning, traditional ecological knowledge, local conservation, citizen science and service learning. As a rural community, Nevada City, CA, has unique assets and challenges that make socioecological education a particularly appropriate and effective model for both youth and adult learners. By collaborating with tribal, conservation and advocacy groups as well as traditional and alternative education systems, we are able to provide integrated lesson plans that engage students of all ages and encourage active learning and creative problem solving. We currently work with home, charter, and public school students and also provide community training days and workshops. Our methodology encompasses both traditionally defined environmental education that focuses on connecting people with their local ecosystem, as well as more novel approaches to learning such as seminars about the human health effects of mining toxins in the environment, and collaborations with local farms to enhance nutrition education. We are part of a growing movement in this region that emphasizes collaboration, resource sharing, environmental awareness and problem solving on issues both local and global. Though still in its infancy, this program is proving to be extremely engaging and successful, providing students with a deeper understanding of their environment as well as the tools required to affect significant positive change.
[D] 4.7

SCIENCE FOR, BY/WITH THE PEOPLE – A REGIONAL SCIENCE CENTER AS FOCAL POINT FOR CITIZEN SCIENCE INITIATIVES
Claudia Hernández-Pellicer and Paloma Nuñez, Centro de Estudios Avanzados en Zonas Áridas-CEAZA, Chili; Martin Thiel, Universidad Catolica del Norte, Coquimbo, Chile
One of the main goals of regional science center CEAZA is to advance the scientific-technological development in the Region of Coquimbo. In its quest to understand the effects of climatic-oceanographic oscillations on the hydrological cycle and biological productivity (natural and cultivated) in arid and marine areas of northern-central Chile, the scientists of the center have always been closely collaborating with stakeholders and decision-makers. The center also maintains a very active outreach section, which provides basic scientific information to the general public, reaching from schoolkids to their grandparents. By efficiently transferring the latest scientific results to all sectors of society, CEAZA fosters environmental protection and education and thereby contributes to the progress and living quality of inhabitants of the Coquimbo Region. These close links with society and the diverse range of scientific questions being investigated by CEAZA scientists provide an ideal scenario for implementing a citizen science program with a strong regional character. Currently, CEAZA scientists already collaborate with school kids in surveying marine litter, with fishermen in monitoring fisheries species, with farmers in checking potential pest species and monitoring water resources. Herein we discuss the ideas and plans for consolidating and expanding these collaborations between professional and citizen scientists, always considering the local identity of the Coquimbo region, which is characterized by limited freshwater resources and highly variable climatic and oceanographic conditions.
[B] 15.7

SCIENCE ACTION CLUB: EDUCATING AND EMPOWERING YOUTH THROUGH CITIZEN SCIENCE IN URBAN AFTERSCHOOLS

Laura Herszenhorn and Levedahl, California Academy of Sciences

The field of citizen science spans a wide range of topics, offers multiple points of entry, and impacts global and local communities in a variety of ways, yet many communities remain underrepresented in these experiences. In an effort to engage a more diverse group of participants, as well as to capitalize on citizen science as a strategy for science learning and civic action, the California Academy of Sciences partners with local community organizations to run a network of Science Action Clubs (SAC) for middle school youth in afterschool environments. SAC reaches youth where they already spend time—in their local schools and neighborhoods—and provides high quality science resources, including curriculum materials linked to citizen science projects, supplies for hands-on investigations, custom-configured digital technology, and professional development for afterschool and school day staff. Our current network of 17 clubs has the capacity to reach more than 650 Bay Area public school youth each year and plans are underway to spread and scale. But there are challenges to embedding citizen science in an academic curriculum - even an informal one. Typically, citizen scientists form a mostly-adult community of self-motivated science enthusiasts: participants choose to spend their leisure time collecting dead bees or documenting the biodiversity of intertidal reefs to better understand and protect our planet. Without thoughtful support and scaffolding, citizen science does not always hold the same intrinsic allure for middle school youth. In this session, we will reflect on the strengths and challenges of using community partnerships to increase the number and diversity of youth engaged in citizen science, as well as explore the value add and obstacles to employing citizen science as an engagement strategy for science learning. We'll share highlights from our Science Action Club resources, including our Citizen Science Toolkit for Educators.

[B] 6.7

TRAINING YOUTH CITIZEN SCIENTISTS TO CONDUCT QUALITATIVE OPEN-ENDED INTERVIEWS: METHODOLOGICAL FAILURE AND HOPE AT THE DAWN OF SOCIAL SCIENCE 2.0

Edward Hind, The School for Field Studies; Kayla Clark, Smith College; **Traci Hamanaka**, Wellesley College; Sarah Stanley, Clark University

Ecologically focused social scientists have looked on with envy as their natural science colleagues, who already had the ability to quickly gather large datasets, have further increased the volume of data available to them through implementing the successful citizen science programs that make up Science 2.0. Social science techniques such as interviewing can be slower to administer and it usually takes a long time for a small number of researchers to gather datasets large enough to be seen as representative and robust. The widespread development of a Social Science 2.0, where citizens could be enrolled to conduct more interviews than researchers have typically thought possible, would be highly advantageous, as the current number of trained social scientists is globally not enough to collect the volume of information required to address the plethora of wicked issues afflicting society. This paper recounts the exploratory efforts of a group of sociologists investigating the socioecological impacts of climate change in the Turks and Caicos Islands to scale-up their data collection by training high school students to conduct interviews for their study. The quality of interview conducted by these high school citizen scientists, as well as of the data they collected, was measured against the best efforts of the sociologists, who conducted their own interviews using the same survey instrument. Content, thematic and discourse analysis of interview transcripts showed that the professional scientists outperformed the citizen scientists to the extent that it is questionable whether efforts to train the former in the first place were worthwhile. More broadly, the findings question the validity of any Social Science 2.0 project. However, citizen scientists in this study did discover small amounts of novel information that professional scientists did not, providing some impetus for renewed and re-structured attempts to make Social Science 2.0 work.

[A] 12.9

ENGAGING VOLUNTEERS IN CITIZEN SCIENCE INITIATIVES

Melinda Hughes-Wert, Nature Abounds

For the past fifteen years, I've managed volunteers in relation to citizen-science opportunities, and I've done so successfully. My volunteers have been engaged in several citizen-science initiatives—water quality monitoring and stream assessment, frog and toad monitoring, bird monitoring, as well as general wildlife and weather monitoring. My poster presentation will walk participants through the steps of recruiting volunteers, engaging them in citizen-science initiatives, as well as keeping them engaged so that your project has consistent results over long periods of time.

[F] 13.9

CITIZEN SCIENCE PROVIDES ACCURATE, RELIABLE DATA FOR MAPPING WHITE-TAILED PTARMIGAN DISTRIBUTIONS ON VANCOUVER ISLAND

Michelle Jackson, Kathy Martin, and Sarah Gergel, University of British Columbia

Wildlife in alpine ecosystems can be elusive and difficult to survey, yet knowledge of their distributions is critical as these habitats disappear due to climate change. Opportunistic citizen science observations submitted by hikers in remote alpine regions can be valuable, as coverage is often extensive compared to scientific field surveys. However, many researchers believe citizen science data contains bias and should be used only to supplement systematic surveys by professional scientists. Here, we compare the performance of five statistical models and an ensemble model to predict the distribution of the Vancouver Island White-tailed Ptarmigan (*Lagopus leucura saxatilis*) based on two datasets: (1) field survey observations from radio-telemetry and call-playbacks, and (2) opportunistic citizen science observations submitted by hikers. The citizen science program was formed by the University of British Columbia's Centre for Alpine Studies and the Strathcona Wilderness Institute, and has resulted in >400 confirmed ptarmigan locations since 1995.

Predictions of suitable ptarmigan habitat on Vancouver Island varied from 370-1,039 km2 based on field survey observations and from 404-1,354 km2 based on public observations. Distribution maps of suitable habitat differed very little between the field survey and citizen science datasets for any given model, implying that opportunistically collected data predicts habitat suitability in a manner consistent with more time and cost-intensive field survey data. All models had fair accuracy (kappa > 0.45) when tested on the alternative dataset, but Generalized Linear Models and Generalized Additive Models over-predicted ptarmigan occurrence, had the lowest accuracy, and were most sensitive to the type of response data used. Accuracy of all other modeling techniques differed little between the datasets. Such similarity across datasets is encouraging for the continued use of citizen science programs for monitoring elusive species, which can save both time and expense while involving and educating the public.

[F] 8.8

A CITIZEN SCIENCE MOBILE APP FOR GLOBAL MARINE DEBRIS DATA COLLECTION

Jenna Jambeck and Kyle Johnsen, University of Georgia

Marine debris (typically a waste material) enters our environment from various pathways including mismanagement of solid waste (direct and indirect littering), which allow it to travel in our waterways and oceans. Marine debris persists in our environment, items and pieces have been found on populated and unpopulated coastlines as well as in the open ocean. As a part of the Southeast Atlantic Marine Debris Initiative (SEA-MDI) partnership with NOAA, a citizen science mobile application was developed for the Android and iPhone platforms called Marine Debris Tracker. Mobile Applications have become synonymous with modern communications, and this ever growing tool was used for its convenience, popularity, cost efficiency, and technical data capability. The widespread nature of mobile applications (or "Apps") in today's world provides an innovative yet simple tool for development and use by citizen

scientists. The Marine Debris Tracker App provides an opportunity for individuals to record location and description of marine debris items on their Smartphone (instead of logging using a data card). The flexibility in the App allows a casual beach goer to record debris they find, or for an organized cleanup group to keep track of debris in beach cleanups. Data is posted on a publicly available web portal, with the most recent five items are shown in a dynamic and engaging "feed" that updates every time a debris item is recorded. Data is also viewable on a map and available for download. Users of the website may observe and download data to use in curriculum development, classroom teaching, and as examples of marine debris throughout the world for education purposes. The Marine Debris Tracker App, database, and website have the potential to develop the mission of marine debris prevention into a regional, national, and global agenda. The website is at: http://www.marinedebris.engr.uga.edu
[C] 10.2

BIOCACHING APP: ENGAGING THE PUBLIC IN A GLOBAL BIODIVERSITY RESURVEY
Rebecca Johnson and Heather Yager, California Academy of Sciences
The BioCaching App is an innovative mobile tool that engages the public in revisiting museum specimen collections in their communities, or anywhere in the world. It puts the power to conduct a local or global biodiversity resurvey in anyone's hands. The application updates our knowledge of current biodiversity distributions and helps make real-time, location-specific connections between historic observations and current conditions. The app integrates current user location data with geolocated species occurrence records found in the Global Biodiversity Information Facility (GBIF), and connects users to related field observations and published literature in the Biodiversity Heritage Library (BHL). With one click, app users can see a map of GBIF occurrence records based on their current location. Users can then identify previously observed species that they would like to search for and conduct a 'trip', attempting to re-document those species. They can then record whether or not they are able to relocate each organism. Users can record new field observations at the same location (or if no species are found, record an absence). This 'trips' function adds the ability to record absence data and time spent searching to the app and the core functionality of iNaturalist (an online platform for recording and sharing biodiversity observations). All verified reports generated by the public will become new GBIF records, and the absence records generated will similarly be aggregated and made accessible to scientists. The app is a concrete way for users to 'see' habitat modification and connect that change to biodiversity change and loss. In addition, it engages users with species occurrence data and historic literature and provides historical context for observing flora and fauna in nature. The BioCaching app is a collaboration between the California Academy of Sciences Library, Citizen Science team and iNaturalist, supported by the Institute for Museum and Library Studies.
[F] 7.4

CROWDSOURCING LAND RIGHTS, RESTRICTIONS AND RESPONSIBILITIES
Mohsen Kalantari, The University of Melbourne
Land is an important economic asset and sustains the livelihoods of many; community identity, history and culture also have their roots in land. Communities, therefore, can readily mobilise around land issues, making land a central object of conflict and divergence. According to the UN, the challenges associated with preventing, managing and resolving natural resources and land issues may well come to define global peace and security in the 21st century. In this context, almost only 1/6 of the world's land and property rights, restrictions and responsibilities (RRRs) are registered, leaving majority of the population vulnerable in economic hardship, social instability and environmental challenges.
This paper aims to investigate a novel approach building on the potential of crowdsourcing systems as citizen centred and economical approaches in establishing and maintaining land registries with particular attention to information gaps about land and property RRRs. In addressing this aim, the paper discusses the following questions:

1: What types of rights, restrictions and responsibilities can be crowdsourced? It identifies different types of RRRs in the continuum and the possibility of crowdsourcing them.
2: What contributions can the crowd make? It identifies seven potential areas in which crowdsourcing can help in the realisation of a land registry.
3: How to recruit and retain the crowd? It addresses what incentives the system can provide to the crowd to contribute in building the registry.
4: How to evaluate users and their contributions? It addresses the criticism that always has existed for crowdsourced data and that is the quality and integrity of the crowd contribution.
Addressing the four key questions the paper compiles principles that are required for establishing, maintaining and improving land registration system that is sourced by the crowd. These principles describe the environment and circumstances that are required for crowd sourcing land rights, restrictions and responsibilities.
[E] 1.7

CITSCI.ORG METADATA TOOL BOX: ENSURING INTEGRITY AND EXPANDING APPLICATION OF CITIZEN SCIENCE DATA

Nicole Kaplan, Greg Newman, and Russell Scarpino Colorado State University/CitSci.org; Stacy Lynn and Melinda Laituri, Colorado State University

CitSci.org (http://www.citsci.org) is an open, comprehensive cyber-infrastructure platform for citizen science programs currently supporting 97+ programs and curating 81,400+ observations. Recognizing citizen science as a new instrument for collecting data across broad temporal and spatial scales, filling gaps, and providing additional information where none may exists, citizen science platforms (e.g. iNaturalist, eBird, and CitSci.org) are emerging as new sources for data and information. These new data sources contribute information to making science-based decisions and integrating information in synthetic research activities. If citizen science support platforms are to be positioned as valid online resources for novel, valid, and rigorous data, then we must ensure that the information provided is re-useable and of sufficient integrity and quality. Metadata (e.g., "data about data") supports data re-use by providing essential documentation of who, what, where, when and how data are collected. Data discovery online or through automated processes requires machine-readable, structured metadata. For this reason, metadata standards are being established and adopted by many research communities and tools are being developed to create structured metadata (e.g. Darwin Core, Ecological Metadata Language). To support such standards, we are developing a suite of features (a.k.a., a metadata tool box) to make it easier for project coordinators to document metadata associated with their projects, datasheets, protocols, measurements, and sample designs. The design of these tools will be informed by monthly webinars together with stakeholders through a process of participatory design to ensure we balance the need for such metadata tools with system ease of use. We discuss challenges in balancing efforts that produce rich, standardized documentation and high quality information, with the burden placed on project coordinators who must provide such metadata. We conclude by offering suggestions to system developers who may recognize and balance similar tensions in their systems.
[C] 9.8

CITIZEN SCIENCE CAN SUPPORT DEVELOPMENT OF PHYSICAL, NATURAL, AND SOCIETAL INDICATORS FOR THE U.S. NATIONAL CLIMATE INDICATOR SYSTEM

Melissa A. Kenney and Mandy Lamoureux, University of Maryland; Jake Weltzin, U.S. Geological Survey; Ainsley Lloyd, University of Maryland; Richard Pouyat, US Forest Service; Anthony C. Janetos, Boston University

The National Climate Indicators System is being developed as part of sustained assessment activities associated with the U.S. Global Change Research Program (USGCRP) National Climate Assessment. The National Climate Indicators System (NCIS), a proposed sustained assessment activity of the USGCRP, is a set of physical, ecological, and societal indicators that communicate key aspects of the physical climate,

climate impacts, vulnerabilities, and preparedness for the purpose of informing both decision makers and the public with scientifically valid information.
The NCIS will serve as a conceptually unified framework to address questions important to multiple audiences including (but not limited to) researchers, nonscientists (e.g., Congress, the public), resource managers, and state and municipal planners. Because of the diversity of potential stakeholders, where possible indicators will represent states and processes across scales (local to national).
The USGCRP developed a pilot set of indicators for NCIS based on the recommendations of 150+ scientists and practitioners, and 13 multidisciplinary teams, including, for example, greenhouse gases, forests, grasslands, water, human health, oceans and coasts, and energy. The pilot NCIS includes approximately 20 indicators that are already developed, scientifically vetted, and implementable immediately. The pilot is designed for evaluation purposes and feedback received on these indicators will be used to increase their utility for decision makers and to inform the development of a broader, more comprehensive indicators system
Working hand in hand with professional science programs, citizen science projects such as the USA National Phenology Network already provide critical data and derived indicators to support the NCIS. Similar projects may have the potential to support current and planned indicators or make new contributions capable of supporting future indicators efforts. We will present research and implementation opportunities to expand the inclusion of citizen science efforts within an indicator system focused on long-term global change.
[F] 1.4

USING CITIZEN SCIENCE TO MONITOR ECOSYSTEM RESPONSES TO HABITAT RESTORATION
Chelle King and Fernando Bretos, Patricia and Phillip Frost Museum of Science
Virginia Key North Point is a 17-acre restoration site, unique both in its location in central Miami, as well as in the diversity of habitats within the site. Museum Volunteers for the Environment (MUVE) and its partners are creating considerable environmental change through volunteer-led coastal habitat restoration. This presentation is an overview of new tools being deployed to volunteers to determine the ecosystem level success of the ongoing restoration effort.
MUVE is testing multiple citizen science protocols at a site that features four unique habitats: a sea turtle nesting beach, a dune, a freshwater wetland, and a tropical hardwood forest. A NASA-funded buoy equipped with a digital datalogger is being deployed to collect water quality data, along with corresponding meterological data. Photo stations encourage casual visitors to snap a photo with their smart phones and deliver it to MUVE via social media to visually track progress of recent plantings. Volunteers are also assessing vegetative cover through photography and transects. Citizen scientists also conduct faunal surveys (birds, sea turtles, butterflies, reptiles) using guides available both in booklet format and as Pinterest boards, photographing animals, and delivering to project staff via iNaturalist and/or social media. To complement these scientific protocols, volunteers are also encouraged to engage with the habitat restoration in other ways: through oral history projects, through eco-art installations, and through storytelling projects, completing the picture of this natural treasure. Citizen science has proven an effective tool not only to document the effectiveness of environmental change, but to enhance stewardship of an uninhabited barrier island off the coast of downtown Miami.
[F] 6.2

DESIGNING CITIZEN SCIENCE PROGRAM TAKING ACCOUNT OF HUMAN AND NATURAL DIMENSIONS FOR URBAN COMMUNITY GREENING PROJECT IN JAPAN
Hiromi Kobori, Tokyo City University, Japan; Hiromi Kobori, Tokyo City University; Ryo Sakurai, Yokohama National University; Naoya Komatsu, Tokyo City University, Japan
Citizen science can be applied to variety of fields, however, many challenges need to be overcome before this approach could be spread in various areas. We propose a new model of citizen science by applying it to urban greening community project in Japan. The project started in Ushikubonishi, a small

town in Yokohama when it was designated as one of model towns by Yokohama municipal government. Residents and a university located in the town took initiative in designing and operating greening project and 5-year action plan lunched in 2013. Keys to success of the project as a citizen science rely on how to integrate the three important elements; science, education and conservation. This project employed three approaches to integrate these elements. One is scientific evaluation of current status of biodiversity. The result revealed that 24 species of birds and 22 species of butterflies were recorded in the town, and conservation measures were designed by targeting symbolic birds and butterflies. Second approach is evaluation of socio demographic aspect of the residents. The descriptive statistics from survey of all houses in the town (n＝810) revealed residents' high expectation and sense of responsibility to improve the greenery in the community. Most of them evaluated the greening projects as an effective way to promote communication and solidarity of the town. Third approach evaluated educational aspects of the project by utilizing web-based monitoring and direct observation of biodiversity and environment conducted by residents. The university improved the web-site to maintain the accuracy of data provided by residents and developed manuals which help residents to identify species We believe that this integrated model could improve quality of the project in three aspects; science, education and conservation and serves as a community platform for co-management of natural and human systems.
[A] 7.8

CITIZEN SCIENTISTS COLLECT BASELINE DATA ON BAT DISTRIBUTION, HABITAT USE, AND SEASONAL ACTIVITY IN SOUTHEAST ALASKA

Michael Kohan and Karen Blejwas, Alaska Department of Fish and Game

Little is known about the ecology of bats in Southeast Alaska. The Alaska Department of Fish & Game's Wildlife Diversity Program initiated a citizen science program in the summer of 2014 to collect baseline information on the distribution, habitat use, and seasonal activity of bats in the region. Southeast Alaska is an island archipelago, and most communities are accessible only by boat or plane, making it logistically challenging and expensive for biologists to collect data at multiple locations. In Southeast Alaska, public libraries connect the community members to local events and serve as a 'hub' for information sharing. We partnered with public libraries in 2 communities to establish a citizen science acoustic survey project. The libraries served as centers for advertising the project and recruiting citizen scientists and librarians were responsible for checking out the equipment and downloading and submitting the data. A total of 30 community members participated in 18 driving surveys that covered specific survey routes and followed standardized protocols. Through this citizen science effort, we were able to identify which species are present in these remote communities, as well as the habitats they are using. These data will also be contributed to a new national database for monitoring bat population trends. The successful partnership established between ADFG biologists and community libraries will enable us to continue monitoring bat populations in these remote communities.
[F] 8.5

THEME: DATA ANALYSIS OF CITIZEN SCIENCE PROJECT ON WEB BASED ANIMAL SURVEY IN PRIVATE GARDENS IN JAPAN

Naoya Komatsu and Hiromi Kobori, Tokyo City University, Japan; Ryota Furui, Center for Ecological Education; Wataru Kitamura, Tokyo City University; Takao Ogawara, Center for Ecological Education

Urban biodiversity has been lost in Japan mainly due to urbanization. Green of the urban matrix such as private gardens and roadside trees is important to maintain urban biodiversity. However, few studies have been clarified the diversity of species and its relationship with environmental factors in private gardens at nationwide spatial scale in Japan. Although, it is difficult to gather information from broader area, this challenge can be achieved with citizen science. The purpose of this study is to estimate the potential of biodiversity in private gardens by analyzing data of "Garden Wild Life Watch" which was initiated by CEED (Center for Ecological Education). In this study, program which participants monitor

the appearance of selected 20 species including common 5 species of birds and 11 species of insects and the other at least once in a month from May to August and factors in each garden such as size of the garden and existence of green near the garden were analyzed. The data from 335 private gardens in the last 4 years from 2010 to 2013 were analyzed by using multiple logistic regression analysis. The number of observed species in the gardens significantly increased with the size of the garden and when a bird feeder put at the garden. The probability of appearance of barn swallow in the garden significantly increased with existence of balcony and feeder in the garden and existence of rivers near the garden. The significant positive relationship was also observed between the appearance of great tit and existence of nest box in the garden or brush near the garden. These results clarified that private garden becomes a platform for adaptive management and nationwide citizen science supports research to demonstrate the importance of private gardens as ecological matrix in the area.
[E] 6.5

CITIZEN SCIENCE: AN ANTHROZOOLOGICAL TOOL
Amy Kovacs, Canisius College
Anthrozoology is the interdisciplinary study of human-animal interactions and has the potential to include aspects of sociology, psychology, science, law and public policy. There is growing public concern for anthropogenic issues and there is general attention to raise public scientific literacy. Citizen Science is a network, or system, based on the exchange of knowledge between the public, the world around them and the scientists. By using Citizen Science as a tool for the field of Anthrozoology we can not only begin to address some of the concerns for anthropogenic issues, we can also educate the public in both formal and informal settings. This poster will present two of the ways we can utilize Citizen Science as a tool for Anthrozoology. The first of those involves the inclusion of Humane Education. Humane Education is at the base of Anthrozoology and is the practice of promoting humane attitudes towards animals, people and the environment. By combining Citizen Science and Humane Education we can create abundant opportunities for both formal and informal education in k-university level students. Additionally, Citizen Science can be used as a tool for Anthrozoology by incorporating research projects and programs to further both the biological and cultural knowledge of place and other species. These deliberate and inclusive programs can facilitate opportunities for thinking critically and intellectually about the ecosystems around them including both people and animals.
[D] 10.9

KEEPING THE CITIZENS SCIENTISTS: PARTICIPANT MOTIVATIONS IN CITIZEN SCIENCE
Erica Krimmel, University of California Berkeley's Sagehen Creek Field Station
Citizen science is evolving the way ecological research is conducted, and yet, research into citizen science project design and efficacy is limited. In the future, study of participant motivations will hopefully provide theory to enhance both citizen participant satisfaction, and scientific result quantity and quality. This presentation will address the question of how project resources (e.g. tools to keep track of personal sightings, knowledge bases, training opportunities, and online analysis programs to visualize the aggregate project data) and participant community affect citizen science activity. It will also present project design recommendations for maximizing the motivations volunteers most respond to.
[E] 13.8

OAKQUEST: COLLABORATIVE MAPPING AND STEWARDSHIP OF OREGON WHITE OAK
Ted Labbe, Kingfisher Ecological Services; Lori Hennings, Metro
Biodiverse and imperiled, native white oak ecosystems represent a top conservation priority in Oregon. Responding to a lack of basic inventory data, the Intertwine Alliance Oak Mapping Work Group (OMWG) formed in 2011 to coordinate a Portland, Oregon regional partnership of over 20 public agencies, park districts, and non-profit organizations. Initial efforts have focused on development of a cross-jurisdictional oak distribution map for the region combining citizen science and remote sensing surveys.

During summer 2014, OakQuest engaged over 80 citizen scientists to collect field observations of Oregon white oak across 641 square miles, spanning urban and fringing rural areas of the Portland metropolitan region. Volunteers recorded tree or stand locations, and took photos and field notes using a custom smartphone application, which enabled users to see each other's work via a continuously updated map. During the 2.5 month-long effort we collected over 7,200 observations of native oak across varied land use settings and stand conditions.
OakQuest citizen science data is supplemented with professional surveys to address geographic gaps and collect observations of non-oak vegetation needed to revise our remote sensing model. During winter 2014-15, we will refine the remote sensing model, conduct an accuracy assessment, and determine whether and where additional model development and citizen science observations are needed.
The OakQuest citizen science effort proved highly successful, enabling the OMWG to collect substantial ground-truthing data while providing meaningful natural resources stewardship opportunities for volunteers. In addition, two college-age Native American youth were employed to help coordinate field volunteers, providing career training opportunities for a traditionally under-served population. Through the collaborative OakQuest mapping project, the OMWG has strengthened community support for conservation of the region's Oregon white oak natural legacy and developed a habitat inventory to better inform conservation planning and decision-making.
[C] 6.10

EXOTIC AQUATIC PLANT WATCH: DEVELOPMENT OF A VOLUNTEER MONITORING PROGRAM FOR INVASIVE SPECIES IN MICHIGAN LAKES

Jo A. Latimore and Angela de Palma-Dow, Michigan State University

Volunteers have monitored water quality of Michigan's lakes since 1974. In 2007, a new "Exotic Aquatic Plant Watch" program was piloted, in which volunteers survey lakes for a few invasive plants of highest environmental concern. The goal is to provide lake communities and state agencies with valuable invasive plant data to inform management and assess control efforts. The training session was immediately popular. Volunteers were clearly interested in learning how to identify problematic invasive plants, but enrollment in the monitoring program was extremely low (1-3 lakes/year) in 2007 and 2008. The pilot enrollment goal of twenty lakes was reached in 2009 after the participation fee was reduced, volunteer experience requirements for enrollment were relaxed, and program marketing increased. The requirement to use GPS and online mapping was relaxed to allow other methods of reporting species locations. Although enrollment increased, the number of those lakes submitting data at the end of the season was less than 50%. A post-season survey of non-reporting volunteers revealed the most common reasons for non-reporting: (1) not realizing the importance of reporting negative results, and (2) the sense that monitoring was unnecessary if a professional plant management contractor had been hired for the lake. In 2010, the written protocol and training were updated to address these issues. While reporting rates improved somewhat, both reporting and enrollment were still lower than desired. We visited 20 lakes in 2013-2014 and learned that many volunteers lacked confidence their ability to choose sampling locations and correctly identify plants. In response, we developed a clearer sampling protocol and improved plant identification resources and access to professional assistance by adding the option to submit digital photographs of plants, and continuing site visits to lakes new to the program.
[A] 3.1

CAN CITIZENS CONTRIBUTE TO THE SAFE PASSAGE OF WILDLIFE ACROSS TRANSPORTATION CORRIDORS?

Tracy Lee, Miistakis Institute, Mount Royal University

To better understand and address safe passage for wildlife along a busy transportation corridor that bisects the Canadian Rocky Mountains and fragments wildlife populations the Miistakis Institute has used a citizen science approach. Through the development of two projects, Road Watch in the Pass and

Collision Count the institute has informed highway mitigation and developed a community of concerned citizens. Road Watch in the Pass is a long-standing citizen science program, with over 5,000 citizen observations that have helped to inform the location of wildlife vehicle collision hotspots. Collision Count is a new citizen science project where volunteers report road kill observations using a smart phone app at identified transportation mitigations sites. In association with other partners, citizen scientists have helped transportation planners better understand why, where and how to ensure safe passage for wildlife.
[F] 6.4

UNLIKELY BEDFELLOWS: INDUSTRY, CONSERVATION AND CITIZEN SCIENCE IN THE CANADIAN OIL SANDS

Tracy Lee, Danah Duke, and Ken Sanderson, Miistakis Institute, Mount Royal University

The Miistakis Institute in partnership with Cenovus Energy developed Wild Watch (iwildwatch.ca) a program that enables employees and contractors working at Cenovus industrial sites in northern Alberta to report wildlife observations. The program was developed as a stewardship tool to engage and increase participant's knowledge regarding wildlife use around industrial sites as well as to inform industry wildlife mitigation planning. Wild Watch participants enter their observations through a smart phone app or interactive mapping tool. The mapping tool also enables participants to view their wildlife observations as well as all wildlife observations in the database. The program has been evolved to include bear alert warnings and notifications of rare species to environmental managers on site.
Wild Watch has been shared with other industrial partners working in the Canadian Oil Sands and some are joining the program with the goal of informing broader landscape scale patterns of wildlife issues in the region.
[F] 6.1

CITIZEN SCIENCE PARTICIPANTS SHOW INCREASED INVOLVEMENT IN CONSERVATION

Eva Lewandowski, Conservation Biology Graduate Program, University of Minnesota; Karen Oberhauser, University of Minnesota

Nature-based citizen science projects have the potential to educate their volunteers about conservation issues and encourage them to engage in conservation actions. We surveyed participants from butterfly citizen science projects from across the United States to determine the extent to which volunteers are receiving information on butterfly conservation threats and action strategies from their citizen science projects. We also investigated the extent to which projects are actively encouraging their volunteers to engage in conservation through the use of incentives, direct appeals, and projects' social structure. Finally, we asked respondents how their engagement in 12 different conservation actions, ranging from planting host and nectar plants to contacting the media about butterfly conservation, has changed since they became involved with citizen science. 79% of our respondents reported that they have received information on butterfly conservation from their citizen science project, and 55% felt that their project actively encouraged them to engage in conservation. 95% of the respondents reported that they had increased their involvement in butterfly conservation since they became involved with citizen science. Notably, volunteers who received information on conservation and who were encouraged to engage in conservation by their citizen science project were more likely to have increased their engagement in conservation. A sense of connection to other volunteers was also linked to increased conservation action. Our work identifies areas in which citizen science projects are greatly promoting conservation actions among their volunteers, as well as areas of untapped potential.
[D] 10.7

CYBERTRACKER AND CITIZEN SCIENCE

Louis Liebenberg, CyberTracker Conservation; Associate of Human Evolutionary Biology, Harvard University

CyberTracker has grown from a simple hypothesis: The art of tracking may have been the origin of science. If this is the case, then scientific reasoning may be an innate ability of the human mind. This means that everyone should be able to make a contribution to science.
Furthermore, it implies that modern-day trackers should be able to do science. However, the best trackers in Africa cannot read or write. To overcome this problem, the CyberTracker software was developed in 1996 with an icon-based user interface for a PDA connected to a GPS. This enabled trackers to record complex geo-referenced data on animal behaviour.
Releasing CyberTracker as Freeware resulted in a proliferation of projects worldwide. It requires no programming skills to develop a data capture Application and no GIS skills to analyse and view the data in tables and maps. CyberTracker projects therefore involve bottom-up, self-defined independent initiatives, resulting in rich, diverse data.
From its origins with the Kalahari Bushmen, CyberTracker projects have been initiated to monitor gorillas in the Congo, snow leopards in the Himalayas, butterflies in Switzerland, the Sumatran rhino in Borneo, jaguars in Costa Rica, birds in the Amazon, wild horses in Mongolia, dolphins in California, marine turtles in the Pacific and whales in Antarctica.
CyberTracker is being used by indigenous communities, in national parks, scientific research, citizen science, environmental education, forestry, farming, social surveys, health surveys, crime prevention and disaster relief.
CyberTracker software has been downloaded more than 80 000 times from more than 210 countries. Our ultimate vision is that smart phone users worldwide will use CyberTracker to capture observations on a daily basis. Data streaming into the Cloud will make it possible to visualise changes in the global ecosystem in real time.
[C] 9.6

FROM SMARTPHONE TO FINE DUST: HOW DO PARTICIPANTS CONSTRUCT THEIR UNDERSTANDING OF THE iSPEX PROJECT?

Evelien Lingeman and **Anne Land-Zandstra,** Leiden University, The Netherlands

iSPEX is a Dutch citizen science project utilizing new techniques such as smartphones and a specially designed add-on that measures the concentration of fine dust in the atmosphere via diffraction of light. It is important to measure fine dust to be able to keep track of the concentrations in the atmosphere which, for example, influence health and environment.
One of the aims of the iSPEX project was to verify the feasibility to use thousands of individual measurements to collect reliable data of fine dust concentrations. The second aim of the project was to teach the participants about scientific methods and the scientific concepts behind iSPEX.
In a previous survey possible discrepancies appeared between the constructed knowledge by the participants and the actual scientific concepts. To find out how the participants constructed their knowledge, we conducted face-to –face semi-structured interviews with 20 iSPEX participants.
The results of this study show that the overall knowledge and understanding of the scientific methods and techniques is better than was expected based on the results of the survey. But to accomplish further improvement in the participants' understanding, respondents showed a strong preference for short and simple information. Visual information in the form of a film-clip was received well. This showed an improvement in half of the respondents' understanding.
The respondents also indicated that the health aspect of the project is the primary motivator to participate. The opportunity to contribute to a project, possibly improving health and living conditions, seemed more important than the opportunity to learn more about science. In addition, feedback about the scientific results is vital to keep participants involved and motivated. Lack of feedback noticeably affected participants' motivation.
This study shows how communication with citizen scientists influences scientific learning and motivation.
[E] 4.2

TACKLING TRASH: DEVELOPING A NATIONAL MARINE DEBRIS MONITORING PROGRAM

Sherry Lippiatt, Courtney Arthur, Nancy Wallace, NOAA Marine Debris Program

NOAA's Marine Debris Monitoring and Assessment Project (MD-MAP) has evolved from an effort to develop scientifically rigorous standardized protocols to a contributing network of nearly 50 different volunteer-based organizations. Project partners conduct shoreline assessments on a monthly basis and enter survey data to an online database. One unanticipated focus of the MD-MAP is to investigate the impact of debris generated from the devastating March 2011 earthquake and tsunami in Japan. This presentation will provide an overview of efforts to date, challenges and lessons learned, and management applications of the data collected.

[F] 10.3

IF YOU CURE CANCER IN YOUR BACKYARD, WHO WILL KNOW? THE NEED FOR A FRAMEWORK TO EVALUATE AND SUPPORT INNOVATIONS FROM CITIZEN SCIENCE: EXPERIENCE FROM A WEBSITE FOR PROBLEM-SOLVING ECZEMA

A. J. Lumsdaine, SolveEczema.org

If citizen scientists claim to cure a disease, who would believe it?

Research by nonprofessional investigators—or, DPI "democratized principal investigator" citizen scientists—is an emerging area of citizen science. When billions of people live keystrokes away from the greatest libraries of knowledge in history, with commensurate opportunities to collaborate across boundaries, the potential for disruptive innovation by people working outside of professional research paradigms multiplies. Especially in medicine, where general scientific knowledge can be accessed easily from open-source environments, but knowledge of what it is like to experience disease is far more "sticky"—more difficult to convey from one person to another—highly motivated citizen scientists stand poised to make unique contributions to solving long-standing disease problems, especially where intense empirical observation may be key.

DPI citizen scientists face unique challenges, particularly the need for a respected framework for evaluation and validation of research equivalent to — but more nimble and appropriate to citizen science than—traditional peer review and publication. Other hurdles include finding economic support and overcoming an "ivory tower" barrier to productive open-source collaboration with professional researchers.

I will discuss lessons from my experience creating a website-based heuristic for alleviating eczema and related allergy/asthma, accessed by hundreds of thousands of unique users over the past decade. The solution is not a simple avoidance of triggers or irritants; it has led to normal, repaired skin-barrier, lung, and immune function, in a way the underlying basis suggests and without ongoing treatment. I will also discuss how the solution could satisfy traditional criteria for causality and potentially revise the "hygiene hypothesis." I will expand on validating such findings and gaining acceptance for the radical idea that solving intractable disease problems might be possible, even uniquely amenable to citizen science.

[G] 12.8

UTILIZING SOCIAL MEDIA IN A CITIZEN SCIENCE PROJECT

Renee Lyons and Michelle Cook, Clemson University

The Vanishing Firefly Project is a citizen science project that asks communities to help scientists collect data on firefly populations. Our project provides a tool for the general public to monitor the quality of their own environment and learn first hand about the effects of urbanization, pollution control, and sustainability.

In the past three years of our project's existence, the citizen scientists have ended up being a fairly homogeneous group. They tend to be older, white, and well educated. Our goal for 2014 was to engage a more diverse crowd of participants. Researchers in this study proposed social media as a mode of communication that could be effectively used to recruit, sustain involvement and educate a more

diverse group of participants. The project's field day event was pushed through posts and tweets on social media. Researchers created tutorial videos explaining the project goals and how citizens can help. These and other educational materials were posted on our project's Facebook and Twitter pages. Throughout the summer, researchers gave count updates and encouragement to keep counting. New citizen scientists were recognized on social media and welcomed to the project. The scientists are currently using social media to communicate project results to the citizens.
The findings of our study reveal that social media was an effective means to sustain engagement in our project but was ineffective at changing the demographic make-up of who is participating in the project. We learned that not all social networking sites are created equal. Next year we plan to have a focus group with a diverse representation of community members to better understand what social media avenues they are most utilizing. We also learned that social media primarily supports pre-existing social relations. In the future we plan to utilize the demographic ads offered by social media platforms.
[B] 9.4

NATIONAL GEOGRAPHIC BIOBLITZ: FOSTERING DIVERSITY AND INCLUSION, LIFELONG LEARNING, AND MEANINGFUL EXPERIENCES

Melissa MacPhee, Mary Ford, and Sean O'Connor, National Geographic Society

The National Geographic Society, in collaboration with the U.S. National Park Service, hosts an annual BioBlitz, a 24-hour species inventory that involves students, citizens of all ages, scientists, and other interested individuals. National Geographic also reaches out to schools and communities to support schoolyard bioblitzes and community bioblitzes. The goals of these species inventories are widespread—capturing a snapshot of species living within a variety of areas (including residential, urban, and industrial zones); engaging local communities in efforts to collect data and get outside to explore their own backyards; and encouraging a relationship between the natural and human communities of a given area. The 2014 Nat Geo BioBlitz, held in San Francisco's Golden Gate National Recreation Area, aimed at including students from underrepresented communities. In this case, supporters were able to provide some school districts with funding to enable students to attend, though budgetary restrictions cannot always allow projects to do this. What options exist for fostering inclusion of those students who aren't traditionally represented in citizen science? Teacher professional development prior to the San Francisco BioBlitz focused on engaging students before, during, and after the main event. Time in the field is short, and students' experience should extend beyond this. How do we keep students connected to their environment after the event? Technology presents a range of challenges, from privacy issues for young students to connectivity in the field. Do all students have access to smartphones? Is there an Internet connection available at every site? Is there meaning attached to data collection? We continue to work through these issues as we conduct more park-based, schoolyard, and community bioblitzes. In this presentation, we will share these questions and the lessons we've learned through more than eight years of hosting and supporting BioBlitzes.
[D] 14.2

UTBIOME: CITIZEN SCIENCE AND CAMPUS COMMUNITY ENGAGEMENT

Juan P. Maestre, Harish Sangireddy, Paola Passalacqua, and Kerry A. Kinney, University of Texas at Austin

The University of Texas main campus is located at the heart of the city of Austin. The university campus can be used as "living" laboratory to engage students, faculty, and the public in general, in science. The UTBiome (aka "Mapping the UTBiome") project, is a cross-disciplinary educational, research and outreach effort to (1) engage the community in the collection and analysis of environmental samples from campus environment, and (2) to create an open access web-based mapping platform to disseminate the environmental and microbiological data obtained. In this project, both indoor and outdoor environments are being interrogated to answer diverse scientific questions.

Over 250 citizens from the university community have been involved to date in the collection of biological samples and environment metadata associated with key water quality metrics including temperature, nitrate, phosphate, dissolved oxygen, alkalinity, pH, turbidity and fecal indicator bacteria. A data management system was designed and implemented for both, 'online' data input through student's mobile phones and to facilitate sample tracking. In order to fully engage the students and the UT community, we envisioned an interactive and innovative workflow, involving technology, automation, and social media.
The interactive mapping platform we have created allow users within and outside the university to access and download the results and associated environmental data by simply clicking on the interactive map. The comprehensive UTBiome map created in ArcGIS can be found in this website http://crwr-utbiome.austin.utexas.edu/utb_webapp/utbiome.html (or just http://tinyurl.com/UTBiomeMap). The online platform design offers access to the environmental information, providing resources for students, faculty and the general public to learn more about the environment that surrounds us.
[D] 4.9

CHAMPIONS FOR NATURE: VOLUNTEER RECRUITMENT AND RETENTION STRATEGY
Astrid Maldonado de Jesús, Yogani Govender, and Lee Ann Rodriguez, Para la Naturaleza, Puerto Rico
When working to recruit and retain participants of all ages, education levels, and low levels of STEM background in Citizen Science (CS) projects a methodological approach should be adopted. Historical data of first NSF funded awarded to Conservation Trust of Puerto Rico (CTPR) for Citizen Science project showed bias towards participants from metro areas and from Universities of Puerto Rico. Therefore, for the second Citizen Science project we developed detailed specific strategies of recruitment and retention within 4 target underrepresented, underserved, municipalities to increase inclusion and foster greater diversity. The communication and marketing strategy to recruit participants to pass through contributory, collaborative, co-created phases of Informal Science Education (ISE) included catchy designs, simple language about relevant community environmental issues through multi media. While these strategies were successful in 80% recruitment to all ecological research projects for the contributory phase, they were unsuccessful in recruiting majority of participants from 4 municipalities or participants willing to commit to the collaborative and co-created phases. During the process of reflection with staff and evaluators it was concluded that using virtual media was ineffective in the target municipalities and modifications were required to increase participants from 4 municipalities. The adaptive strategies employed included 1) paper flyers to be distributed in frequently visited areas within municipality such as shopping malls, stores, libraries, municipality buildings 2) for retention, volunteer leaders were recruited to give follow up telephone calls to one time participant 3) open house for family members of repeat participants to encourage participation and return to projects. CTPR recommends a marketing study be carried out at the beginning of the project and that reflection, evaluation and adaptation be a critical part of the recruitment and retention plan of the Citizen Science project.
[B] 13.7

CHALLENGES ASSOCIATED WITH CITIZEN SCIENCE ENGAGEMENT IN AMPHIBIAN MONITORING IN THE ROCKY MOUNTAINS
Brenna Marsicek, University of Wyoming Biodiversity Institute; Wendy Estes-Zumpf, Wyoming Natural Diversity Database
Amphibians are declining globally and many declines are discovered too late for effective conservation measures because monitoring of amphibians is notoriously difficult and rarely attempted at large spatial scales. In the Rocky Mountain region, monitoring is further complicated by the remoteness of breeding sites and the difficulty of the terrain in the survey area. The Rocky Mountain Amphibian Project is a program that assigns survey catchments, or a set of streams, ponds and wet meadows within a predefined area, to citizen scientists in order to assist the U.S. Forest Service with monitoring these vast and remote areas for amphibian breeding. In this program, we ask our citizen scientists to collect

rigorous, standardized data that is used in high-profile species trend analyses, is compatible with regional and national amphibian datasets and meets the Forest Service's needs for understanding amphibian habitat and tracking population trends.
As part of this program, citizen scientists select which predefined catchment they want to "adopt," attend a training (in-person or online), receive materials (dip nets, GPS units, gloves, maps, datasheets, etc.) and conduct their surveys twice during the breeding season. Although amphibian breeding data is the primary objective, we also are able to collect information about habitat for multiple amphibian species, monitor how habitat changes over time, and perhaps more importantly educate and interest a large collection of the public about the needs of and threats to amphibians, as well as their importance as indicators of ecosystem health.
This presentation will outline the challenges associated with requesting citizen scientists to collect high-quality standardized data in remote areas, helping the scientific community to incorporate data collected by citizen scientists into high-profile analyses, and recruiting and retaining citizen science volunteers.
[F] 5.4

CITIZEN SCIENCE ON THE BEACH: SCIENTIFIC USES AND POLICY IMPACTS OF DATA FROM GRUNION GREETERS
Karen Martin, Vincent Quach, and Emily Pierce Pepperdine University
An elusive marine fish, the California Grunion *Leuresthes tenuis* is seen only during its spectacular midnight runs. Coming completely out of the water, the surfing silversides spawn on wave-washed shores, burying their eggs beneath a few inches of sand before disappearing back into the ocean. Traditional fisheries methods cannot assess this species. The best data are produced by over 4000 citizen scientists trained as Grunion Greeters to observe spawning runs on local beaches, over the entire habitat range. Started in 2002, this long-term dataset influences resource agencies, affects shoreline management, reveals range extensions, and addresses population status and basic science for this charismatic endemic species living along one of the world's most populous coastlines. Data are used by the California Coastal Commission, California Department of Fish and Wildlife, California State Parks, National Marine Fisheries Service, US Army Corps of Engineers, and many local entities.
[F] 11.5

MEASURING URBAN FOREST BENEFITS WITH A FEW SWIPES ON A SMARTPHONE
Virginia Matzek, Sophia Huang, Guilherme Carvalho, and Tian Zhang Santa, Clara University
Here we present a new, in-development mobile application and associated citizen science website that allows users to measure urban trees and instantly appreciate their ecosystem service benefits, including carbon sequestration, pollution relief, and energy savings. The app is based on OpenTreeMap, but its features are simplified for citizen science use, and the phone itself is used to perform the diameter measurement that lies at the heart of the calculation of benefits. Also, we have developed a user-friendly field guide to urban trees that permits the citizen scientist to decide how specific about species identification to get. The app, website, field guide, and video tutorials have all been developed by students at Santa Clara University.
[C] 6.6

GLOBAL FRESHWATER BIOBLITZ–CROWDSOURCING FOR CONSERVATION
Alex Mauroner, IUCN-SSC/WI Freshwater Fish Specialist Group; Ian J. Harrison, IUCN-SSC/WI Freshwater Fish Specialist Group, Conservation International; Michele Thieme, IUCN-SSC/WI Freshwater Fish Specialist Group, World Wildlife Fund
The Global Freshwater BioBlitz began in February 2014 as an effort to engage nature lovers in freshwater fish conservation. The objective was to increase the amount of data being collected on freshwater fishes. Alarmingly, freshwater fishes may now be the most threatened group of vertebrates,

based on more than 7,000 species currently assessed for the IUCN Red List of Threatened Species. The more data collected on freshwater fish species and their habitats, the better. Nature lovers could both contribute to a good cause (wildlife conservation) and help in an international scientific effort simply by taking and uploading photos. Conservation is not just for scientists. Everyday people can make significant contributions. Participants aid in the data collection process by photographing and uploading information on freshwater fishes and their habitats into the project database. These data help map species distributions, fill in gaps where fieldwork has not been conducted, identify invasive species threats, supplement other sources for assessments, and may even identify new species. "Research-grade" data (those observations verified by the ichthyologists serving as project "curators") have already been fed into the IUCN Red List and data archives such as the Global Biodiversity Information Facility and Encyclopedia of Life.
[F] 3.2

CREATING AND ADAPTING CITIZEN SCIENCE EXPEREINCES FOR YOUTH IN ENVIRONMENTAL EDUCATION SETTINGS

Kerri McAllister, NatureBridge Golden Gate

Most citizen science engagement is geared toward long-term adult participation. To reach and engage youth audiences in citizen science at the appropriate development levels, special considerations are needed. In many cases this includes creating supplemental materials to introduce and express the importance of participating in citizen science; teaching about the project subject; streamlining of methods; adaptating data collection tools; and supporting understanding of results and the larger context of citizen science efforts.
Through communication with citizen science project leaders, needs assessment, and curriculum development- these adaptations have been successfully implemented and applied to the environmental science programs at NatureBridge Golden Gate. NatureBridge is a residential environmental education facility with campuses in many National Parks. Serving over 10,000 diverse youth annually, the nearby Golden Gate campus empowers participants to explore and contribute to a variety of citizen science projects that benefit Bay Area and national data collection efforts.
Learn more about the perceived barriers to youth engagement in citizen science and the steps that can be taken to broaden the scope and to support inclusivity of all participants as the public's interest in citizen science rapidly grows.
[B] 15.5

CITIZEN SCIENTISTS NEGOTIATING POLITICS AND POLICY: STRATEGIES AND OUTCOMES FOR VOLUNTEER WATER QUALITY MONITORING PROGRAMS

Jaime McCauley, Northern Kentucky University

This study uses interview (n=19) and participant observation data from five volunteer water quality programs in the Greater Cincinnati / Northern Kentucky region to assess strategies utilized in achieving monitoring goals. Goals articulated by participants in these programs are fairly straightforward, i.e. "I want to protect the water." In practice, however, protecting the water may not be as straightforward as it sounds. Volunteer monitoring programs are enmeshed in a network of political jurisdictions and regulatory agencies that may be more or less receptive to working with them and whose efforts may facilitate or constrain the impact of the program's work.
Data reveal that programs often strive for maximum impact by partnering with local and county regulatory agencies (i.e. storm water districts, soil and water districts, etc.), but these partnerships can be complicated. Volunteer monitoring organizations benefit in a number of ways, for example, monitoring programs often receive funding and/or various in-kind donations from local regulatory agencies (i.e. use of lab space and equipment), and such partnerships can act as a conduit to data and information sharing between volunteer monitoring programs and regulatory agencies. On the other

hand, there is evidence that volunteer programs may hesitate to pressure agencies to take action for fear of alienating their sponsor.
Successfully navigating these partnerships requires volunteer monitoring programs to strategically position themselves as neutrally as possible on policy matters and to resist actions that may be construed as activism. This strategy builds trust between regulatory agencies and volunteer monitoring organizations, and creates opportunities for volunteer data to be taken up in policy making and regulation. This study underscores the importance of crafting an apolitical stance as an effective strategy for volunteer monitoring organizations to influence politics and policy on water quality issues.
[F] 2.2

METHODS REVIEW: TWO CITIZEN SCIENCE PROJECTS IN THE TRUCKEE MEADOWS REGION, NEVADA
Kelsey McCutcheon, Justin White, Kelsey McCutcheon, Scott Bassett, and Donica Mensing, University of Nevada Reno
Citizen science provides many benefits to society and nature. Valuable community connections form when scientists and institutions collaborate with local residents on environmental research projects. These collaborative studies create education and environmental awareness opportunities that facilitate the future conservation of wildlife and habitat. In the Truckee Meadows region of western Nevada, the Truckee River flows through the urban area of Reno-Sparks. The blending of humans and wildlife habitat provides opportunities for citizen scientists to help document how wildlife survive in urban environments. This is especially important with regard to species which are top consumers who are highly sensitive to urbanization of natural habitat. This poster presents methods and preliminary results of two citizen science projects aimed at connecting Truckee Meadows residents with local wildlife: 1) A public education and participatory mapping project using online map entries, via the WordPress Google Maps plugin, which allows citizens to contribute wildlife observations and photos to an interactive digital Truckee River wildlife guide; and 2) An urban raptor nest locating and monitoring study conducted by voluntary residents and trained scientists across urban density gradients classified as urban, suburban, exurban, and wildland. The quality of the observational raptor data collected by residents will be assessed by supplementary nest camera and trained scientists' records. Both projects will use related websites to serve as communication media and provide gateways to external resources. The outcomes of these projects are expected to engender awareness of urban wildlife, create engagement in community stewardship, increase public scientific literacy, and contributing to the scientific understanding of local ecosystem health in the Truckee Meadows urban habitat.
[B] 1.9

BETTER DATA FROM SMARTER SENSORS: TOOLS, TECHNIQUES, AND TRENDS
Ken McGary, Nerds For Nature
We are challenged to monitor a growing array of environmental factors in more remote locations, almost always with smaller budgets. Commercial instrumentation, along with adequate calibration, maintenance, and user training can produce impressive results—but at great expense. Open source tools like Arduino and cheap sensors from popular DIY sources promise more affordable and adaptable solutions, yet systems built with these tools and sensors often suffer from terrible accuracy and poor reliability. How can we bridge the gap?
Ken is a Nerds For Nature Organizer and an electronics engineer with considerable experience in both academia and industry. In collaboration with USGS, Creative Commons, and others, he has recently been tackling these issues for several air and water quality sensor projects and will share some insights.
He will start with a brief overview of common low-cost environmental sensors and circuits and will explain why you might not want to use many of them. Conversely, he will present some novel off-the-shelf and DIY sensor options that just might fit your needs. Finally, he will consider how to make individual sensors smarter about themselves and the data they report by using Smart Transducer

Interface Modules (STIMs), Transducer Electronic Data Sheets (TEDS), and similar techniques that can improve calibration accuracy and simplify deployment in the field.
Ken McGary has worked for leading aerospace, telecommunications, and biomedical companies, including General Dynamics, DiCon Fiberoptics, and Allergan-Humphrey Instruments (now Zeiss Meditec), and for over a decade helped neuroscientists develop research apparatus at UC San Francisco. Now he's focused on designing open source smart sensor circuits and systems that collect higher quality environmental sensor data with lower overall project costs.
[C] 4.1

EXPLORING THE POTENTIAL OF CITIZEN SCIENCE IN NATURAL RESOURCE MANAGEMENT ORGANIZATIONS
Duncan McKinley, US Forest Service; Abe Miller-Rushing, National Park Service
Citizen science has contributed to science and has influenced natural resource management decisions and policies across the nation. Recently, citizen science has seen explosive growth in the United States, particularly in ecology, the environmental sciences, and related fields of inquiry. However, there still is a lack of clarity about what value citizen science can add to organizations that management natural resources. Here we explore the current use of citizen science in natural resource and environmental science and decision making in the United States, and make recommendations for the future. Our findings draw from the work of an ambitious working group report that is currently in press.
We find that organizations generally conduct citizen science for two reasons: (1) to do science that might not otherwise be feasible, and (2) to better engage the public in helping to make decisions. We suggest that these goals reflect the two primary ways that citizen science can inform and assist managers and policymakers. The pathways converge and generate synergies between science and public input and engagement. Moreover, the two pathways can help organizations meet their goals by contributing at various points in a typical policy cycle. We find that citizen science can make valuable systematic observations and identify problems or issues; help in formulating public policy; strengthen public input into policymaking by legislators and other decision makers; help government agencies and other organizations implement the corresponding policies; help evaluate the impact of a policy or decision; and help in enforcing laws and regulations pertaining to natural resources. Organizations that use citizen science should carefully choose project designs that match their needs and goals. We also provide recommendations for future investments in citizen science that could help address grand challenges in natural resource management.
[F] 2.9

CITIZEN SCIENCE WITHIN THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
John McLaughlin, National Oceanic and Atmospheric Administration (NOAA)
As a science mission agency, the National Oceanic and Atmospheric Administration (NOAA) has a rich tradition of supporting citizen science as means to tackle grand challenges and everyday problems. Today that tradition is being carried on with citizen science projects fostered and supported across the Agency. There are over 65 active such projects, many of which began within the past few years.
A NOAA Citizen Science Community of Practice was launched in the fall of 2013. This Community of Practice fosters sharing of best practices for designing, implementing, and managing citizen science projects. This past year has focused on supporting evaluation of efforts undertaken by the Community. The Community is facilitated by NOAA's Office of Education to help make education and lifelong-learning connections. In the spirit of the citizen science field, it relies on grassroots participation from community members throughout the Agency.
In addition, NOAA partners with a number of institutions and networks to accomplish its citizen science goals. This presentation will overview NOAA's portfolio of projects and efforts to foster stronger collaboration within that collection. Notable examples will eb highlighted. Further, there will be a

discussion to solicit feedback on how the Agency might better partner and connect with the broader community.
[F] 4.4

GROUNDING A PROGRAM THEORY TO ENABLE AUTHENTIC INQUIRY THROUGH CITIZEN SCIENCE
Nathan Meyer, Pamela Nippolt, and Andrea Lorek Strauss, University of Minnesota Extension
Citizen Science programs are well-suited to immerse youth and adults in science practice. However, designing citizen science-based education programs that fully engage young participants in authentic science inquiry is a complicated challenge. This presentation will describe how grounded theory research can be used to define and understand these program models, and guide program evaluation. The Driven to Discover: Enabling Authentic Inquiry through Citizen Science project (D2D), funded by the National Science Foundation, demonstrates potential for this approach to identify factors that provoke authentic inquiry by youth/adult research teams using citizen science experiences. During this five-year project, Extension staff have trained and supported a purposeful mix of citizen science research teams, using a flexible curriculum aimed at enabling youth to conduct their own ecological investigations. Researchers systematically observed these teams. They collected written reports from adult leaders and scientists that describe team goals, activities, and experiences. Youth and adult team members also participated in focus group discussions about their experiences. Through a deductive coding approach, researchers are analyzing these data to build understanding of elements that worked well and challenged the citizen science research teams. Preliminary analysis describes citizen science as a rich environment for sparking science inquiry. The program setting/situation, design/structure, and team characteristics are the roots from which authenticity and engagement can grow into inquiry. Research teams can pull from their programmatic roots on 14 key elements, which serve as nutrients to fuel the growth. Some of these elements interact to strengthen or weaken engagement and authenticity. So, teams must balance focus on both engagement and authenticity. Too much focus on either can hinder authentic inquiry for youth participants. The grounded theory approach is proving useful for D2D staff in articulating and improving their education program, and evaluation.
[E] 15.1

AUTHENTICALLY CONNECTING CITIZEN SCIENCE WITH NATURAL RESOURCE MANAGEMENT: A CASE STUDY IN ACADIA NATIONAL PARK, MAINE
Abe Miller-Rushing and Christie Anastasia National Park Service; Seth Benz and Mark Berry, Schoodic Institute; Rebecca Cole-Will, National Park Service
Connecting citizen science with the management of protected areas and natural resources can be difficult. Even without the management component, citizen science is a difficult, interdisciplinary endeavor if done well. Connecting science—whether conventional or citizen science—with management action is also difficult all on its own. Management agencies and conservation organizations have long struggled with this problem.
In this poster we describe our work to connect citizen science with natural resource management in Acadia National Park in Maine. The park is re-visioning its approach to resource management to be more deliberate, holistic, and adaptive, and to focus on restoring natural resilience to rapid environmental changes. In this re-visioned approach, citizen science can help meet key monitoring, management, and education objectives. (Most of the threats to Acadia's ecosystems come from outside the park, so education is a key management action, in addition to having other benefits.)
We describe the approach we are using, the areas where we find the best fit between citizen science and management, and our strategy for making our work sustainable. We find that citizen science can be a key component to collect the data necessary to improve management decisions and can contribute to restoration and management projects. Moreover, we find that using citizen science in concert with conventional science may actually enhance our ability to tie science to management. The process of engaging volunteers helps to engage park staff, too. Moving forward we plan to build on this interest,

and continue to integrate citizen science as a key component of the park's adaptive management and restoration activities related to rapid environmental change.
[F] 3.10

A NATURAL HISTORY MUSEUM AS A PLATFORM FOR ACCUMULATING VERIFIABLE INFORMATION ON NON-NATIVE FISHES: A JAPANESE EXAMPLE

Yusuke Miyazaki, Kanagawa Prefectural Museum of Natural History; Atsunobu Murase, Tokyo University of Marine Science and Technology; Hiroshi Senou, Kanagawa Prefectural Museum of Natural History

Natural history museums provide permanent storage for specimen collections, including non-native species. We extracted the records for specimens and photographs of exotic non-native fishes collected in Japan by experts and citizens at the Kanagawa Prefectural Museum of Natural History, Japan. The museum began operation in 1994. The records of alien species known to be established in Japan (FSAK) consisted of 1756 specimens (789 lots) belonging to 29 species and 611 photographs (494 lots) of 25 species. Additionally, there were records of alien species that were introduced to Japan but not known to be established (FSUK) consisting of 23 specimens (23 lots) belonging to 11 species and of 46 photographs (31 lots) of 17 species. The FSAK could be classified as 23 primary freshwater, six diadromous, and one marine species, whereas the FSUK were classified as 12 primary freshwater, one diadromous, and six marine species. We identified a significant difference in the life-cycle types of FSAK and FSUK probably reflecting an increase of aquarium fish introductions due to dereliction of pet fish, ejectment for pleasure, or crime by traders. The museum collections were mostly provided by experts, followed by citizens and other institutions. We also discussed the functions of a public museum of natural history for accumulating information and for citizen participation.
[D] 14.6

RELEVANCE OF ICTS TO CITIZEN ENGAGEMENT FOR SUSTAINABLE WATER RESOURCES IN THE LAKE VICTORIA BASIN: RESEARCH EXPERIENCE AND EVALUATION FRAMEWORK

Hector Mongi and Aloys Mvuma, The University of Dodoma; Samuel Kucel, Busitema University; Albino Tenge and Maria Gabriel, The University of Dodoma, Tanzania

Among many governance challenges of water resources in developing countries are inadequate participation of communities, poor coordination of water resources institutions, inadequate transparency and accountability. One of several ways of improving participation and coordination is the use of appropriate technologies including integrated Information and Communication Technologies (ICTs). Integrated ICT solutions can play a pivotal role in engaging water resource institutions to attain sustainability goals of water resources management. They provide tools and techniques that can create a common platform for sharing information at the bottom level. They can provide many options through which community can engage in giving and receiving information regarding water resources. Despite this potential, integrated ICT solutions have not been adequately researched and evaluated against their relevance to community engagement for sustainable water resources. The research on integrated ICTs for multi-scale water resources governance was conducted within trans-boundary Lake Victoria Basin (LVB) in East Africa. The input, process and outcome dimensions of intergrated ICTs were carefully investigated and applied with close involvement of community of users in Tanzania, Uganda and Rwanda parts of the LVB. These dimensions are presented and discussed. Furthermore, the study is proposing a multi-theory, two-dimensional framework for evaluation of relevance of integrated ICT solutions. The framework focuses on citizen participation and coordination activities of formal water resource institutions. Three theories considered in the framework are relevance theory, social theory of change and technology adoption model. This architecture is believed to complement strengths and minimize weaknesses of individual theories. This research concludes integrating ICTs for water resources governance can involve arrays of citizens, improve their participation and minimize costs. However, relevant ones have to identified using the citizen oriented framework in the context of trans-boundary water resource of a developing country.

Key words: ICT, sustainability, citizen engagement, formal institutions, water resource
[E] 2.7

CITY TO SEA CITIZEN SCIENCE: CREATING A MODEL TO ENGAGE UNDERREPRESENTED MINORITIES IN CITIZEN SCIENCE

Rochelle Mothokakobo, Ocean Discovery Institute; Theresa Talley, University of California, San Diego; Lindsay Goodwin, Ocean Discovery Institute

In the past two decades, citizen science has been shown to be a powerful tool to build STEM literacy and decision-making skills in participants, increase the body of scientific knowledge, and inform conservation and management practices. Citizen science has recently become a focal point of growth for the informal science education community; however the latest literature review found little research on how these projects can specifically engage underrepresented minority groups (URMs). The participation of these groups in citizen science is currently unknown, however it has already been documented that these groups are less likely to participate in STEM broadly.

Ocean Discovery Institute is developing a community citizen science program model that targets URMs. During the first half of this study ODI developed, piloted, and enhanced a model that provides guided experiences, interactions with scientists, to increase interest in science and increase science knowledge among community participants. We piloted the model engaging 40 of middle and high school students in a study to better understand sources of trash in local canyons and pathways trash traveled through the watershed.

Surveys conducted revealed patterns related to sources of debris (stormwater versus littering) and showed the majority of debris was plastics. As well we determined how to implement our best practices and the model to provide a clear relevancy message and methods for data collection.

During the second half of the study we will be taking the model and recruiting community members to participate in the project throughout from October 2014-March 2015. They will take part in every step of the project including: data collection, data entry, data management, analysis and dissemination. We will share the innovative model, lessons learned, scientific results to date, and the challenges still underway.

[B] 15.9

NEON CITIZEN SCIENCE: BUILDING A NETWORK THROUGH PARTNERSHIPS AND COLLABORATIONS

Sarah Newman and Rebecca Cheng, National Ecological Observatory Network, Inc.; Andrew Richardson, Harvard University

Citizen Science (CS) projects are a cornerstone of the National Ecological Observatory Network (NEON) Education and Public Engagement program. NEON CS represents a multi-pronged approach including Project BudBurst (budburst.org), a continental-scale plant observation program; Citizen Science Academy (citizenscienceacademy.org); and a new crowdsourcing approach to the categorization and annotation of remotely sensed phenological images. Each project is national in scope with a strong partnership component designed to create local connections for a variety of non-scientific audiences. Although Citizen Science Academy, an online professional development resource, originally focused on Project BudBurst, current offerings reflect the intent to engage external CS programs. Finally, collaboration between Harvard University and NEON resulted in a crowdsourcing approach to remotely sensed phenological imagery that will utilize approaches from the social sciences and the gaming community.

Results

Working with external partners has increased the reach of NEON's CS programs and activities. A key outcome is advancing continental scale ecology by making it relevant at a local level. Project BudBurst partners identify local plants for education and outreach at wildlife refuges, national parks, botanic gardens, and other nature based centers. These partners represent all regions of the country including Alaska and Hawaii. Observations from previously underreported areas have increased as a result of

these partners. NEON's CSA expanded its reach by partnering with other programs offering citizen science based instruction. For example, the US Forest Service and NEON staff developed an online course for field staff that is anticipated to result in an increase in phenology observations from forests and grasslands. An online course focused on citizen science for educators was developed in collaboration with other CS programs external to NEON (eBirds; COCORaHS; PicturePost, and FrogWatch USA). The second cohort of educators graduated from this course in December 2014 and resulted in registrations from educators across the country.
[A] 13.2

DESIGNING AN EFFECTIVE ENVIRONMENT FOR CITIZEN SCIENTIST RESEARCH
Tiffany M. Nuessle, Denver Museum of Nature & Science; Patty McNamara, Independent Evaluator; Brian Hostetler and Nicole L. Garneau, Denver Museum of Nature & Science
In 2009, The Denver Museum of Nature & Science established its first citizen scientist-run, community-based Genetics of Taste laboratory. In the past five years of active research, we have learned many key design features for creating a positive space for citizen scientists to collect scientifically sound human data. For research study design, involvement of citizen-scientists in the planning process is not only a suggested best practice, but also helps to establish motivation and commitment early in the study. Initial design should include in-depth discussions of intended outcomes and a clearly defined timeline with tangible milestones implemented to measure progress. Educational goals for citizen scientists and the public should be included, and care should be taken to define these outcomes as clearly as the research goals. After these initial steps are taken to create a foundation for citizen science, ways to improve citizen scientist retention and project management include targeting populations likely to volunteer, and forming partnerships with professionals who are experts in the field and who can take over some training and independent evaluation ensure the steps implemented are accomplishing their intended purposes. Here we present the lessons learned in developing a community-based lab and how informed science education centers, museums, academic and research institutions alike can apply this model to their studies.
[A] 12.10

THE POTENTIAL FOR YOUNG CITIZEN SCIENTIST PROJECTS: A CASE STUDY OF CHILEAN SCHOOLCHILDREN COLLECTING DATA ON MARINE LITTER
Paloma Nuñez, Centro de Estudios Avanzados en Zonas Áridas-CEAZA; Lucas Eastman, Valeria Hidalgo-Ruz V Hidalgo-Ruz, Vivian MacAya, and Martin Thiel, Universidad Catolica del Norte, Coquimbo, Chile
A wealth of environmental and ecological questions are answered with the help of citizen scientists of all ages, but schoolchildren (<18 years) rarely participate in these projects. This is surprising considering that many citizen science projects would ideally complement modern school curricula, ranging from science, to math, reading and arts. Here we present a citizen science project supported by schoolchildren who investigate the problem of marine litter along the Chilean coast. Schoolchildren received specially designed education materials, carefully tested instructions and sampling kits. Wherever possible they were accompanied by recent university graduates, who supported the teacher in supervising the sampling process. After the samplings, schoolchildren were enthusiastic and expressed interest in participating in future environmental projects. Based on our experience, we present seven steps for designing a successful citizen science project with schoolchildren. We suggest that involving schoolchildren in citizen science projects will not only enhance the spatial and temporal scale of data collection, but also support school curricula, public understanding of the scientific process, and environmental management decisions.
[D] 10.1

THE SOUTHERN CALIFORNIA SQUIRREL SURVEY: EXPLORING THE SPATIAL ECOLOGY AND EDUCATIONAL ROLE OF SQUIRRELS IN SOUTHERN CALIFORNIA

Miguel Ordeñana and Jim Dines, Natural History Museum of Los Angeles County
The behavior and local ecology of squirrels in southern California has made them ideal study species for a mammal-focused citizen science study. Southern California squirrels are easy to observe for people of all ages and backgrounds since most are diurnal, and two species are ubiquitous in even the most urban settings. The current distribution of squirrels is of interest to local mammalogists, especially with regards to the competition between native western gray squirrels (*Sciurius griseus*) and nonnative eastern fox squirrels (*Sciurus niger*) over remaining habitat in southern California. The Southern California Squirrel Survey is a citizen science project on iNaturalist.org established to track the distribution of local squirrels with geo-referenced photographs. The scientific objective of the study is to compare current species distributions, which are largely based on these citizen science observations to historical distributions based on museum records. Further, we hope to identify behavioral trends that may explain the range expansion and contraction of certain species. The educational objectives are to introduce the public to local squirrel ecology and get them involved in the scientific process by bringing scientists and non-scientists into direct communication and breaking down traditional barriers. The Natural History Museum (NHM) will use various strategies to encourage participation including on and off-site school and public programs in order to cast the widest possible net. Project leaders are committed to making the data open access and useful to both internal staff and other relevant squirrel studies throughout the region (e.g., California State University of Los Angeles western gray squirrel genetic study). Squirrels are not only charismatic but they are a diverse family of species allowing for many opportunities to connect with people of various interests and backgrounds. The project's overall success will be reliant upon public involvement and coordination between NHM research, marketing, and education staff.
[F] 8.4

INVOLVING CITIZEN SCIENTISTS IN NATURAL RESOURCE MANAGEMENT AND PUBLIC ENGAGEMENT AT A NATIONAL WILDLIFE REFUGE

Jennifer Owen-White, US Fish and Wildlife Service; Erin Posthumus, USA National Phenology Network; **Lorianne Barnett**, USA National Phenology Network
Located on 570 acres of the South Valley region near Albuquerque, New Mexico, Valle de Oro National Wildlife Refuge is the first urban refuge in the southwestern U.S. Objectives of the refuge include (1) tracking the ecological condition of plants and animals and their response to environmental and climatic change, as well as management activities, (2) communicating these patterns and responses to stakeholders, and (3) engaging the general public. In order to meet these challenges, the Refuge has undertaken a monitoring program that involves citizen scientists in data collection, summary, and communication of results back to the public.
Phenology monitoring is carried out through use of the USGS-led USA National Phenology Network's phenology monitoring program, Nature's Notebook, appropriate for professionals and citizen scientists. A core group of 10 volunteers makes weekly visits to the Refuge to carry out monitoring of focal species including birds, native tree and invasive plants. The project also incorporates youth: senior students from a local high school are involved in monitoring design, data collection, and resources for species identification, and members of the Youth Conservation Corps assist with weekly observations.
While these citizen scientists require guidance in initial training, monitoring scheduling, and troubleshooting data collection and entry issues, a locally-based individual in a leadership position can provide guidance with minimal time commitment. The effort of these citizen scientists toward data collection, data entry, and public engagement saves the Refuge an estimated $5,000 annually. The data collected will be used in design and development of habitat restoration from current farm field to native habitats in support of biodiversity and conservation of native species. This project serves as an example for other National Wildlife Refuges and protected areas in how to successfully engage citizen scientists in natural resource management and community engagement goals.
[F] 2.10

CITIZEN SCIENCE AS A CENTRAL TOOL FOR STUDYING URBAN FAUNA IN A BIODIVERSITY HOTSPOT

Gregory B. Pauly and Richard Smart, Natural History Museum of Los Angeles County

Urbanization presents one of the world's greatest threats to biodiversity. Not only is urbanization responsible for habitat modification, but the number of people and goods moving through urbanized areas also increases the chance of nonnative species being introduced. Further complicating the situation is the fact that urbanized areas largely consist of private property (e.g., backyards) that is typically difficult for biologists to access. At the Natural History Museum of Los Angeles County, we think that citizen science is the best solution to this challenge.

Consider the Greater Los Angeles Area, which is the second largest metropolitan region in the United States and also sits within the California Floristic Province (CFP), one of the Earth's 35 biodiversity hotspots. This region is home to 18.4 million people, the 6th busiest airport in the world, and the busiest container port in the United States. With so many people, goods, and cargo moving through the region, coupled with southern California's mild Mediterranean climate, there is an extremely high threat of nonnative species becoming established. We created the Reptiles and Amphibians of Southern California (RASCals) citizen science project to understand how species ranges have been impacted by urbanization. This is done by comparing modern citizen science generated records to historical museum records. We also use RASCals data to detect nonnative species and document changes to their ranges. Although open for only 1.5 years, this project has already generated multiple discoveries including several for which citizen scientists and museum researchers co-authored peer-reviewed, scientific publications.

[F] 7.5

CAT TRACKER: MAPPING THE ECOLOGICAL IMPACT OF CATS THROUGH CITIZEN SCIENCE ANIMAL TRACKING

Troi Perkins, North Carolina Museum of Natural Science; North Carolina State University; Shelby Powers, Holly Menninger, and Rob Dunn, North Carolina State University; Roland Kays, North Carolina Museum of Natural Sciences; North Carolina State University

Cats were domesticated for their ability to kill wildlife humans considered pests, but now have become pests themselves in some cases. Cats have moved with people to live all around the world, often at very high densities due to food subsidies from people. Cats have caused the extinction of numerous species endemic to islands, and are estimated to kill many billions of small mammals and birds in the continental United States each year. However, cats themselves are subject to predation by larger carnivores, which may limit the spatial extent of their hunting, and reduce their threat to native wildlife. Existing tracking studies of cats have found high variability in movement rates, but not had sufficient sample size to explain why some cats hunt widely in natural areas while others are homebodies. To address this question we have launched a citizen science project called 'Cat Tracker.' We recruit volunteers to use inexpensive GPS units to track their pet's movement for one week (or longer). In the last year we have tracked 57 different pet cats across three states, making this the largest cat-tracking study to date. Preliminary analysis of these data shows that most North Carolina cats tend to stay within a small area around their house and don't venture into nearby natural areas. We aim to expand the study to reach a total of 1000 cats by loaning our GPS units to volunteers, and by encouraging them to purchase one themselves for $50. Attention from national press has helped us already sign up another 200 participants across 48 States, four Canadian provinces, and two European countries. We are also working with colleagues to track cats in more areas with varied communities of larger predators including Long Island NY (no coyotes), and Australia and New Zealand (no native large predators).

[F] 8.3

COLLECTING SURFERS' WAVE KNOWLEDGE TO PREDICT IMPACTS OF SEA-LEVEL RISE

Dan Reineman, Stanford University Emmett Interdisciplinary Program in Environment and Resources

In the coming century, sea-level rise will affect coastal people and communities in both obvious and subtle ways. Worldwide, millions of people rely on breaking waves as a source of recreational

opportunity that drives a multi-billion dollar industry and defines the ethos of many coastal places. It has been suggested that rising sea levels will impact wave quality, but these impacts have not been quantified. Numerical models can predict the relationship between breaking wave height and water depth, but extrapolating these models to predict wave quality along future coastlines is not feasible. Surfers observe wave quality in order to optimize their surfing experience; they have been described as amateur oceanographers and meteorologists because of the acuity of their individual and collective attention to the interactions between swells, winds, tides, and coastlines. This insight, colloquially referred to as Wave Knowledge, accumulates over lifetimes and across both generations and oceans and thus represents a significant repository of local knowledge of coastal oceans worldwide. By gleaning this knowledge with a variety of methods, we triangulated a prediction of the impacts of sea-level rise on wave quality. Initial results suggest that more than one third of California's surf-spots could be threatened by rising seas, while a fraction of other surf-spots may actually improve. As coastal planners and decision makers prepare our coasts for elevated sea levels, understanding the impacts to and interests of large coastal user constituencies will be essential for preserving the character of many coastal communities.
[F] 11.6

CONTESTED DATA: A PLACE-BASED EXPLORATION OF TWO DECADES OF CITIZEN SCIENCE IN CALIFORNIA'S SOUTHERN SAN JOAQUIN VALLEY

Lauren Richter, Northeastern University

This project investigates the history of community efforts to validate local health and environmental concerns to third parties using data collection in California's San Joaquin Valley. The San Joaquin Valley is arguably a completely industrialized rural region, serving as the produce basket to the nation and housing over 80% of the state's oil and gas extraction. Additional land uses include: the nation's most productive dairy operations, two of the state's largest hazardous waste dumps and open-air biosolid land application (i.e. sewage sludge) from urban areas such as Los Angeles. Using semi-structured interviews and participant observation, this project explores nine unique cases of community-based data collection tied to local health and environmental concerns around pesticide exposure, unconventional oil and gas extraction, and toxic waste dumps. For decades, communities and non-profits have undertaken citizen science data collection in the Valley, deploying strategies that include: bucket brigade air monitors, summa canister air monitors, pesticide drift catchers, and health surveys. Interviews were conducted with community leaders, environmental justice groups and larger national environmental organizations regarding their experiences collecting health and environmental monitoring data in the San Joaquin Valley. Results indicate that community-based data collection has generated a range of results across industries monitored, tools deployed and monitoring timeframes. It appears as though accident-based community monitoring across this region can build networks of shared knowledge and opportunities for collective action targeting local industries and state agencies. However, community generated data in the Valley has historically faced significant opposition and criticism from local government agencies and industries. Further research will explore the relationship between data collection and political organizing in achieving community goals of pollution reduction.
[E] 4.6

THE NORTH AMERICAN BUTTERFLY MONITORING NETWORK: NEW SYSTEMS FOR DATA MANAGEMENT, ANALYSIS, AND VISUALIZATION

Leslie Ries, University of Maryland, College Park; Jeffrey Glassberg, North American Butterfly Association; Elise Larsen, University of Maryland, College Park; Thomas Naberhaus Butterfly and Moth Information Network; **Karen Oberhauser**, University of Minnesota; Doug Taron, Peggy Notebaert Museum; Kyle Bibby, Kalamazoo Nature Center; Nathan Brockman, Reiman Gardens, Iowa State University; Jutta Burger, Irvinve Rance Conservancy; Jaret Daniels, University of Florida; Kelly Lotts, Butterfly and Moth Information Network; Steve McGaffin, Knoxville Zoo; Sarah Garrett, The Butterfly

Pavilion; Lea Morgan, Museum of Science; Matt Scott, Redshift Technologies; Jim Springer, North American Butterfly Association; Maxim Larrivee, eButterfly; Regina Rochefort, National Park Service; Ashley Wick, Kalamazoo Nature Center; Tad Yankowski, Missouri Botanical Garden
Citizen scientists throughout North America perform thousands of butterfly surveys each year, yet these programs remain little known and the data have been underutilized both for local management or large-scale analyses. Despite this, the growth of these programs over the past five years has been astounding. The North American Butterfly Monitoring Network (www.nab-net.org) has recently formed to promote and support data management, access, and analysis of butterfly monitoring data. This group is also joining forces with MonarchNet (http://www.monarchnet.org) to help connect efforts between general butterfly surveys and the large network of surveys focused solely on monarchs (*Danaus plexippus*). This community of practitioners has come together to leverage efforts, build and share resources, and coordinate protocols and data standards to allow easier integration of data across programs. We present a broad overview of general butterfly and monarch monitoring efforts, including currently-available online tools. We also discuss plans for taxonomic resolution between programs that adhere to different standards and data integration and analysis for programs that use divergent protocols. We then present two new efforts that will greatly expand data access and visualization. The first is a platform for the North American Butterfly Association's multiple monitoring programs and the other is a data platform (PollardBase) for a consortium of regional (transect-based) monitoring programs. We believe these efforts could serve as a model for other organism-based networks of programs, such as dragonflies, bees or moths.
[C] 5.6

THE WASHINGTON CASCADES BUTTERFLY PROJECT – MONITORING SUBALPINE BUTTERFLIES AS CLIMATE CHANGES
Regina Rochefort, National Park Service
The Cascades Butterfly Project is a long-term citizen science project that monitors subalpine butterfly populations in the Northern Cascade Mountains of Washington. The project was initiated in 2011 with the goals of establishing a current baseline of butterfly populations; detecting trends in subalpine butterfly populations as climate changes; and most importantly, engaging the public in these efforts. Monitoring is conducted at 10 sites in North Cascades National Park Complex, Mount Baker-Snoqualmie National Forest, Mount Rainier National Park, and Okanogan-Wenatchee National Forest. At each site, volunteers monitor butterflies along a 1-kilometer survey route using the Pollard Walk method.
Over the last four years, we have had more than 35 volunteers devote over 800 hours to documenting 35 butterfly species in these remote, high-elevation sites. Our greatest challenge is attracting volunteers who are willing to hike 2-4 miles (one- way) to our study sites, often with a gain of up to 3,000' in elevation. Despite this, the number of returning volunteers has increased each year, as has the number of volunteers skilled enough to conduct surveys independently.
In 2014, we were fortunate to join with Dr. Leslie Ries of the National Socio-Environmental Synthesis Center and the data platform (PollardBase) she developed for a consortium of regional (transect-based) monitoring programs. We believe our program is stable and increasing due to a core of dedicated local lepidopterists and we are now starting to reach out to other land management agencies to expand our network to low elevation sites.
[F] 5.5

ESTABLISHING THE CITIZEN SCIENCE NETWORK AUSTRALIA
Chris Gilles, Earthwatch Australia; **Philip Roetman**, University of South Australia; Carla Sbrocchi Wentworth Group of Concerned Scientists; Gretta Pecl, Institute for Marine and Antarctic Studies
Citizen Science Network Australia (CSNA) is a developing 'community of practice' which supports researchers, educators, businesses, natural resource managers, government, community groups and volunteers in all aspects of citizen science. The aims of the Network are to:

- Improve communication among citizen science practitioners within Australia through the development of an active peer to peer network;
- Provide support to new and existing citizen science projects by facilitating partnerships, distributing information and assisting with supporting resources;
- Promote the benefits of citizen science to the wider Australian community;
- Act as a facilitator to international citizen science associations;
- Provide community volunteers with information on how to volunteer or how to start your own citizen science project;
- Support the development of a national plan for citizen science.

Momentum in the field led to an workshop held in May 2014 which brought together the diverse interests in citizen science in Australia to discuss the potential for forming a national representational body. More than 90 people attended the workshop in Brisbane, Australia and since then more than 200 individuals have registered their interest in becoming members. Four working groups were formed to develop aspects of representational body covering Charter and Objectives, Governance and Entity, Funding, and Communications. This poster will present the latest activities of the CSNA and its role in progressing the field of citizen science in Australia.
[F] 12.1

KIDS CAN DO REAL CITIZEN SCIENCE
Edward Ross
Four years ago, when I was in 4th grade, I became very interested in science. I did some experiments with balloons, which triggered my interest in why balloons make a loud noise when they pop. Online there are two main, conflicting explanations for why popped balloons make a loud noise. I popped hundreds of balloons and took loudness data, waveform data, and frequency data.
I took all my data to Dr. Jayanta Panda, an acoustician at NASA Ames Research Center, and he said my data showed that neither of the two common explanations was true. He made a new hypothesis using my data, although this hypothesis needs to be verified.
This new explanation is the result of my work and my data, which proves kids can do real science in their own backyards. Seeing these explanations online that sounded pretty good but my work proved were wrong, showed me that just because someone has a good explanation, and it is supported by a small amount of data, doesn't mean it's right. It also showed me that we don't always understand "simple" phenomena as well as we think we do.
I displayed my work in a science fair and I saw many other people who had projects that were new science. Kids can be citizen scientists. Adult citizen scientists can mentor kids and help them to publish their work.
[B] 15.4

CHRISTMAS BIRD COUNT FOR KIDS (CBC4KIDS)
Thomas Rusert, Sonoma Birding
Every year for over a century, "Christmas Bird Counts" (CBC's) have been organized across America through Audubon, mainly for adults, during mid-December and early January. Young kids with their families are often not included with this important 24-hour rigorous "citizen science" effort...so we (Sonoma Birding) created the CBC 4 Kids and families...a stand-alone, half-day event instilling some of the important basic ingredients of this grand old Audubon tradition.
The target age is 8-16 and a parent must participate with each youngster. Today there are nearly 100 events offered from Alaska to Florida and in every providence of Canada, in Spanish, French, and English. The objective is to have fun and potentially create a "hometown team" of birders and conservationists for the future, while encouraging families to enjoy and respect nature together. It simple takes only 2-3 small teams of kids to get started! Target a date over the Christmas and New Years holidays sometime in December-January, while the winter birds are settled. It is a simple, healthy,

holiday celebration for almost any school, youth group, Audubon Chapter, or nature center, wildlife refuge or local community...anywhere!
The work of Tom Rusert and Darren Peterie through Sonoma Birding (founders of the CBC4Kids) won the 2013 John Muir "Conservationist of the Year" Award, and the American Birding Association's 2011-12 Ludlow Griscom Award, which was first presented to Roger Tory Peterson. The CBC4Kids movement has been featured on NPR's BirdNote and their Annual Report, Cornell Lab's eBird (online tool) and Young Birders newsletter, American Birding Association's Birders Guide to Conservation and Community, the Wilderness Society's magazine, The Washington Post, and Audubon's American Birds magazine. Bird Studies Canada is our international partner for the CBC4Kids.
[F] 15.3

ROLE OF PARTICIPATORY MAPPING IN CITIZEN SCIENCE: CHALLENGES AND OPPORTUNITIES
Brett Sanders, Richard Matthew, Doug Houston, Victoria Basolo, David Feldman, **Wing Cheung**, Jochen Schubert, Beth Karlin, Irvine Kristen Goodrich, and Santina Contreras, University of California, Irvine
Recent advances in geospatial technology such as global navigation satellite systems (e.g. GPS), virtual globes (e.g. Google Earth), and location-based services have increased the public's exposure to geographic thinking and information. This created an unprecedented opportunity for researchers to leverage these technologies to assess the public's spatial understanding and perception of natural hazards such as flood risks.
Much scholarship has been devoted to the substantive, normative, and instrumental arguments in favor of a participatory approach to decision making and the management of environmental risks. However, there is considerable less research aimed at bridging the theories of ideal citizen participation with technical implementation of participatory approaches. One of the major goals of this talk is to engage citizen science organizers and practitioners in this effort, and solicit suggestions in which the ideals of deliberative democracy and participation theory can be better integrated into the practice of participatory mapping and citizen science.
With support from the National Science Foundation, the Planning, Policy, and Design department and Civil and Environmental Engineering department at the University of California-Irvine have spearheaded an interdisciplinary project to assess flood risks due to climate change in Newport Beach, California. In this talk, we will assess the implementation of a cloud-based geospatial system to collect public perception and mental maps of flood risks in the study area. In particular, we will examine the challenges that the research team encountered in (1) the development of the platform, (2) the implementation of the survey, and (3) the analysis of crowdsourced data and data integrity issues. The talk will conclude with recommended suggestions for greater stakeholder involvement and field testing as means of overcoming the identified challenges.
[A] 8.9

THE JUGGLING ACT: THE CHALLENGES AND ACHIEVEMENTS TO COORDINATING 7 RESEARCH PROJECTS IN A CITIZEN SCIENCE PROJECT IN PUERTO RICO
Jean Sandoval, Yogani Govender, and Lee Ann Rodriguez, Para la Naturaleza
In order to determine Efficacy of Informal Science Education (ISE) practices to develop Hispanic citizen scientists in the Watershed of the Rio Grande of Manatí, Puerto Rico, the Conservation Trust of Puerto Rico (CTPR) developed two objectives; How do Hispanics 1) Learn and 2) teach science in an informal setting. To achieve these goals, we partnered with five ecologists and two evaluators that investigate process of learning and teaching. Each ecologist has different replicate study sites and has developed a different calendar of activities within four municipalities in the watershed. The evaluators implemented their IRB approved instruments at various stages within the planned ecology activities. The CTPR has provided a full time and 2 staff that work 50 % of their time to coordinate these activities and follow up deadlines of key tasks. The logistics of preparing the field equipment, waivers documents, tracking pre-post evaluations, surveys, questionnaires, transportation, snacks, etc. for the seven research projects

simultaneous has been a logistical challenge especially since majority of the activities occur during the weekends. The use of volunteer leaders within the project has been a success to address these challenges. The volunteer leaders were properly train in environmental interpretation, filming techniques, first aid and recruitment of volunteer to assist CTPR staff and researchers in logistical support. Through this experience CTPR recommends for future Citizen Science projects to use one rather than five ecological research project to evaluate impacts on education. Additionally we recommend having a task force of volunteer leaders to manage the many logistical factors within the project. Further, we encourage scientists that partner in Citizen Science projects to choose research methodologies that are easy to learn with low complexity that still demonstrate the science inquiry methodology.
[A] 14.10

FINDING SYNERGIES BETWEEN DATA GENERATORS AND DATA CONSUMERS IN NATIONAL GEOGRAPHIC'S GREAT NATURE PROJECT

Carrie E. Seltzer, National Geographic Society; Scott Loarie, iNaturalist.org, California Academy of Sciences

Since 1888, National Geographic has been inspiring people to care about the planet. In 2013, National Geographic launched the Great Nature Project (GNP) to encourage people to get outside, explore nature, and share photos of biodiversity in "a project as big as the world itself". The goal was to make participation as easy as possible in order to reach the greatest number of people. In its first year, GNP reached over 17,000 people and amassed >300,000 photos by aggregating data from 9 different photo/observation-sharing platforms. However, there was not a pre-defined scientific use for the data produced since the initial goal was about engagement and participation. National Geographic has broad reach and a long history of success based on identifying and supporting exciting research, and that's what we hope to do with the Great Nature Project moving forwards. We want to find people who have big research questions that can be answered using the kind of data generated by GNP, and we want to facilitate their research by providing a platform and promotion. In 2014, GNP began working more closely with iNaturalist.org and encouraging iNaturalist contributions as the preferred method of participation through direct iNaturalist integration on our site. In collaboration with iNaturalist, we are soliciting "data consumers" who have clearly identified uses for the data. Ideally, projects have clear science objectives from the start, but the reality is that sometimes projects start generating data before there are clear uses for the data itself. In these cases, it is important to consider where the organization's strengths lie and determine how to best leverage them to create mutually beneficial collaborations.
[A] 7.2

IBERCIVIS, THE IBERIAN CITIZEN SCIENCE INITIATIVE. PROJECTS AND ACHIEVEMENTS

Fermin Serrano Sanz, Francisco Sanz, Eduardo Lostal, Carlos Val, Mari Carmen, Alfonso Tarancón Lafita, and Alejandro Rivero, Institute for Biocomputation and Complex Physics Systems of the University of Zaragoza, Ibercivis Foundation; Rui M. M. Brito, Cândida G. Silva, António Monteiro, and Paulo Gama Mota, University of Coimbra

Ibercivis is a private non-profit organization devoted to citizen science. It was created in 2011 by some of the most important Spanish public research institutions: Ministry of Economy and Competitiveness, University of Zaragoza, CSIC, CIEMAT, Red.es, Zaragoza City of Knowledge Foundation, Ikerbasque Foundation and Aragon Government.
In this poster we share the timeline, challenges and success stories that we experienced in order to create a new national trans-disciplinary institution with the support of several policy bodies and research institutions who understood the need of such a common initiative to effectively promote and support the uptake of this new kind of science-society interactions. Our roles include the promotion of experiments, coordination of groups, representation with stakeholders, technologies operation and user

support. We have worked with dozens of research groups leading to enhanced research and new learning scenarios. This roadmap was already easily upscaled to Portugal (with the following institutions: UMIC, University of Coimbra, LIP, FCCN and Ciencia Viva) and it may be adopted and adapted by any other national or international wiling to.
In addition to the development and adaptation of tools and technologies, we deploy participatory projects aiming to enrich our analysis and to explore new inspirational ideas. With the focus on non-English speaking countries, we count with roughly fifty thousand of volunteers in a wide range of participation models: volunteer computing, crowdsourcing scientific images analysis, environmental monitoring, social participatory experiments, collective intelligence. In this talk, we will also present some of the most important projects and their achievements in fields like physics, biotechnology, digital social sciences or arts.
[A] 1.10

CITIZEN SCIENCE IN EDUCATION: STUDENTS BECOMING CELL BIOLOGY RESEARCHERS
Fermin Serrano Sanz, Eduardo Lostal, **Fermin Serrano Sanz**, Francisco Sanz, and Carlos Val Ibercivis, Foundation, Spain; José Alberto Carrodeguas, Institute for Biocomputation and Physics of Complex Systems; Cândida G. Silva, António Monteiro, Paulo Gama Mota, and Rui M. M. Brito, University of Coimbra
Success stories of Citizen Science projects demonstrates how valuable is this open science paradigm and encourages organizations to shift towards new ways of doing research different to the traditional ones. While benefits for researchers are clear, outcomes for individuals participating in those kind of projects are not that easy to assess. One of the reasons that makes that difficult to evaluate such outcomes is the wide spectrum of volunteers collaborating on those projects. Focusing on a segment of that spectrum may help to identify its particular outcomes. Given the strong links between science and education, that one seems an interesting section of volunteer population to be studied.
In this work, we present an experience with students who participate in a project on cell biology research. More than 4500 students from various grades before high school of two different countries have collaborated so far with the analysis of around 50000 cell images. Beyond introducing the experiment and resources involved, we aim to provide an overview of the benefits of integrating Citizen Science in Education and what students may obtain from it. In this case, besides improving their background on biotechnology, some other types of informal learning have been observed in addition to the feeling of playing a key role what means an increase of their motivation.
[D] 15.2

PARTICIPATORY RESEARCH OF NATURE'S IMPACT ON HEALTH
Valentine Seymour, Extreme Citizen Science (ExCiteS) Research Group, University College London
With the increase in aging population, costs of health provision and the growing important of wellbeing is of increasing concern for UK policy makers and public health officials. The exponential rise in the numbers of eco-health programmes emerging in the past decade can be seen as an attempt to address these concerns. Calls for a green agenda within the UK health care system follows the growing evidence that suggests nature's benefits of people's physical health and wellbeing. A key challenge in existing assessments of well-being is that they remain predominantly subjective and have yet to be scrutinised to rigorous scientific analysis. The current study is aimed to provide a longitudinal evidence to strengthen measuring the impact that connecting with nature has on people's physical as well as mental well-being. This is done by utilizing The Conservation Volunteers' national Green Gym volunteering programme as a case study. The study puts forward a holistic model of 'Individual Well-being' in the context of connectivity to nature to develop a novel mobile data collection framework and spatial mapping sampling methodology which recruits volunteers as 'citizen scientists' to capture nature's impact on their health.
[A] 11.10

THE CALIFORNIA NATIVE PLANT SOCIETY'S RARE PLANT TREASURE HUNT: CITIZEN SCIENCE AS A TOOL FOR UNDERSTANDING THE CALIFORNIA FLORA

Danny Slakey, California Native Plant Society

The California Native Plant Society's (CNPS) Rare Plant Treasure Hunt (RPTH) program seeks to answer this basic question: what is the status of our State's rare plants? The premise of the program is to engage, train, and support volunteers to relocate populations of rare plants that haven't been seen in decades. This is an important goal, as nearly half of California's known rare plant populations haven't been seen in over 20 years. The data generated in this program inform the CNPS Rare Plant Program and California Department of Fish and Wildlife (CDFW), which maintain data on all of California's 2300+ rare plant taxa. The data are crucial to conservation efforts, as they help CNPS and CDFW determine which plants merit protection under the California Environmental Quality Act (CEQA).

Educational outreach and training help raise awareness of the plight of rare plants and engage hundreds of volunteers. The program offers several different opportunities for volunteer participation. Many CNPS Chapters have formed groups that participate in the project by collecting data on their local rare plants, while other individuals and small groups lead their own surveys with direction from CNPS staff. Also, CNPS staff lead trips and trainings in areas where land managers award grants to support rare plant surveys. These staff-led events offer opportunities for beginning plant enthusiasts to become exposed to the field of botany and gain rare plant survey skills. To date, RPTH volunteers and staff have gathered data on over 2200 rare plant populations. There have been important discoveries among those observations, including significant range extensions, addition of new plants to the Rare Plant Inventory, and even the downranking of plants too common for protection under CEQA. In the future, there are plans to expand the scope of this project to include specimen collection and conservation seed banking.

[F] 9.1

CITIZEN SCIENCE AT NHM: A MUSEUM-WIDE APPROACH

Richard Smart, Miguel Ordeñana, and Lila Higgins, Natural History Museum of Los Angeles County

Los Angeles sits within the California Floristic Province, one of 35 global biodiversity hotspots as identified by Conservation International. The Natural History Museum of Los Angeles County (NHM) has begun a multi-year study on Los Angeles's urban biodiversity so that scientists, educators, the public and decision makers can understand threats to L.A.'s flora and fauna. NHM is uniquely positioned to study biodiversity because we can compare current species distribution records to historic records housed in our extensive collections. This work enables NHM to better understand how biodiversity is affected by urbanization and the introduction of non-native species.

NHM's citizen program is at the heart of this study. The program consists of three full-time employees focused on citizen science. They work closely with the Museum's education and research staff on myriad citizen science projects to insure that appropriate data are collected and that participants understand how their contributions support this research. To accomplish this agenda, NHM created the 3.5-acre Nature Gardens. The gardens are used as a public field site for surveying urban biodiversity and as a training ground for citizen scientists.

NHM has four goals for its citizen science participants: to have fun, enjoyable experiences in nature; to increase their science self-efficacy; to increase their engagement with NHM; and to have greater appreciation and understanding of L.A.'s biodiversity. With this poster, we showcase how NHM uses a museum-wide, visitor-focused approach for incorporating citizen science into our interpretive, school/teacher, member, and training programs.

[D] 14.8

REVEALING AND RECOMMENDING BEST MANAGEMENT PRACTICES FOR VOLUNTEER RIVER HERRING MONITORING PROGRAMS IN MAINE AND MASSACHUSETTS SEACOAST COMMUNITIES

Jason Smith, University of Southern Maine; Karen Bieluch, Dartmouth College; Theodore Willis, University of Southern Maine

Citizen science is a popular data collection method applied and relied on by state, university, and citizen researchers. For example, in Maine, New Hampshire, and Massachusetts, volunteer monitoring programs and harvesters are the primary sources of river herring population data. Under these programs, harvesters and community members count fish at designated monitoring sites. Count data can then be used by state natural resource managers, policymakers, and other nongovernmental organizations to assess stock status and determine future management options. Beyond data for policy development, volunteer programs often yield cultural, economic, and ecological benefits. Also inherent to citizen monitoring programs are programmatic, economic, technical, and geographic barriers that can discourage participation, decreasing program effectiveness. Consequentially, as citizen science programs are increasingly implemented and relied on to produce data for natural resource management, it is important to assess current schemes facilitating them. This study conducted field observations, informal and formal interviews, and a regional survey at and of river herring-monitoring sites and participants to verify their efficacy, thus sustainability. Current program structures, level of communication, perception of resulting data, preferred level and form of participation of volunteers, and economic, geographic, and technical barriers affecting participation and program success were some of the factors examined. Results were used to reveal and collate best management practices that were provided to state and municipal officials, non-governmental organizations, harvesters, and volunteers aiming to improve program management.

This poster presentation will discuss the best management practices identified through this research and how they may be applied in different citizen science programs.

[F] 3.3

CITIZEN SCIENTISTS ENABLE STREAMWATCH TO BUILD A LONG-TERM DATABASE TO MONITOR STREAM HEALTH OF A CENTRAL VIRGINIA WATERSHED

Marilyn Smith, David Hannah, and John Murphy, StreamWatch

StreamWatch is a nonprofit organization dedicated to monitoring stream health in the Rivanna River watershed of Central Virginia. The Rivanna is a tributary of the James River and within the Chesapeake Bay Watershed. This 768 square mile watershed is home to over 165,000 people and is a major source of drinking water for the City of Charlottesville and surrounding counties.

Using a team of dedicated volunteers, StreamWatch has provided the community and local governments with high-quality scientific data and information about stream and watershed conditions for eleven years. In each of the past two years, more than 100 citizen scientists have helped monitor and assess the health of streams at 50 stations covering approximately 400 stream miles. Volunteers and staff sample and identify benthic macro-invertebrates following Virginia's Department of Environmental Quality's (DEQ) certified methodology. This requires training of all certified monitors to identify organisms to the family level. StreamWatch is the only volunteer organization to achieve a level of certification that allows data collected to be used by DEQ when identifying “impaired" waters. Volunteers also assist with bacterial monitoring, habitat surveys, data QC, data entry, lab work, training and outreach.

Data and methodology from the latest StreamWatch report will be shown to demonstrate that nearly 70% of the streams assessed fail to meet the Virginia water quality standard for aquatic life. While the data are disappointing, stream health is unchanged despite a population growth of 15% over the past decade. Continued growth is anticipated. Critical factors affecting stream health will be discussed. Several of the streams that are rated just below Virginia's quality standards are in rural or exurban areas and are capable of recovering without extraordinary efforts. StreamWatch provides a long term, high quality database to the community and its nine formal partners to monitor and restore water quality.

[F] 2.3

EMERGENT FRAMING PHENOMENON OF MOSQUITO CITIZEN SCIENCE PROGRAM

Amanda Sorensen, Rutgers University

The Baltimore Mosquito Project "Mosquito Stoppers," is a citizen science collaboration between University of Maryland Baltimore County, The Cary Institute, and Rutgers University. This project is aimed at engaging local individuals of West Baltimore in mosquito control. Here, I will talk about how issue framing may effect the citizen scientist perception of individual contributions and motivation for participation. Our data show a gradient of individuals' belief in personal efficacy in mosquito control, perception of mosquito effects on individuals' every day lives, and perception of municipal efficacy in meeting public needs. Individuals were less likely to report that mosquitoes kept them from enjoying the outdoors post Mosquito Stoppers participation. Individuals who reported being satisfied with their municipalities handling of mosquitoes and pest dropped by half after participation. Belief in personal efficacy in mosquito remediation also increased post participation. There was no statistically significant difference in mosquito knowledge between pre and post participation of Mosquito Stoppers, yet participants ranked highly in mosquito knowledge at project outset. Emerging from our data, we see that framing of project goals (public health versus environmental stewardship) as an important driver of participant outcomes. It is long known that framing influences individuals perceptions and judgments. These preliminary data from the Mosquito Stoppers Program have led to further questions for my dissertation work, particularly within citizen scientists' perceptions of participation and project framing.
[E] 5.9

WHALE MAPP: MOBILE AND WEB APPLICATIONS FOR ENCOURAGING CITIZEN SCIENCE CONTRIBUTIONS OF MARINE MAMMAL SIGHTINGS

Lei Lani Stelle, University of Redlands; Melodi King, Smallmelo: Geographic Information Services

Traditional methods of gathering the data needed to map marine mammal distributions and assess human impacts on their populations require extensive time and resources. To reduce the burden associated with collecting and managing marine mammal observations, a geographic information system (GIS) solution was developed using a citizen science approach. Whale mAPP is a system of mobile and web applications that provide easy access for the public to submit marine mammal observations and visualize the results on maps. A mobile application utilizes GPS enabled smart phones or tablets to record sightings, automatically track boat path to provide data on effort, and collect photographs which are then transmitted to an online geodatabase that is accessible to researchers and the public. The web application provides users with the ability to visualize and filter sightings and download data in shapefile format. Educational materials on the website include basic biological information on each marine mammal species along with images and illustrations of identification features. To help encourage conservation efforts, threats to marine mammals are discussed and research efforts highlighted with brief stories, interviews, and videos. Curricular materials with conservation themes are designed for middle school students and utilize ESRI ArcGIS Online software to provide experience with applying the scientific method and helping to improve spatial literacy. The additional data collected by citizen scientists using Whale mAPP will help supplement the knowledge of marine mammals to aid in research and management efforts.
[C] 11.1

SYNERGISTIC CITIZEN SCIENCE: BRINGING IT ALL TOGETHER

Cassandre Stymiest, NERACOOS; Pamela Dibona, Massachusetts Bays National Estuary Program; Riley Young Morse, Gulf of Maine Research Institute

We have yet to take advantage of the synergies of citizen science. With a synergistic approach, we could take advantage of the vast amount of data being collected every day, a lot of it through community-based, site-specific, and long-term monitoring programs. These data sets are not always available to the scientific community, although their potential to address scientific need is great. Our collective ignorance of localized efforts limits our ability to effectively monitor, and therefore understand and

respond to ecosystem change. This talk will describe an effort to document and incorporate citizen monitoring contributions as part of the Northeast Integrated Sentinel Monitoring Network We will share some ways how we are working to overcome barriers, such as variable quality control measures and rating scale, lack of a robust data management framework, and sporadic engagement between scientists and citizens. We base our effort on the belief that it is just as important to empower citizens who collect data as it is to address scientific needs. Building capacity for local groups to collect and use their data to contribute to decision making is essential. We will also share some of our own best practices for data management framework, an essential component for meeting our goals of data availability, accessibility, and interoperability.
[F] 12.3

DEAD ZONES AND MORTAL MOMENTS: THE EXPANDING ROLE FOR CITIZEN SCIENCE IN DEFINING TOTAL HYPOXIA IN CHESAPEAKE BAY

Peter Tango, U.S. Geological Survey

Dead Zones in coastal estuaries are indicative of poor water quality and degraded ecosystem functions. They are described as areas of low dissolved oxygen or hypoxia, and have been spreading in coastal waters around the globe for decades. Chesapeake Bay, located along the eastern seaboard of the Atlantic Ocean, is the largest estuary in the United States with a surface area of 4,479 square miles and a drainage area of approximately 64,000 square miles. It experiences an annual dead zone, mostly in its deepest waters, during the summer season. This event is tracked and reported each year by the United States Environmental Protection Agency's Chesapeake Bay Program Partnership as a signature measure of overall Bay health. However, both historical and recent water-quality data illustrate that the Bay experiences low dissolved oxygen more extensively in space and time than has been described by the dead zone reports alone. For example, near-shore, high temporal frequency (e.g. a measurement every 15 minutes) water quality monitoring data show a range of short-duration hypoxic events occurring in shallow waters of the Bay at sub-daily to weekly temporal scales. The occurrence of fish kills has also been an obvious sign that illustrates the extent and impacts of a potentially larger hypoxia issue within the Chesapeake Bay ecosystem.
Contributions to understanding Bay health through citizen science are growing in the Chesapeake Bay region. Citizen monitoring can provide support for expanding data collection designed to better define the magnitude and extent of hypoxia beyond the traditional description of the dead zone. The combination of existing and growing sources of high quality dissolved oxygen data can lead to overcoming the challenges of providing estimates for total annual hypoxia in the tidal waters of Chesapeake Bay and provide a more comprehensive evaluation of overall Bay health.
[F] 10.6

MONITORING THE WORLD'S OCEANS—THE GROWING ROLE OF CITIZEN SCIENCE

Martin Thiel, Guillermo Luna, Miguel Penna, Universidad Catolica del Norte, Coquimbo, Chile;
Sonia Salas, Universidad de La Serena, La Serena, Chile; Javier Sellanes and Wolfgang Stotz, Universidad Catolica del Norte, Coquimbo, Chile

The oceans of the world are changing, and one of the most important challenges for marine scientists is to document these changes and generate solutions. Due to enormous extension of the oceans and the pace at which changes occur, many local changes go unnoticed. Currently, a large number of volunteers, also called citizen scientists, support marine research, and in this contribution we examine the role that citizen science can play in helping professional scientists to document these changes. Hotspots of marine citizen science projects are in North America and Europe, but also in other regions of the world, reaching a global coverage over the last decade. Most studies supported by citizen scientists focused on animals, followed by plants and other issues such as pollution. Many of the studied animals were commercially important or emblematic, endangered species. Studies on invasive species made use of the extensive spatial scales that can be covered by a large number of volunteers. Data generated by

citizen scientists provide information on population dynamics, health and distribution of marine organisms, and also support monitoring programs in marine protected areas, on harmful algal blooms, or of marine debris, among others. Considering the vastness of the oceans and the diversity of habitats, communities and species, a proper understanding of this realm requires intensive research in time and space. Collaboration with citizen scientists improves research capacities, achieving larger temporal and spatial scales at relatively modest costs. Moreover, the exchange of knowledge between professional scientists and participating volunteers fosters communication, trust and capacity building, thereby facilitating effective collaborations in marine conservation initiatives.
[F] 11.4

VOLUNTEER LAKE & STREAM MONITORING: EXPERIENCE WITH THE MICHIGAN CLEAN WATER CORPS PROGRAMS

Thomas Tisue, Muskegon Community College

Two programs of the Michigan Clean Water Corps (MiCorps) serve the needs of volunteer-based lake and stream monitoring efforts by providing training, equipment, analytical services, quality assurance protocols, technical backstopping, and a secure database. The Cooperative Lakes Monitoring Program emphasizes measures of trophic status and aquatic macrophyte surveys. The Volunteer Stream Monitoring Program focuses on benthic macro invertebrates and stream habitat characterization, and also provides limited competitive grant funds to support start-up initiatives. The recent experiences of two West Michigan watershed organizations illustrate several strengths of the MiCorps approach, but also help define limitations imposed by modest funding levels currently available from both State and local sources. A key feature of these two watershed organizations is their nearly complete reliance on volunteers, not only for manpower but for professional expertise as well. This presentation will underscore why mobilization of local scientific and managerial expertise deserves emphasis in efforts to encourage citizen science. Our experience shows that MiCorps programs can provide an appropriate mechanism.
[E] 2.1

BIRDS, BUTTERFLIES, BULLFROGS, AND BEYOND—BRINGING BIOLOGY EDUCATION TO LIFE WITH CITIZEN SCIENCE

Nancy Trautmann and Jennifer Fee, Cornell Lab of Ornithology

How can we inspire more teachers to integrate citizen science into their teaching? With that goal in mind, we recruited lesson submissions from educators nationwide and published a book containing 15 selected lessons, four case studies, and advice about implementation in a variety of contexts (Trautmann, Fee, Tomasek & Bergey. 2013. Citizen Science. NSTA Press). This poster will illustrate how the lessons we selected can meet the mandates of the Next Generation Science Standards, including engaging students in an array of scientific practices to learn about crosscutting concepts such as "cause and effect" and "stability and change." We will show how the lessons address key science topics including habitat, adaptation, ecosystem dynamics, and human impacts. Some lessons focus on a targeted aspect of scientific investigation while others engage students in the full cycle from making observations and posing questions to collecting, analyzing, and sharing results. Options for implementation span the seasons, with some lessons conducted indoors and others requiring fieldwork in schoolyards or beyond. We aim to provide jumping-off points for discussion among educators and citizen science project leaders. This ties in with the proposed symposium entitled "Developing a framework for citizen science in education—join the conversation!" We invite you to stop by and share ideas—how can we, and the Citizen Science Association more broadly, best pursue the goal of supporting and promoting participation in citizen science by educators and students?
[D] 14.5

DEVELOPING A NEW, ONLINE, CITIZEN SCIENCE PROJECT STUDYING BAT BEHAVIORS

Shannon Trimboli, Mammoth Cave International Center for Science and Learning
Bats are an animal that many people love to hate. They evoke a range of strong reactions in people—some people love bats and are fascinated by them; others harbor deep fears of bats. These strong emotions have led to many public misconceptions and misunderstandings. These misconceptions are unfortunate because bats play an important role in the ecosystem.
Despite their importance, relatively little is known about the behaviors of many North American bat species. This lack of basic knowledge is partly because it is difficult to study wild bat colonies in their natural environments. Recent improvements in cost and technology have resulted in an increased use of infra-red cameras to remotely record videos of bats in and around roosts. However, one scientific study can result in thousands of hours of recorded videos for a single season. All of those videos need to be watched and coded for behaviors which can present additional challenges related to staff time.
We are developing a new citizen science project focused on bat behaviors. It will be one of the first citizen science projects to use videos for studying animal behavior. The project will contribute to the fields of citizen science, informal science education, and bat behavioral research. This poster will describe the project, seek input from other citizen science professionals, and provide information for others wishing to develop similar, video-based, citizen science projects.
[F] 8.6

DON'T CRAWL UNDER A ROCK, LOOK THERE FOR PIKAS! ENGAGING THE PUBLIC IN CLIMATE-CHANGE SCIENCE THROUGH SURVEYS OF A ROCK RABBIT, THE AMERICAN PIKA
Johanna Varner, University of Utah; Liesl Erb, Colorado College; April Craighead, Craighead Institute; Amy Masching, Denver Zoological Foundation; Lucas Moyer-Horner, University of Utah; **Megan Mueller**, Rocky Mountain Wild; **Emily Olson**, Mountain Studies Institute; Chris Ray, University of Colorado, Boulder; William Simpson, US Fish and Wildlife Service; Shankar Shivappa, Cascades Pika Watch; Mike Weddle, Jane Goodall Environmental Middle School
Engaging humanity in the issue of climate change is one of today's grand challenges. One promising avenue for increasing engagement is public participation in research projects that document local environmental changes. The American pika (*Ochotona princeps*) is an ideal focus for citizen science with respect to climate change. Pikas are small mountain mammals that are charismatic, easy to identify, and accessible in popular recreation areas. These traits, paired with concerns about recent pika population declines, have made pikas popular with citizen science efforts throughout the western United States. More than ten formal projects across seven states are training citizen scientists to monitor the status of pikas. These include several programs specifically for K-12 students. Here, we summarize the scientific insights and educational impacts of public participation in pika research. A comparison of pika detections between volunteers and professional field crews suggests that citizen-collected data are reliable and can be used to identify changes in pika distribution and density. Public observations have since led to high-impact discoveries about the biology of the species, and surveys suggest that participation also helps volunteers appreciate the causes and consequences of climate change. However, data synthesis across projects has proven challenging, particularly with respect to reconciling disparate survey protocols. Overall, our analysis suggests that pika research can be a powerful platform for public engagement in climate change, but future attention is needed to balance educational, scientific and management objectives in project design.
[F] 8.2

HOW OUTDOOR EXPLORERS CATALYZE CONSERVATION
Merrill Warren and Emily Wolfe, Adventurers and Scientists for Conservation
Conservation challenges are as vast as the ecosystems in which they are found. Consequently, these challenges demand data solutions of an equally large geographic scope. Adventurers and Scientists for Conservation mobilizes outdoor enthusiasts to collect environmental data, and disseminates this information to catalyze conservation initiatives worldwide. Our specialized constituency of citizen

scientists, known as "adventure scientists," have the outdoor know-how to gather data in remote and logistically difficult ecosystems. Targeting conservation projects with measurable outcomes, ASC partners with well-established scientists to fine-tune our data collection protocols. ASC's suite of services also includes data management, media production and community building. To broaden and deepen these services, we utilize two models of volunteer management:
1) Adventurers at Large: ASC mobilizes outdoor enthusiasts to collect data/samples during independent expeditions; incoming data contributes to ongoing national and international research.
2) Partnership Projects: Government agencies and private groups contract ASC to recruit, train and manage teams of volunteer adventure scientists to gather environmental data/samples from remote locations.
By engaging these volunteers, we create a network of informed advocates intimately involved in hands-on conservation, and we connect the conservation and outdoor communities. Featuring dramatic images of adventure science in action, our poster will outline this non-traditional, cross-community approach, and convey the power of collaboration, the impact of rigorous science, and the dedication of specialized volunteers.
[F] 10.8

TOOLS FOR DATA LITERACY: ENGAGING CITIZEN SCIENTISTS IN ANALYSIS OF MERCURY DATA FROM NATIONAL PARKS ACROSS THE U.S.
Hannah Webber, Schoodic Institute at Acadia National Park; Collin Eagles-Smith, USGS Forest and Rangeland Ecosystem Science Center; Colleen Flanagan Pritz, Air Resources Division, National Park Service; David Krabbenhoft, USGS Wisconsin Water Science Center; Molly Schauffler, School of Earth and Climate Sciences, University of Maine; Bill Zoellick, Schoodic Institute at Acadia National Park; Sarah J. Nelson, Mitchell Center and School of Forest Resources, University of Maine
The educational goals for many citizen science programs include improved science literacy, yet the analysis of scientific data is most often left to professional researchers. Working with data—evaluating the quality of scientific information and the capacity to pose and evaluate arguments based on evidence—is foundational to the process of science and science literacy. The Maine Data Literacy Project was created to help non-scientists—specifically school teachers and students in citizen science-based Scientist-Teacher-Student Partnerships—develop tools and skills to use data they collect to productively answer their own questions. We identified challenges that non-scientists face when working with raw or messy data and developed a framework for teaching data literacy. Over the past year we have expanded our focus on citizen science and data beyond teachers and students to the Dragonfly Mercury project, which is a National Park Service-wide initiative engaging citizen scientists in ~50 national parks in the collection of dragonfly larvae from park waterbodies. The project brings together National Park Service staff, school groups and teachers, and older citizen scientists—many of whom ask for the project data and all of whom can benefit from an opportunity to develop skill in making sense of data they collect. Here we will present a set of data literacy tools developed by the Maine Data Literacy Project for an original audience of teachers and students together with versions of those tools adapted for the more diverse citizen scientist audience of the Dragonfly Mercury project. The set of three tools deal with key concepts of data sense-making: showing and describing variability; displaying, describing, and interpreting data in the context of a question; and explaining how the interpretation is supported by the evidence.
[D] 3.8

BioCUBES: EXPLORING BIODIVERSITY IN ONE CUBIC FOOT
Michele Weber, Jen Hammock, and Seabird McKeon, The Smithsonian Institution
Most of the world's biodiversity occurs at small scales; organisms hidden in leaf litter, soil, and the nooks and crannies of environments. The BioCube exercises generate a census of living organisms within a

cubic foot. Students count individuals, create images and learn to ID taxa. By focusing on an accessible cubic foot of nature, participants discover that the 'ordinary' life around us is extraordinary.
The BioCube process stresses perception of the environment. Students start with site selection; they observe the cube in a local context and then extract the cube material. Together they discover, sort, identify and report the organisms that they find. Data analysis includes exploring patterns of abundance and diversity. A suite of free online tools that integrate with iNaturalist will support taxon identification, data analysis and delivery of results to naturalists and scientists. Scientists provide feedback to the students and the community as they incorporate the data into their research projects.
The tools and equipment needed to implement a BioCube project are simple and easily obtained at hardware stores for under $30. Teacher workshops and online video trainings were designed to disseminate BioCube protocols. We collected feedback from 44 educators who were introduced to the BioCubes exercise in workshops and conference presentations. We trialed BioCube exercises, produced training videos and refined protocols with three student groups. Ten exemplar BioCubes were professionally sampled and data from these BioCubes are being published online. A BioCubes exhibit will debut at the Smithsonian Museum in the fall of 2015.
The BioCube platform will take advantage of materials available in museum collections and modern tools like genetic barcoding. Up close and personal exposure to local biodiversity and related scientific research will inspire the next generation of naturalists pursue interests in Natural History and contribute to a growing body of ecosystem knowledge.
[D] 7.1

THE SCIENCE MIGHT BE A BIT IFFY, BUT OUR PARTICIPANTS ENJOYED THEMSELVES!
Sarah West, Stockholm Environment Institute, UK; Sian Lomax, University of York, UK
As passionate practitioners, there can be a tendency to assume that our citizen science projects are an overwhelming success, and often our 'evaluation' is limited to counting the numbers of participants, taking photographs and selecting nice quotations sent by happy participants to our funders. Here, I discuss a simple evaluation of a citizen science project which looked at both the quality of the data collected and the impact of participation on knowledge and interest in nature. This revealed a significant increase in knowledge after participation, demonstrating the effectiveness of the survey as an educational tool. However, there were some discrepancies between data collected by the participants and a trained scientist. Recommendations are made for how to improve the quality of the results obtained through citizen science projects and the learning experience for participants. It is hoped that others will be inspired to evaluate their own projects, and I will end by recommending some resources that can help people evaluate their work, and asking the audience to share their own recommendations too.
[E] 13.10

WE'RE GOING ON SAFARI: STRIKING THE APPROPRIATE BALANCE BETWEEN PRECISION IN RESEARCH AND A REWARDING EXPERIENCE WITH SCIENCE
Suzanne Whelan, Andrea Williams, and Janet Klein, Marin Municipal Water District
A citizen science project's design must be optimized to balance the scientific and social objectives for the goals of the particular project. The way objectives are recognized, considered and balanced can affect all stages of project development and implementation. (Shirk et al. 2011. Public Participation in Scientific Research: Converging on Effective Design Strategies.) This poster aims to investigate the validity of claims to citizen science through three case studies of programs run by the Marin Municipal Water District (MMWD) on Mt. Tamalpais. The frog docent, turtle observer and Mt Tam bioblitz programs are evaluated using criteria and design strategies discussed in the literature.
Degree of training, requirements of staff, difficulty and number of tasks, complexity of protocols, depth of scientific inquiry, accessibility of data, integration of online processing and participant targets are all

pieces to consider when molding a citizen science initiative. The functionality and the relative success of a program relies on the intentional combination and dynamic reorganization of these elements.
The Mt. Tamalpais Watershed is a working landscape; MMWD manages 18,500 acres of this land, which is part of an internationally recognized biodiversity "hot spot." MMWD serves its customers and their very real concerns which include rare and invasive species. Citizen-collected data and volunteer stewardship support their conservation goals and inform land use management decisions.
Each of these projects has been in existence for multiple seasons and protocols have been refined. Considering these models and criteria best practices and lessons learned are shared. But also what improvements could be made to further improve the socio-scientific outcomes? Will the investment pay off with a more empowered citizenry or more responsive science? Would deeper public participation and direction by volunteers yield more powerful outcomes? If this is an appeal and not a contribution then would it be sincere?
[A] 12.7

ZOOPLANKTON SAMPLING BY CITIZEN SCIENTISTS: MERGING HUMAN AND DIGITAL CAPABILITIES TO BETTER UNDERSTAND AQUATIC SYSTEMS

Adam Wickline and Jonathan Cohen, University of Delaware

Zooplankton community structure is an important biological indicator of physical and chemical processes in aquatic and marine systems, but monitoring can be both costly and time-consuming. Citizen participation in this research could help mitigate these challenges. A recent model for citizen participation in zooplankton research involves citizens identifying and quantifying individual plankters online from images captured by in situ cameras deployed on oceanographic cruises. Here we describe a different approach for inclusion of citizen scientists in plankton research. Rather than identifying and quantifying individuals, citizens would collect zooplankton at local established sites and send in their collections for quantification and identification using the ZooScan, a new optical tool that can process zooplankton samples much faster than traditional microscopy. These data provided by ZooScan can then be analyzed and synthesized by citizen groups. We will discuss an ongoing collaboration with the University of Delaware Citizen Monitoring Network employing this model to study a region faced with water quality issues and a changing climate.
[C] 10.4

PARTNERING FOR DISCOVERY: EXPLORING THE CONNECTION BETWEEN CITIZEN SCIENCE AND MUSEUMS

Katherine Wolfson and Deane Bowers, University of Colorado, Boulder

Over the past few decades, citizen science has become a popular way to gather scientific data as well as engage and educate the public. Because this is a rapidly growing field, there is a need to learn what types of projects are being carried out, what disciplines are utilizing citizen science, and what partnerships are common and beneficial to citizen science efforts. A better understanding of these areas can inform future project design, implementation, and management to create more successful citizen science projects. This study surveyed citizen science project managers and analyzed citizen science database websites to explore and summarize broad scale patterns in citizen science project formats, topics, and affiliations. As a focus, we were particularly interested in the relationship between citizen science and museums. Our initial results, based on a sample of responses from 50 citizen science project managers, showed that about 80% of projects were field based and 50% were associated with museums. Additional data currently being analyzed will expand the data set to further understand the present and future roles of museums in the expanding field of citizen science. Strengthening our understanding of the ties between citizen science and museums will help promote the maturation of this growing field and encourage museums to determine what role they will play in the development of the citizen science endeavor.
[A] 14.7

INCORPORATING NEXT GENERATION SCIENCE STANDARDS INTO CITIZEN SCIENCE: LESSONS LEARNED FROM NATUREBRIDGE

Becky Zentmyer, NatureBridge Yosemite

The Next Generation Science Standards (NGSS) contain an important shift in science education policy, away from an exclusive focus on content toward active participation in the process of science. Because they are long-term and involve hands-on data collection, citizen science projects provide an opportunity for K-12 learners to engage in the eight science practices defined in the NGSS. The practices are: (1) Asking questions (for science) and defining problems (for engineering), (2) Developing and using models, (3) Planning and carrying out investigations, (4) Analyzing and interpreting data, (5) Using mathematics and computational thinking, (6) Constructing explanations (for science) and designing solutions (for engineering), (7) Engaging in argument from evidence, and (8) Obtaining, evaluating, and communicating information. Aligning your citizen science effort with science standards may allow for greater integration of K-12 students. While many projects naturally incorporate several of these practices, others require careful planning and framing.

NatureBridge, an educational non-profit that delivers hands-on, residential environmental science programs in several national parks, is experimenting with incorporating practices (1), (3), (4), and (6) into our students' experience as they engage in citizen science projects. We will share lessons learned from our attempts to weave NGSS practices into citizen science projects such as water quality monitoring, Sierra snowpack survey, and tracking ecological change after the removal of the Elwha Dam on the Olympic Peninsula.

[D] 14.1

HIGH SCHOOL STUDENTS CONTRIBUTE TO REDWOOD PARK RESOURCE PROTECTION AND CONSERVATION THROUGH CITIZEN SCIENCE

Deborah Zierten, Save the Redwoods League; Sara Fetterly, East Bay Regional Park District

Through Save the Redwood League's Redwoods and Climate Change High School program students and teachers have an opportunity to conduct scientific research in a local redwood forest. This program makes climate change tangible and relevant by showing students how environmental changes affect a local resource. The field trip component of the program allows students to participate in the League's citizen science projects Redwood Watch and Fern Watch. Additionally, we partner with the East Bay Regional Park District (EBRPD) and their naturalists to make sure the students' data provide critical information on how the forest is changing due to changes in climate. Students track changes in the forest by measuring redwood trees, sword ferns and documenting the phenophases of plant and animal species. The EBRPD naturalists will use this data to see how their parks are changing over time. We are currently in our second year of this program and have had great success in our partnerships between the League, the Regional Parks and the schools. We have also found that the teachers and students are more engaged when learning about a local resource and contributing to a project where the data will be used for resource protection and conservation. We are still in the process of establishing specific research areas and tagging trees and plants, which students will go back to year after year to monitor. Once this is established it will be easier to monitor changes in the forest. Additionally once several years of data is collected we will establish methods to interpret and display the data for park staff and the students.

[D] 1.6