Richard D. Leonard
Vice President, Research Infrastructure
Battelle/National Ecological Observatory Network
Major Science Initiatives (MSI) Workshop
November 29-30, 2018

Major research facilities user communities: from engagement to demonstrating research outcomes

Battelle's mission and purpose

Gordon Battelle, Founder

Our mission: To translate scientific discovery and technology advances into societal benefits

- Nonprofit, charitable trust formed in 1925

- Profits reinvested in science & technology and in charitable causes, making the world better for generations to come

- Knowledge, talents and resources applied to help our customers achieve their most important goals

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Battelle-affiliated national labs

Pacific Northwest National Laboratory
Richland, Washington – 1965

Brookhaven National Laboratory
Long Island, New York – 1997

National Renewable Energy Laboratory
Golden, Colorado – 1998

Oak Ridge National Laboratory
Oak Ridge, Tennessee – 1999

Idaho National Laboratory
Idaho Falls, Idaho – 2004

National Biodefense Analysis/ Countermeasures
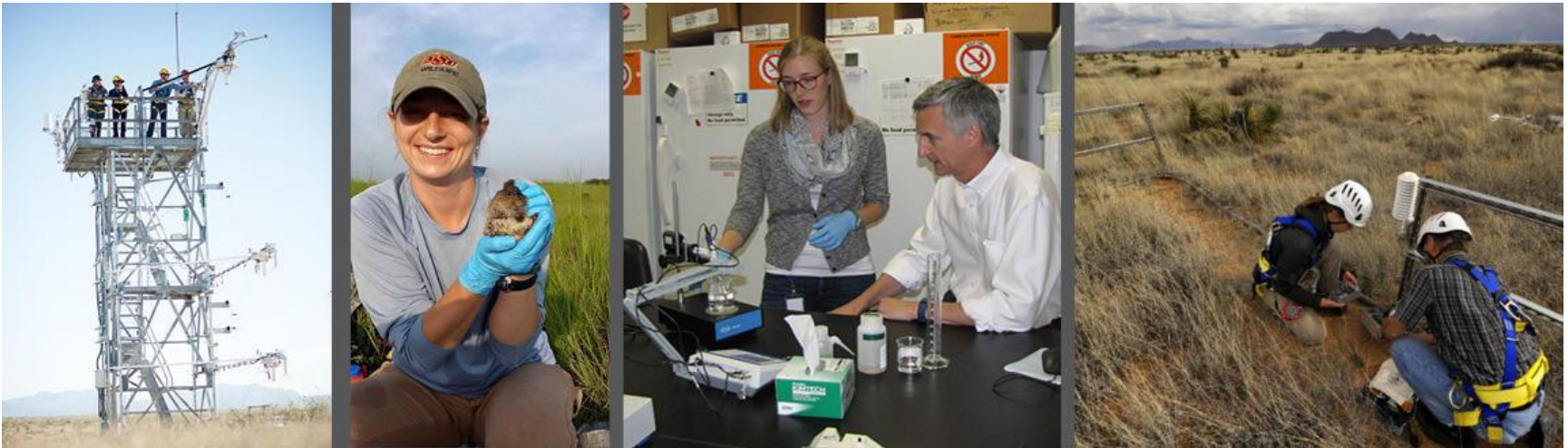Frederick, Maryland – 2006

Lawrence Livermore National Laboratory
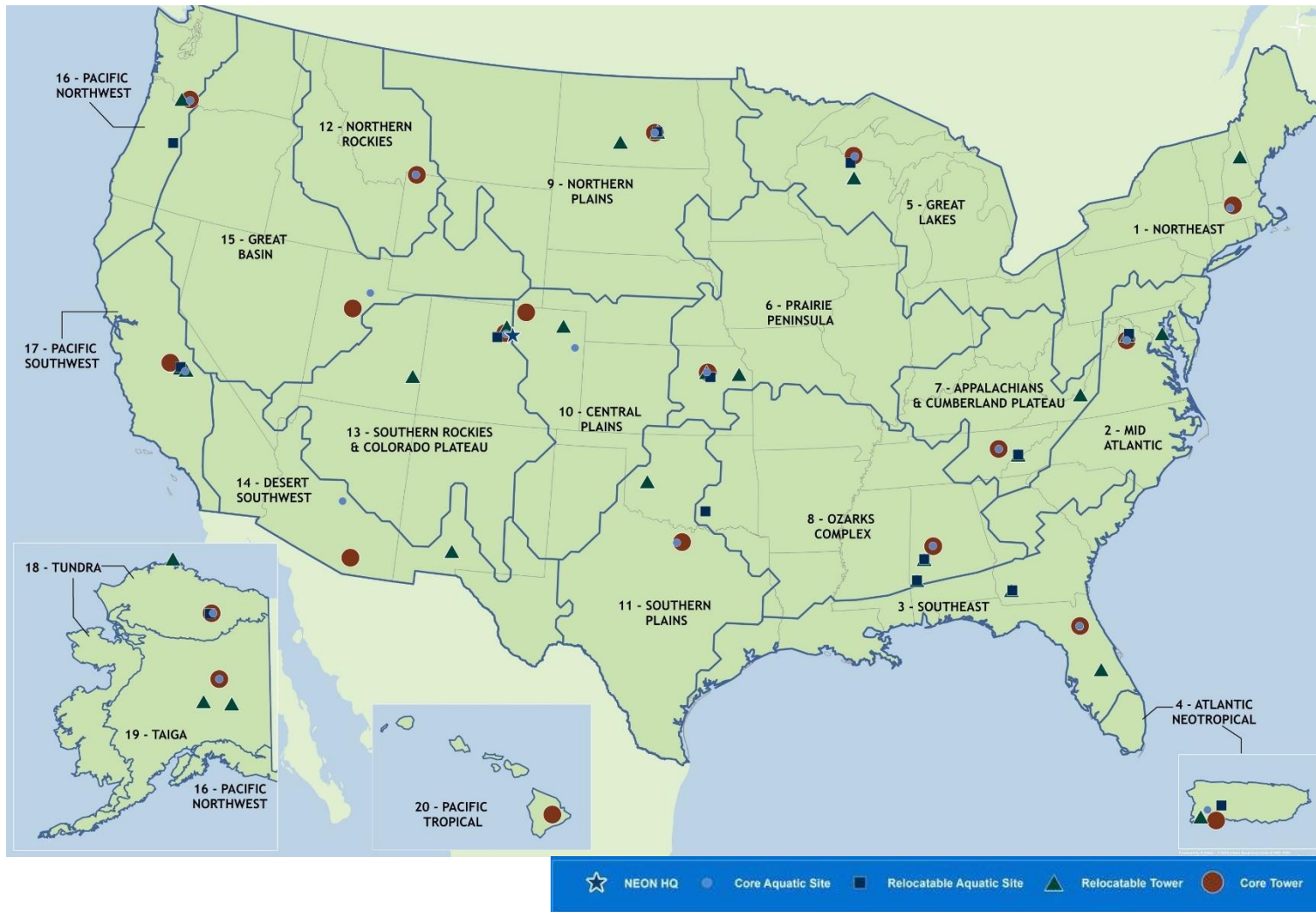Livermore, California – 2007

NEON's mission

*NEON's **primary purpose** is to enable scientific research and education by providing:*

- Continental-scale environmental data

- Infrastructure for research

- Educational tools to work with large data sets

NEON field sites and data products

81 FIELD SITES
- 47 terrestrial
- 34 aquatic

Approximately **180** DATA PRODUCTS

Map legend:
- ☆ NEON HQ
- ● Core Aquatic Site
- ■ Relocatable Aquatic Site
- ▲ Relocatable Tower
- ● Core Tower

Domains:
- 16 - PACIFIC NORTHWEST
- 12 - NORTHERN ROCKIES
- 9 - NORTHERN PLAINS
- 5 - GREAT LAKES
- 1 - NORTHEAST
- 15 - GREAT BASIN
- 17 - PACIFIC SOUTHWEST
- 6 - PRAIRIE PENINSULA
- 7 - APPALACHIANS & CUMBERLAND PLATEAU
- 2 - MID ATLANTIC
- 13 - SOUTHERN ROCKIES & COLORADO PLATEAU
- 10 - CENTRAL PLAINS
- 14 - DESERT SOUTHWEST
- 8 - OZARKS COMPLEX
- 18 - TUNDRA
- 11 - SOUTHERN PLAINS
- 3 - SOUTHEAST
- 19 - TAIGA
- 16 - PACIFIC NORTHWEST
- 20 - PACIFIC TROPICAL
- 4 - ATLANTIC NEOTROPICAL

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NEON's impact

For science and society

- Provides unprecedented opportunity for scientific discovery at continental and decadal scales

- Enables ecological forecasting to project impacts of environmental variability on food and water security, human health, invasive species

- Offers immense job opportunities (e.g., 237 temporary field staff in 2018) for next generation of STEM students

- Elevates professionalism of young scientists through rigorous training and valuable experience

- Facilitates unique exposure to data science and ecology

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Engagement Goals

- ***Optimize NEON***

  - Continuously improve and adapt NEON data, resources, and infrastructure through interactive community engagement.

- Build a robust, active, and inclusive NEON user community

  - Build and leverage community relationships across scales (local, regional and continental) to facilitate community-driven research using NEON data, resources, and infrastructure.

- Cultivate future NEON users

  - Facilitate collaborative training and professional development for scientists and other potential NEON users.

Target Audience 2018-2019: Scientific research community

Goal 1: Optimize NEON

- Objective 1: Leverage NEON Advisory Groups

- Objective 2: Request and respond to community feedback

- Objective 3: Communicate data quality processes with the science community

- ***Objective 4: Improve discoverability and accessibility of NEON data***

- Objective 5: Create tools to facilitate use of NEON Data

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Improve Discoverability and Accessibility of NEON Data

Action Plan

- Improve user interactivity with data and resources

  - Integrate Jupyter notebooks into the data portal for server-side interactivity with the data

  - Integrate shiny applications into the data portal to enable easier data exploration

  - Replace current document library with an integrated resource library

- Develop and implement plan to continually assess and adapt the user interface and API to make it easier for users to discover, access and download data

Timeline

- Q1 2018+: Respond to feedback from Contact Us form and GitHub issues (API) to improve portal and API usability.

- Q2-Q4 2018: Finish features of current NEON data portal

- Q2/Q3 2018: Improve web resources explaining how to use the NEON Data Portal and data packages.

- Q1 2019+: Improve user interactivity with data and resources

- Q4 2018+: Develop and implement regular assessment, prioritization and feature improvement plan

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Improve Discoverability and Accessibility of NEON Data

- **Outcome**: Data consumers satisfied with quality, usability, and accessibility of NEON data to further grow network of collaborators that promote and use NEON data.

- Activity: Improve user interactivity with data and resources

Stage	Outcome	Metric	Success Indicator
Product	Data consumers satisfied with quality, usability, & accessibility	Y/N data portal features updated quarterly based on community feedback	Data portal features updated quarterly
Delivery Channel	Stakeholder community aware & knowledgeable of activities	# of data product downloads by diversity of data product	Each resource accessed / downloaded 25 times in first year and growth of 10% in each subsequent year each year
Promotion	Stakeholder community aware & knowledgeable of activities	Y/N promotion of new data portal features	All new data portal features promoted via communication channels (see communications plan)
		UTM parameters: how are users finding data products content?	Data guide iterative changes in communications plan
Usage	An active user community	# of data package downloads	10% growth in downloads annually
		# of data citations	10% growth in citations annually

Data Skills Resources

Data Tutorials

Teaching Modules

Science Videos

Workshops

Engagement Products and Plans

FY18 Metrics (to date)

Product	Metric
Data tutorials	19 tutorials
Science videos	7 videos
Teaching modules	6 modules
Workshops	15 workshops
Data Institute	23 participants
Research products	12 publications (by community)
Web site visitors	100,064 unique visitors
Digital outreach	Social media, Bi-monthly eNewsletter

FY19 Plans

Product	Plan
Data tutorials	8 tutorials
Science videos	6 videos
Data tools	6 tools
Workshops	TBD by funding
Digital outreach	Social media, eNewsletter
Engagement activities	Min of 2 activities per quarter
Training activities	Min of 1 activity per quarter
Research products	10% increase from FY18
Community Requests	# tickets/# responses>95%

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Local Outreach & Early Career Program

- 96 Domain outreach events to-date during FY2018

  - STEM-focused High School program visit to HQ (D10/13)

  - Student visit to UNDERC (D05)

- NEON-ESA Early Career Scholars Program

  - Received 102 applications

  - Funded 17 students to attend ESA conference in August 2018, including 4 special NEON programs at conference

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QUBES-NEON Partnership
NEON Faculty Mentoring Network (FMN)

NEON Community Engagement

Advisory groups

- Science Technology Education Advisory Committee (STEAC)
  - High-level strategic advice on planning, construction and operation of NEON Project

- Technical Working Groups (TWGs)
  - Science, education and engineering experts provide input to the Observatory's data collection and processing methods

NEON Technical Working Groups

- Airborne Sampling Design Technical Working Group

- Aquatic Instrument Technical Working Group

- Aquatic Observational Sampling Technical Working Group

- Aquatic Technical Working Group

- Atmospheric Chemistry Technical Working Group

- Biorepository Technical Working Group

- Breeding Birds Technical Working Group

- Data Standards Technical Working Group

- Fish Technical Working Group

- Foliar Sampling Technical Working Group

- Ground Beetle Technical Working Group

- LiDAR Technical Working Group

- Microbial Technical Working Group

- Mobile Deployment Platform Technical Working Group

- Mosquito Technical Working Group

- Small Mammals Technical Working Group

- Soil Sensor Technical Working Group

- Spatial Sampling Technical Working Group

- Surface Atmosphere Exchange Technical Working Group

- Terrestrial Biogeochemistry Technical Working Group

- Terrestrial Instrument Data QA/QC Technical Working Group

- Terrestrial Observational Sampling Technical Working Group

- Terrestrial Plant Diversity and Phenology Technical Working Group

- Terrestrial Plant Productivity and Biomass Technical Working Group

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Scientists Using NEON

Left chart — Publications Using NEON:
- 2011: 1
- 2012: 5
- 2013: 3
- 2014: 8
- 2015: 9
- 2016: 18
- 2017: 11
- 2018: 12

■ Publications Using NEON

Right chart — ESA presentations referencing NEON:
- 2016: 5
- 2017: 13
- 2018: 19

■ ESA presentations referencing NEON

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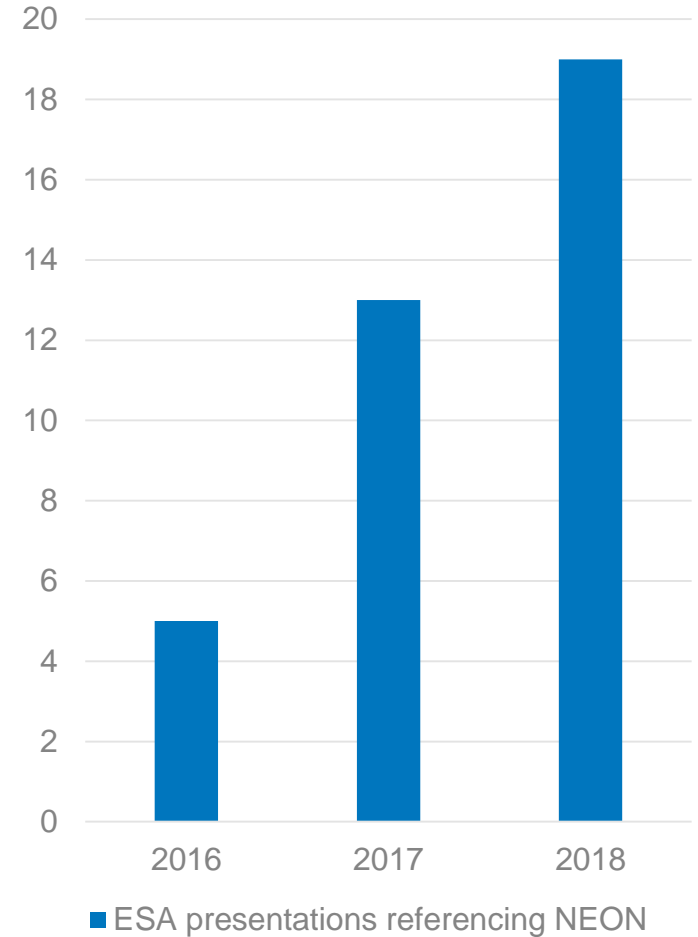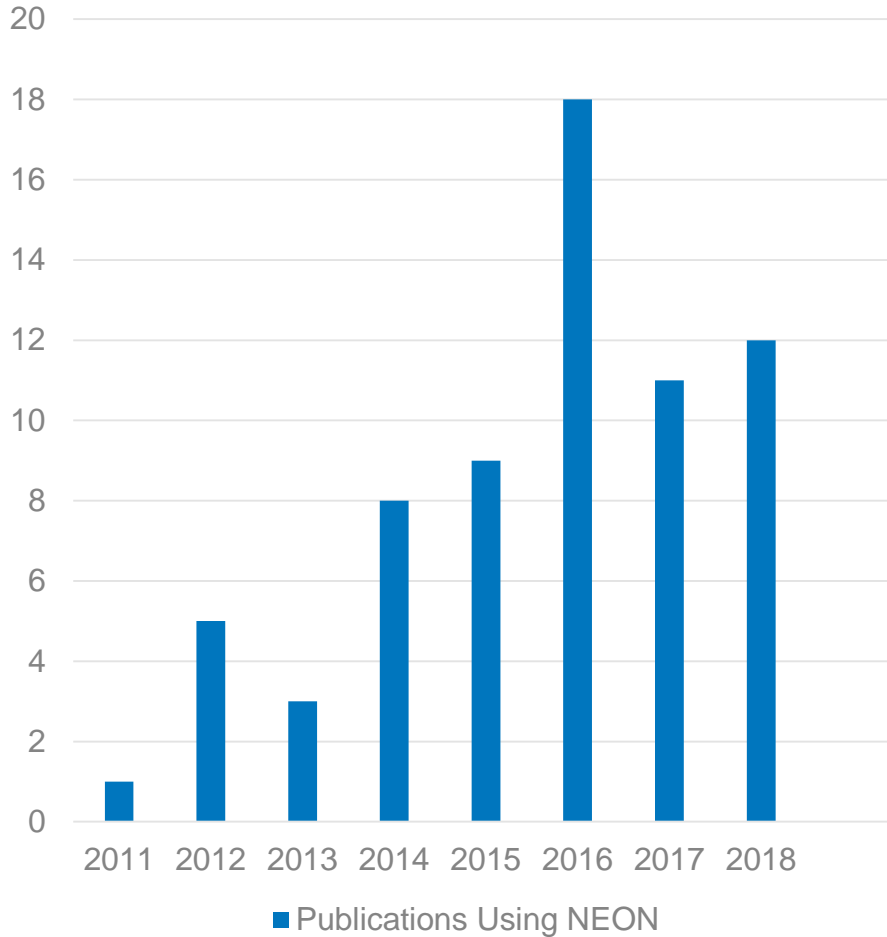
2017 Macrosystems Biology Awards

- **The future of US forest function under changing climate, disturbance, and forest management:** Christina Staudhammer, University of Alabama; Gregory Glass, University of Florida; Courtney Schultz, Colorado State University; Paul Stoy, Montana State University

- **Testing abiotic drivers of activity, abundance, and diversity of ground-dwelling arthropod communities at a continental scale:** Michael Kaspari, University of Oklahoma

- **Causes, consequences, and cross-scale linkages of climate-driven phenological mismatch across three trophic levels:** Morgan Tingley, University of Connecticut; Allen Hurlbert, University of North Carolina-Chapel Hill; Leslie Ries, Georgetown University

- **A multi-scale framework to quantify and forecast population changes and associated uncertainties:** Elise Zipkin, Michigan State University; Leslie Ries, Georgetown University

- **Linking thermal tolerance to invasion dynamics: Climate and physiological capacity as regulators of geographical spread:** Kristine Grayson, University of Richmond; Salvatore Agosta, Virginia Commonwealth University; Dylan Parry, State University of New York

- **Grassroots global network science: a macrosystems model:** Kathleen Weathers, Cary Institute of Ecosystem Studies

- **Improved Understanding of Feedbacks between Ecosystem Phenology and the Weather-Climate Nexus at Local-to-Continental Scales:** Andrew Richardson, Northern Arizona University; Steve Frolking, University of New Hampshire; Mark Friedl, Boston University; Toby Ault, Cornell University

- **Ecosystems in four dimensions: Measuring changes to forest structure and function in the Anthropocene:** Kyla Dahlin, Michigan State University

- **Leveraging NEON data to investigate remote sensing of biodiversity variables and scaling implications:** Jessica Mitchell, Appalachian State University

- **A macrosystems science training program: developing undergraduates' simulation modeling, distributed computing, and collaborative skills:** Cayelan Carey, Virginia Tech

Research Facilitation: How do you measure impact

Projects leveraging NEON data and infrastructure

https://sites.duke.edu/neon/

Jim Clark et al. - Ecological Forecasting

Carabid Dynamics: Increase in catch rates with latitude - Kaspari et al.
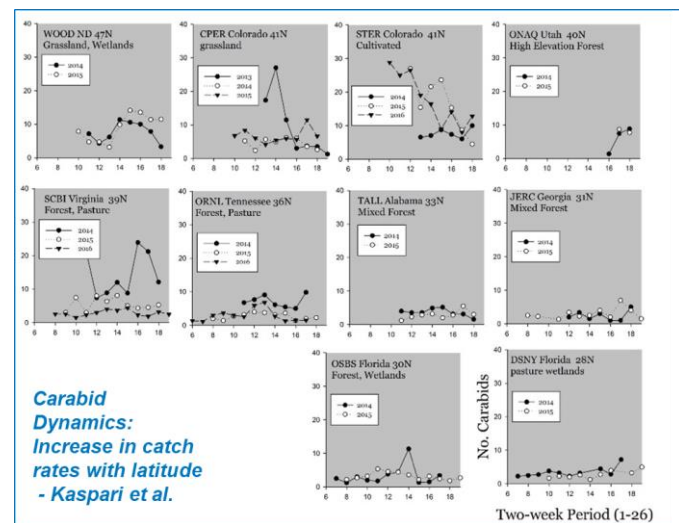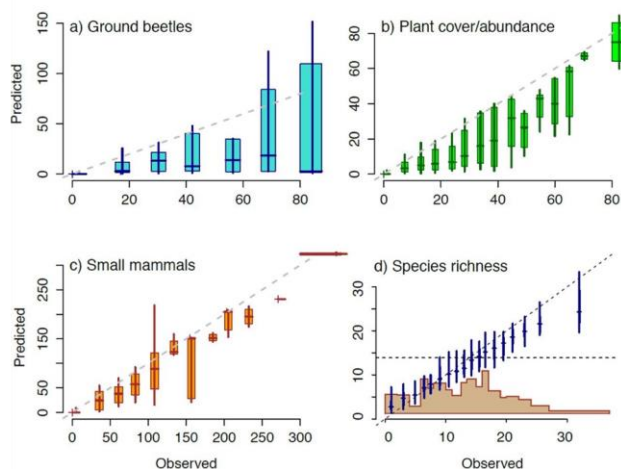
Read et al. 2018 - Among-species overlap in rodent body size distributions predicts species richness along a temperature gradient, Ecography
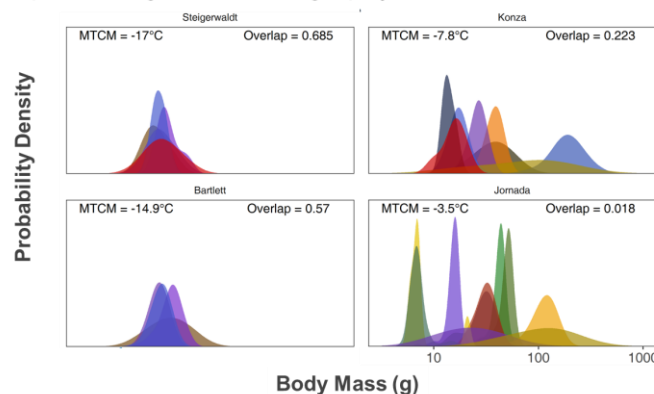
Digital Outreach Summary

Social Media

Medium	Total Followers at end of 2017	2017 Growth in Followers	2016 Growth in Followers	2015 Growth in Followers
Twitter	4044	11%	17%	29%
Facebook	2419	19.5%	25.4%	44%
LinkedIn	2472	7.9%	8.8%	No data

Stories on Web Site

Year	# of Stories Posted
2017	18
2016	37
2015	62

Tools for Collecting Metrics

- Google Suite of Tools

  ![Google logo]

  - Google Sheets

    − Online spreadsheet that can link directly to Data Studio

  - Google Analytics

    − Generates data on website usage and can link directly to Data Studio

  - Google Data Studio

    − turns analytics data from a suite of sources (e.g., YouTube, Facebook, gSheets) into informational, easy-to-understand reports through data visualization

- LimeSurvey

  ![LimeSurvey logo]

  - Open source survey platform

  - Online form for staff to enter data on engagement activities

Tools for Collecting Metrics

- Constant Contact
  - Email marketing platform
  - Analytics available for newsletters sent to stakeholders

- Twitter, Facebook, LinkedIn
  - Social media platforms
  - Analytics available for each platform

- Buffer
  - Platform that allows outreach team to schedule posts, analyze performance, and manage all social media accounts in one place
  - Analytics available across social media platforms

Citing NEON Data

- **Citation for <6 data products:** National Ecological Observatory Network. [YEAR OF DOWNLOAD]. Data Products: [DPID1, DPID2…DPIDN]. Provisional data downloaded from http://data.neonscience.org on [DOWNLOAD DATE]. Battelle, Boulder, CO, USA

- **Citation for >=6 data products:** National Ecological Observatory Network. [YEAR OF DOWNLOAD]. Provisional data downloaded from http://data.neonscience.org on [DOWNLOAD DATE]. Battelle, Boulder, CO, USA

- **Details**: https://www.neonscience.org/data/data-policies

Gaps in Collecting Metrics

- Tracking data downloads when user login not required

- Tracking data use before implementation of DOIs

- Tracking open code platform productivity of staff

  - GitHub does not capture these types of data so how do we capture engagement with open source community?

- Standardized metrics for NSF Large Facilities

  - Would allow for comparisons across facilities

  - Better understanding of what is working, what is not working, and why to support strategic decision making

NEON's impact: Testimonials

Dr. Kaitlin Stack Whitney
@KStackWhitney

Following

Replying to @naupakaz @NEON_sci @jessicablois

One of my students is using some @NEON_sci datasets this summer and we are AMAZED at the QC compared to other 'available' public data and metadata. Great to teach students what best practices look like

11:02 PM - 6 Jul 2018

"…in this time of rapid environmental change, the societal need and technological capacity for forecasting have never been greater…"

"Big data is driving many of the advances in ecological forecasting. Today ecologists have orders of magnitude more data compared to just a decade ago, thanks to sustained public funding for basic science and environmental monitoring. This investment has given us better sensors, satellites and organizations such as the National Ecological Observatory Network, which collects high-quality data from 81 field sites across the United States and Puerto Rico."

--*Michael Dietze, Boston University, Author of Ecological Forecasting*

"I have worked with small datasets but for someone with my background and experience [in statistical ecology], the data coming from NEON is basically a gold mine.

I have been intrigued by NEON since I found out about it almost a year ago but always felt intimidated by it. Attending the workshops is a great opportunity for me to get started with NEON and get involved with it."

--*Javiera Rudolph, NEON-ESA Early Career Scholar (2018)*

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NEON enables a broad user community to do more

thousands of
early data
users

hundreds of
scientists & educators
participating
in NEON workshops & online courses

dozens of **NEON-related**
research projects
funded by NSF

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