2018 NEON Community Engagement Assessment Report

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National Ecological Observatory Network (NEON) is a project sponsored by the National Science Foundation and proudly operated by Battelle.

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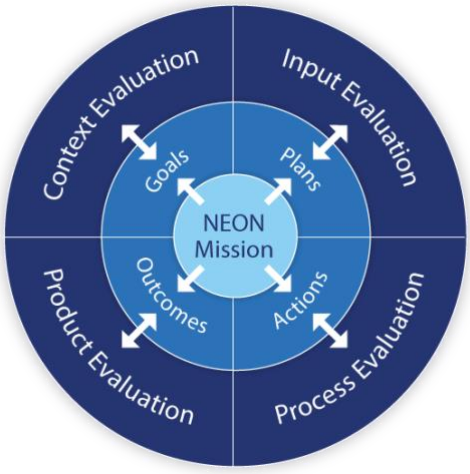
Introduction: NEON Engagement

The National Ecological Observatory Network (NEON) was established in 2006 as a continental-scale observatory designed to collect high-quality, standardized data from field sites across the United States. From the onset of the project, engagement with a variety of stakeholders was seen as crucial to the project's success. An external report published in 2004 states (American Institute of Biological Sciences 2004):

> *"To function effectively, NEON…should be accountable to and consider the needs of constituents. It can leverage the expertise and resources provided by legions of interacting scientists, government agencies, nongovernmental organizations, and the private sector to provide our nation with high-quality and accessible information concerning critical changes in the biological processes that sustain our quality of life."*

To ensure development of the project was community-driven, working groups as part of the Infrastructure for Biology at Regional to Continental Scales (National Research Council 2003) and the NEON Design Consortium guided development of the project prior to construction. Throughout project construction, NEON staff also relied upon input from 28 technical working groups (TWGs) of content experts that guided protocol development and implementation. TWGs continue to provide input on protocol modifications and data accessibility and usability as the project transitions into operations. The Science, Technology, and Education Advisory Committee (STEAC) now serves as an advisory body to the project providing strategic advice on the planning, construction, and operation of the project and other relevant programs. Its members, and those of the TWGs, act as liaisons between the project and the broader stakeholder community.

However, there has been a growing concern among the broader community that the project's engagement activities have been too limited to ensure the project's relevance and value as a community-owned resource. When Battelle took over management of the project in 2016, an article was published to outline a new engagement strategy for the project (Kuhlman et al. 2016). It was during this time that NEON decided to follow the Context, Input, Process, and Product (CIPP) model for evaluation to guide the evaluation process for its engagement activities (Stufflebeam 2003, Stufflebeam and Coryn 2014). This model uses a systems approach that identifies stakeholder needs (context evaluation), develops resources that meet those needs (input evaluation), makes iterative adjustments over time (process evaluation), and identifies the final intended and unintended outcomes (product evaluation; Zhang et al. 2011). As the project transitions from construction into operations, a context evaluation was conducted to guide strategic engagement initiatives that support the needs of the existing and potential NEON user community (Frye and Hemmer 2012). The findings from this evaluation provide the content for this report.



Modified from Stufflebeam & Coryn 2014

Data Sources

To gauge changes in community awareness and perceptions of the NEON project, a survey was distributed to the ecological community in winter 2017/2018 (N=929; Appendix A) as a follow up to a survey conducted by an external evaluation team in 2009 (N=2,458; Corona Insights 2010). For the 2018 survey, many of the questions remained the same as the 2009 survey to facilitate comparisons between years. Similarly, the analyses conducted divided respondents into four segments based on respondent awareness, knowledge, and interest in NEON (full methodology in Appendix B). A majority of the findings presented below focus on the data from the 2009 and 2018 surveys with insights derived from quantitative and qualitative data from several other data sources (detailed in Appendix C).

Segment
Engaged: interested, aware, and knowledgeable of NEON (N=574)
Keen: interested and aware but no knowledge (N=39)
Piqued: interested but not aware (N=101)
Uninterested: not interested regardless of awareness and knowledge (N=215)

- A 2016 survey of data users of NEON's Airborne Observation Platform (N=18)
- Participant feedback from a 2017 Optimizing NEON Science workshop (N=34)
- Interviews with NEON headquarters staff in 2017 (N=9)
- A survey sent to NEON domain staff in 2017 (managers, N=7; technicians, N=18)

Findings

Engaging Diverse Audiences

2018 Survey Demographics

- 32% aged 55+
- 24% in field for 30+ years
- 71% with doctorate
- 86% affiliated with research university
- 90% identified as white/caucasian

The demographics data for the 2009 and 2018 survey respondents were similar. Similarities in these datasets supported making direct comparisons between years but limited feedback from individuals with diverse affiliations. For example, 86% of respondents from both years were affiliated with large research universities. Additional efforts in 2018 to increase responses from individuals with different affiliations did not generate a greater response than in 2009 from sought after groups, including minority serving institutions (3%), natural resource agencies (9%), and the private sector (6%). Therefore, these findings and those from other data collection efforts within this report represent only a portion of the potential NEON user community.

The Optimizing NEON Science (ONS) workshop participants commented that NEON's potential user community has felt isolated from the work being done by the project due to a perceived lack of diverse community engagement and buy-in over time. This makes the project seem inaccessible to many who have not engaged or been asked to engage in the past including federal, state, and local natural resource managers as well as the private sector, non-profit organizations, and educators. Interviews with NEON staff also drew attention to the lack of

engagement with potential users outside of academic researchers, but this may have resulted from prioritizing the selection of individuals with specific expertise to serve as advisors during project construction instead of ensuring diverse membership. Affiliations of TWG members at the end of 2017 were less than 1% from state agencies, 1% from businesses, 1% from community colleges, 8% from non-profits, 11% from international organizations, 22% from federal agencies, and 56% from universities.

The demographic data collected from the 2018 stakeholder community survey further demonstrated a need to engage more directly with individuals affiliated with the private sector and researchers early in their career. These data, divided into segments, showed that *Uninterested* respondents were older and later in their career whereas, the *Keen* and *Piqued* segments were younger and at earlier stages in their careers.

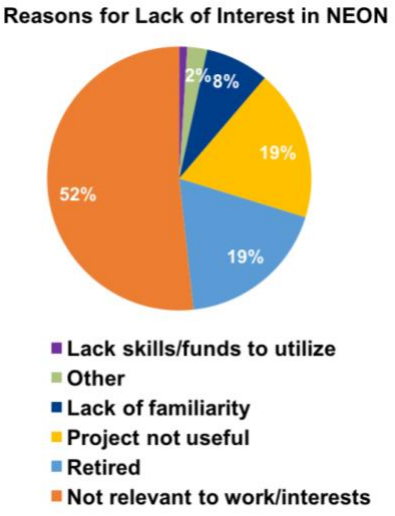
Of the 2018 *Piqued* respondents, 37% were graduate students/post docs and 13% were from the private sector.

A high percentage of respondents affiliated with private industry fell within the *Piqued* category, and it is unclear to what extent NEON has engaged with the private sector in the past due to a lack of documentation. Private companies were mentioned during staff interviews as a stakeholder group that could potentially provide services that were originally in NEON's scope prior to the project's 2015 descoping. A number of Airborne Observation Platform (AOP) data requests have come from private companies that plan to collect or are using similar data products. In some cases, these companies use NEON for data quality comparisons. The AOP team has also worked closely with data software companies like ESRI to design a web service to display the NEON data online and ENVI due to NEON's regular use of their software.

Awareness of, Knowledge of, and Interest in NEON

Awareness of NEON in both the 2009 and 2018 surveys was very high with only a slightly higher percentage of respondents aware of the project in 2018 (86%) compared to 2009 (81%). Most respondents who are aware of NEON have at least some knowledge of the project with the percentage of respondents "very knowledgeable" or "moderately knowledgeable" of NEON greater in 2018 (55%) than in 2009 (34%). This could be the result of the age of the project or the growth in communications related to the project over the nine-year time span. Among those responding to the survey, interest in using NEON was slightly stronger in 2009 (83% interested) than in 2018 (77% interested). The percentage of respondents stating they were "probably not interested" went from 15% in 2009 to 20% in 2018 and those stating they were "not at all interested" went from 1% in 2009 to 3% in 2018.

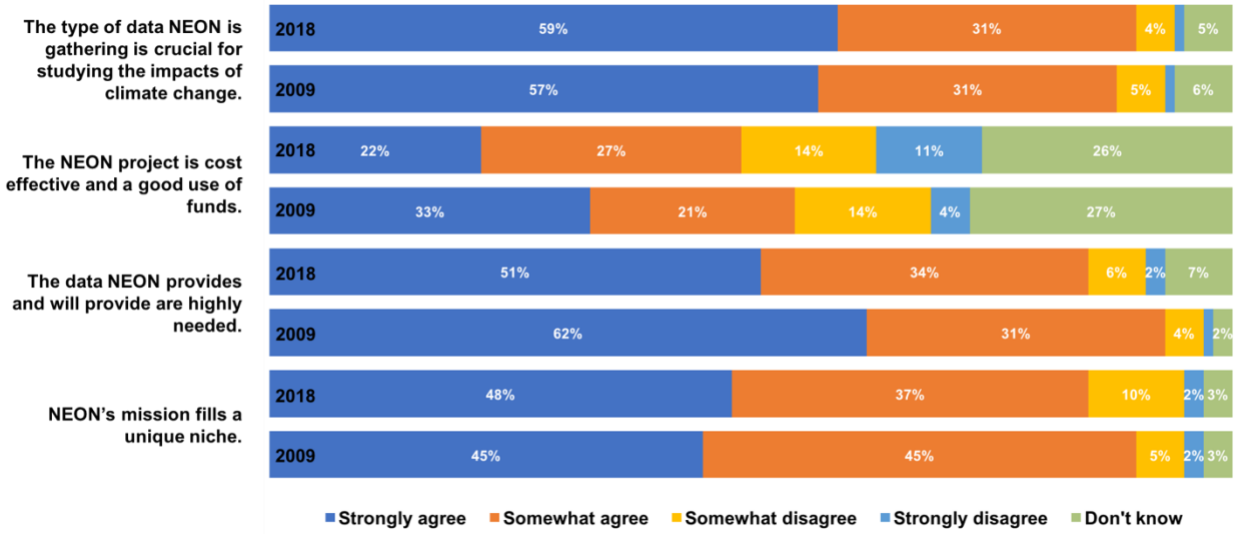
There were a variety of reasons provided for not having interest in the NEON project. Responses were similar to the 2009 survey where respondents most often cited retirement, no longer working in the field, or the project not being related to their work. Specifically, of the *Uninterested* respondents (N=215) to the 2018 survey, 19% cited retirement for their lack of interest while 52% indicated that the project could not be utilized for their research or within their field of work. These responses indicated that researchers with small-scale projects, working internationally, or working in marine, aquatic, or urban environments felt they could not use the



data or infrastructure provided by the project. Those stating that the project is not useful (19%) tended to have more negative perceptions of the project. A common complaint was that the project is redundant to other projects like the Long Term Ecological Research (LTER) and Ameriflux networks. This concern was reiterated in the comments section where, of those providing negative feedback (N=38), 8% cited redundancy to other networked science efforts. Respondents stating that the project was not useful also indicated issues they had with the design of the observatory, including data being collected prior to hypotheses being generated.

Perceptions of NEON

Engaged respondents in 2009 (N=1449) and 2018 (N=541) were asked to indicate how strongly they agreed or disagreed with a series of statements to gauge the community's perceptions of the NEON project. No real change was found in the percentage of respondents agreeing that NEON data will support understanding of the impacts of climate change, with 90% of respondents agreeing that these data are crucial for this type of research. However, there was a decline in those agreeing that the project is cost effective and a good use of funds (54% in 2009 to 49% in 2018). More significant, the percentage of respondents that disagreed with the statement grew from 4% to 10%. When asked to provide additional feedback or comments at the end of the survey, 39% of those providing negative comments (N=38) stated that they felt the project was a poor use of funding resources that were needed for other, more valuable projects in the ecological sciences.



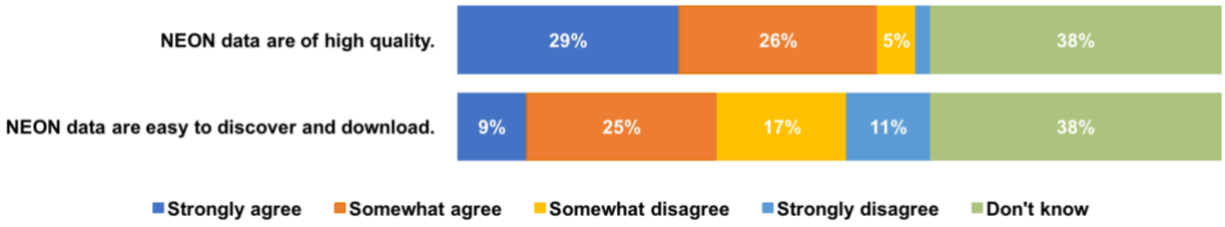
There was a decline in the percentage of respondents that agreed that the data provided by NEON are highly needed (93% in 2009 to 85% in 2018) and that the project fills a unique niche (90% in 2009 to 85% in 2018), but the responses show that a high percentage of respondents (85%) still find value in the project. These responses somewhat contradict concerns expressed by others that the project is redundant to other existing networks.

When requesting general feedback in the 2018 survey, we received 100 comments. Of those, 34% were positive and 28% were neutral. Of the 38 negative responses provided, in addition to the themes mentioned above, 18% of respondents cited the project not being collaborative and 11% cited the project not being responsive to community feedback.

Data Quality, Usability, and Accessibility

In 2017, ONS workshop participants commented that the quality of NEON data is a primary concern of the community, noting that no one will use the data if they are not of good quality or if there is a perception that they are not of good quality. Attendees felt procedures for data quality need to be made more transparent so the community can review the procedures and provide input when needed. Participants also mentioned another concern: data access. If there are delays in the delivery of data, the project needs to be transparent with its users by providing information on when to expect the data and providing updates as the data are processed.

Due to these concerns, two statements were added to the 2018 survey that were not included in the 2009 survey to get baseline feedback from *Engaged* respondents (N=541) on data quality and accessibility. Large percentages of respondents did not know if the data are of high quality (38%) or if they are easy to discover and download (38%). This indicates that many in the potential user community have not tried to access the data. Only 7% of survey respondents indicated that they felt NEON data were not of good quality but a greater percentage felt that NEON data are not easy to discover and download (28%). ONS workshop participants demonstrated similar concerns, noting that if data are too difficult to obtain or understand no one will use them.



The 2016 AOP survey revealed that some respondents encountered challenges with data usability, including the data being too large (30%), users not having the needed software (45%), having difficulties finding the metadata (30%), or having trouble processing the data (25%). No respondents had data quality issues with the spectral resolution of the data, but approximately 21% found issues with the quality of data for geolocation accuracy and spatial coverage/extent.

ONS workshop participants also noted that data produced by NEON should be interoperable with other networks, considering the data standards required of these different user communities. NEON staff are currently engaging with a number of networks to address this concern. For example, the Climate Reference Network wants to do collaborative research through co-location of sensors that facilitate data exchange and interoperability. The aquatic observation systems TWG includes representatives from the USGS and EPA. Both agencies have large national monitoring programs and NEON protocols were designed for data interoperability with these programs.

Communications and Transparency

Data from the community surveys demonstrated a lack of awareness in the number of NEON field sites (63% aware in 2018) and a decline in awareness related to the collection of aquatic data (81% in 2009; 70% in 2018). This lack of awareness could be related to aspects of the descoping. The number of field sites was reduced from 106 to 81 when some relocatable sites were removed and permitting issues arose. Removing the Steam Experimental Observation Network (STREON) aspect of the project also resulted in confusion within the community on which aspects of the aquatic data collection had been removed. Only 48% of respondents knew that Battelle currently manages and operates the NEON project.

69% of *Engaged* respondents were aware that NEON data are open access and freely accessible, while 96% felt that this fact would be helpful to them in their current position.

47% of *Engaged* respondents were aware that NEON will be collecting data over a period of 30 years.

These data tie to another concern for many attending the ONS workshop: a lack of communications that limited project transparency. Due to a lack of communication, attendees were unaware of specific changes that had occurred at NEON. For example, many in attendance were unaware a new STEAC had been assembled, who had been selected to serve, or what the process was for selection. The lack of awareness in the community of basic information about the project indicate that improvements in internal and external communications are needed.

To strategize future communications, we asked community survey respondents to select which methods they would like to learn about NEON. A large majority selected the NEON website (88%) and data portal (74%). Direct communications between NEON scientists and external scientists through conference attendance and publications were also ranked highly (62% and 61%, respectively); whereas, printed materials and an online discussion forum were the least likely strategies to engage participants (16% and 12%, respectively). Respondents also selected what type of information they would like to receive from NEON through these communication channels. Information related to data, including data product updates and data collection processes, were ranked the highest (>60% of respondents for each). Data skills training and other learning opportunities were next with 49% of respondents interested in obtaining information on those opportunities.

Role of Domain Staff in Engagement

ONS workshop participants noted that a general perception exists that NEON domain staff are siloed and not engaging locally. However, the level of community engagement with local stakeholders across NEON domains tends to vary greatly. Most domain staff acknowledged that engagement should be an important part of their work to increase awareness of the project in the region, noting that this would be the best way to get folks to use NEON's data and infrastructure. Domain staff provided multiple ideas on existing and new ways to engage locally with stakeholders that could be pursued as the project transitions into operations. Each domain

now offers a minimum of three engagement activities annually. When asked about priorities for communications, the domains reported signage and coordination of media requests as top priorities closely followed by coordination of community requests.

Next Steps

In 2017, Battelle conducted a search for a new Observatory Director and Chief Scientist. Dr. Sharon Collinge was selected to be the new lead for the NEON project. Dr. Collinge's initial priority with the project is to improve and strengthen NEON engagement with the scientific community. Based on the community and staff feedback summarized in this report, an Initial Operations NEON Strategic Engagement Plan will be released for comment and implementation in the second quarter of 2018. Additional data collection initiatives will also be implemented to ensure existing and potential users not well represented by the data in this report will be included in development of the plan.

References

American Institute of Biological Sciences. 2004. IBRCS White Paper: A Plan for Developing and Governing the National Ecological Observatory Network (NEON). AIBS, Washington, DC.

Choi, B. C. K., and A. W. P. Pak. 2005. A Catalog of Biases in Questionnaires. Preventing Chronic Disease **2**:A13.

Corona Insights. 2010. Stakeholder Study: National Ecological Observatory Network. Corona Insights.

Dillman, D. A. 2007. Mail and Internet Surveys: The Tailored Design Method. Second edition. John Wiley and Sons, Inc., Hoboken, NJ.

Frye, A. W., and P. A. Hemmer. 2012. Program evaluation models and related theories: AMEE Guide No. 67. Medical Teacher **34**:e288-e299.

Kuhlman, M. R., H. W. Loescher, R. Leonard, R. Farnsworth, T. E. Dawson, and E. F. Kelly. 2016. A New Engagement Model to Complete and Operate the National Ecological Observatory Network. The Bulletin of the Ecological Society of America **97**:283 - 287.

National Research Council. 2003. NEON: Addressing the Nation's Environmental Challenges. The National Academies Press, Washington, DC.

Stufflebeam, D. L. 2003. The CIPP model for evaluation.*in* D. L. Stufflebeam and T. Kellaghan, editors. The international handbook of education evaluation. Kluwer Academic Publishers, Boston, MA.

Stufflebeam, D. L., and C. L. S. Coryn. 2014. Evaluation Theory, Models, and Applications. Jossey-Bass, San Francisco.

Zhang, G., N. Zeller, R. Griffith, D. Metcalf, J. Williams, C. Shea, and K. Misulis. 2011. Using the Context, Input, Process, and Product Evaluation Model (CIPP) as a Comprehensive Framework to Guide the Planning, Implmentation, and Assessment of Service-learning Programs. Journal of Higher Education Outreach and Engagement **15**:57-84.

Appendix A: 2018 Community Engagement Survey

2017 Corona Insights Follow Up Survey
The National Ecological Observatory Network (NEON)

Thank you for taking a few moments to answer our questions.

Below is a brief overview of the National Ecological Observatory Network (NEON).

NEON, funded by the National Science Foundation, is designed to collect and provide open data that characterize and quantify complex, rapidly changing ecological processes across the United States. The comprehensive data, spatial extent and remote sensing technology provided by NEON will enable a large and diverse user community to tackle new questions at scales not accessible to previous generations of ecologists.

We, as a followup to a survey of the community conducted in 2010, are gathering feedback from our stakeholder community to better understand its needs to optimize use of the Observatory as it transitions from construction to initial operations. Again, even if you have little or no awareness of NEON, your input is valuable.

The following survey averages 5-7 minutes to complete. In exchange, *following submission of the survey*, interested participants will have the opportunity to provide us with an email address to be entered into a drawing to win one of five $25 gift cards.

All responses are completely anonymous, and you will never be linked to your responses.

A report from this effort will be developed and shared with NEON stakeholders, and the information will be used in its strategic planning process.

AWARENESS & OPINIONS

1. Prior to this survey, had you heard of NEON (National Ecological Observatory Network)?
- ❍ Yes
- ❍ No
- ❍ Don't Know

2. Overall, how knowledgeable about NEON would you consider yourself? [If YES on #1]
- ❍ Very knowledgeable
- ❍ Moderately knowledgeable
- ❍ Slightly knowledgeable
- ❍ Not at all knowledgeable

In the introduction to this survey, we stated that NEON collects and provides open data that characterize and quantify complex, rapidly changing ecological processes across the United States. The comprehensive data, spatial extent and remote sensing technology provided by NEON will enable a large and diverse user community to tackle new questions at scales not accessible to previous generations of ecologists.

3. Are you currently interested in utilizing NEON's resources/data?
- ❍ Absolutely
- ❍ Probably
- ❍ Probably not

❍ Not at all

[If not interested, “probably not” or “not at all” above, skip to “about you” section] Why are you not interested in NEON's resources or data?

_____

[If interested, “absolutely” or “probably” above] What aspects are you most interested in related to NEON's resources or data?

_____

[If yes on #1 / “very, moderately, or slightly knowledgeable” on #2 / and “absolutely” or “probably” on #3, continue below]
[If yes on #1 / “not at all knowledgeable” on #2 / and “absolutely” or “probably” on #3, skip to communications section]
[If “no” or “don’t know” on #1 and “absolutely” or “probably” on #3, skip to communications section]

For what purposes would you like to use NEON data? Check all that apply.
❑ Research
❑ Education/Teaching
❑ Management
❑ Policy/Decision Making
❑ Other _____

We would like to know more about how NEON can best meet your needs as an existing or potential stakeholder. Please provide us with any additional information that would help us better support you and/or information on how you would like to use the Observatory.

_____

ABOUT YOU
Almost complete! We just have a few more questions about you for reporting purposes. These questions are completely optional and are used to ensure that we have heard from a variety of people. Responses here are only reported in aggregate and are anonymous.

What is your age?
❍ Enter age _____

In what state do you reside? If you are not from the US, please select "I do not reside in the United States" (last option).

What is your primary area of expertise?
❍ Botany
❍ Conservation/restoration ecology
❍ Ecosystem ecology
❍ Education and outreach
❍ Evolution/evolutionary ecology
❍ Landscape ecology/biogeography

- ❍ Microbiology
- ❍ Physiological ecology
- ❍ Population/community ecology
- ❍ Wildlife biology
- ❍ Zoology
- ❍ Other: *Please specify* _____

What is your affiliation? *Please check all that apply.*

- ❑ University/College Student/Post Doc
- ❑ University/College Faculty
- ❑ University/College Researcher
- ❑ University/College Administrator
- ❑ State Agency/Federal Agency/Laboratory Researcher
- ❑ State Agency/Federal Agency/Laboratory Manager
- ❑ State Agency/Federal Agency/Laboratory Technician
- ❑ Non-profit
- ❑ Private industry
- ❑ Education (non university/college)
- ❑ Informal Science Institution (Museum, Science or Nature Center)
- ❑ Other: *Please specify* _____

How would you best describe your institution? *Please check all that apply.*

- ❑ Research University (including graduate programs)
- ❑ Four-year College (undergraduate programs only)
- ❑ Community College
- ❑ Minority Serving Institutions (MSI) (including Historically Black Colleges and Universities, Tribal Colleges, and Hispanic Universities)
- ❑ Other: *Please specify* _____

How long have you been employed in your current field of work? Please note this is not necessarily employment at your current organization.

- ❍ Number of years _____

Which ethnic or cultural group are you a member of? *You can pick more than one.*

- ❑ Anglo/white/Caucasian
- ❑ Hispanic/Latino/Chicano
- ❑ African American/black
- ❑ American Indian/Native American
- ❑ Asian/Pacific Islander
- ❑ Multi-racial
- ❑ Other: *Please specify* _____

ADDITIONAL COMMENTS

If you have additional comments for feedback, please provide them below.

_____

Please indicate how strongly you agree or disagree with each of the following statements regarding NEON.

	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree	Don't Know
NEON's mission fills a unique niche.	❍	❍	❍	❍	❍
The data NEON provides and will provide are highly needed.	❍	❍	❍	❍	❍
The NEON project is cost effective and a good use of funds.	❍	❍	❍	❍	❍
The type of data NEON is gathering is crucial for studying the impacts of climate change.	❍	❍	❍	❍	❍
NEON data are easy to discover and download.	❍	❍	❍	❍	❍
NEON data are of high quality.	❍	❍	❍	❍	❍
NEON will transform the way ecologists can do science.	❍	❍	❍	❍	❍
NEON is a trusted and relevant resource for research.	❍	❍	❍	❍	❍

Each of the following statements about NEON is a fact. Please indicate if you were aware of each of the following fact(s) about NEON *prior to* taking this survey by checking the box next to the statement.

- ❑ The NEON project collects ecological and climatic observations from 81 sites across the United States, including Alaska, Hawaii and Puerto Rico.
- ❑ NEON has partitioned the US into 20 ecoclimatic domains, each of which represents different regions of vegetation, landforms, climate, and ecosystem function, to sample continental-scale environmental change.
- ❑ NEON collects data about climate and the atmosphere.
- ❑ NEON collects data about soils.

- ❑ NEON collects data about a variety of organisms.
- ❑ The NEON project will collect data over a period of 30 years.
- ❑ NEON is currently managed and operated by Battelle.
- ❑ The NEON project is funded by the National Science Foundation (NSF).
- ❑ NEON data are open access and freely available from the NEON data portal and via API.
- ❑ NEON collects data about streams, rivers, and lakes.
- ❑ NEON collects airborne remote sensing data from NEON field sites.
- ❑ NEON samples and specimens will be archived for use by researchers.

How helpful will each of the following attributes be to you in your current position?

	Very helpful	Moderately helpful	Slightly helpful	Not at all helpful	Don't know/ Unsure
The NEON project collects ecological and climatic observations from 81 sites across the United States.	❍	❍	❍	❍	❍
NEON has partitioned the US into 20 ecoclimatic domains to sample continental-scale environmental change.	❍	❍	❍	❍	❍
NEON collects data about climate and the atmosphere.	❍	❍	❍	❍	❍
NEON collects data about soils.	❍	❍	❍	❍	❍
NEON collects data about a variety of organisms.	❍	❍	❍	❍	❍
The NEON project will collect data over a period of 30 years.	❍	❍	❍	❍	❍
NEON data are open access and freely available from the	❍	❍	❍	❍	❍

NEON data portal and via API. NEON collects data about streams, rivers, and lakes. NEON collects remote sensing data over NEON field sites.	❍ ❍	❍ ❍	❍ ❍	❍ ❍	❍ ❍
NEON samples and specimens will be archived for use by researchers.	❍	❍	❍	❍	❍

COMMUNITY ENGAGEMENT
Next, we would like to learn about how you prefer to stay informed.

Through which of the following method(s) would you like to learn about NEON? *Please check all that apply.*

- ❑ NEON's website (neonscience.org)
- ❑ NEON's data portal (data.neonscience.org)
- ❑ Through my university, agency, or organization
- ❑ NEON's social media presence (e.g., Twitter, Facebook, LinkedIn)
- ❑ NEON project staff talks
- ❑ NEON's presence at conferences or workshops
- ❑ Printed material, such as brochures or booklets
- ❑ Reading online blogs
- ❑ Through my professional society
- ❑ eNewsletter
- ❑ Personal communications with staff
- ❑ Articles in scientific journals
- ❑ An organized visit by NEON scientists to my organization
- ❑ Webinars
- ❑ Online community discussion forum
- ❑ Other: *Please specify* _____

Please rank the following methods from most useful to least useful by dragging and dropping them in the appropriate order, with "1" or the first method listed indicating the most useful source of engagement.

_____ NEON's website (neonscience.org)
_____ NEON's data portal (data.neonscience.org)
_____ Through my university, agency, or organization
_____ NEON's social media presence (e.g., Twitter, Facebook, LinkedIn)

_____ NEON project staff talks
_____ NEON's presence at conferences or workshops
_____ Printed material, such as brochures or booklets
_____ Reading online blogs
_____ Through my professional society
_____ eNewsletter
_____ Personal communications with staff
_____ Articles in scientific journals
_____ An organized visit by NEON scientists to my organization
_____ Webinars
_____ Online community discussion forum
_____ Other: *Please specify*

What information do you want to receive from NEON? Please check all that apply.

- ❑ NEON-related publications
- ❑ Data product updates (e.g., types available, sites where available)
- ❑ Archival samples
- ❑ Career opportunities
- ❑ Data collection (protocols and design)
- ❑ Information about specific field sites
- ❑ Data skills training or other learning opportunities
- ❑ Upcoming NEON-related events
- ❑ Use cases (i.e., how NEON data are being used)
- ❑ How to contact people at NEON to answer my questions
- ❑ How to access field sites or utilize field site infrastructure
- ❑ How to request use of Assignable Assets (e.g., mobile deployment platform, remote sensing flights)
- ❑ How to participate in NEON advisory activities
- ❑ Other: *Please specify* _____

2017 Corona Insights Follow Up Survey with Personal Information

The following questions are completely optional and are not connected to your previous responses. Therefore, if you do choose to provide your personal information below, your previous responses will still remain completely anonymous. If you are not interested in providing your information, please leave the fields blank and click next below to exit.

If you would like to be entered into the drawing to win a $25 gift card, please provide your email address. Your contact information will be deleted from our records following selection of the gift card recipients.

- ❍ Email _____

NEON's internal evaluator may be performing additional follow-up research with a selected sample of respondents. If you are interested in participating in the follow-up research, please provide your preferred contact information below for contact by the evaluator. Your responses will remain completely confidential and, if selected, you will be compensated for additional involvement in the study. **This is completely voluntary and your information will be kept confidential.**

- ❍ Name _____

- Email _____
- Phone _____

Appendix B: 2018 Community Survey Methodology

The 2018 community survey was a follow up to the 2009 Corona Insights survey (Corona Insights 2010). The original survey instrument was developed via collaboration of staff from Corona Insights and NEON and examined awareness, knowledge of, and perceptions of NEON in addition to the most effective communication strategies for reaching its potential user base (Corona Insights 2010). To facilitate comparisons across years, many of the questions remained the same with slight modifications to align with current and planned activities. Survey logic remained consistent and response choices were randomly presented to negate first-answer bias (Choi and Pak 2005).

Distribution methods varied between the two years. In 2009, the project obtained membership information (i.e., names, emails) from the Ecological Society of America (ESA) and the American Institute of Biological Sciences (AIBS). Membership information allowed customized emails to be sent to members and reminder emails to be sent directly to only those members that did not respond. In 2018, this membership information could not be shared. Instead, several approaches for reaching the existing and potential NEON user community were employed. This included two emails sent by ESA to all members, direct emails to targeted groups to ensure a diversity of responses (e.g., minority serving institutions, community colleges, natural resource managers), targeted social media campaigns, and partner organization newsletter requests. The survey was opened in Qualtrics on December 1, 2017 and remained open until February 19, 2018.

A financial incentive for completion of the survey was provided in both years. To prevent multiple entries, the 2009 survey distribution required a username and password. In 2018, the "prevent ballot box stuffing" feature in Qualtrics was activated to control for duplicate responses. A linked, supplemental survey allowed respondents to anonymously respond to the first survey but provide us with personal contact information if they wanted to be entered into the drawing for the incentive or were willing to participate in a future interview or focus group (Appendix A).

As in the 2009 survey, we conducted analyses using four segments based on respondent awareness, knowledge, and interest in NEON. The first set of questions in the survey classified respondents into each of these segments and each segment was shown questions based on the survey logic.

Segment	Aware?	Knowledgeable?	Interested?
Engaged: *interested, aware, and knowledgeable*	Yes	Slightly, Moderate, or Very knowledgeable	Absolutely or Probably
Keen: *interested and aware but no knowledge*	Yes	Not at all knowledgeable	Absolutely or Probably
Piqued: *interested but not aware*	No or Don't know	N/A	Absolutely or Probably
Uninterested: *not interested regardless of awareness and knowledge*	Yes, No, or Don't Know	Any level of knowledge	Probably not or Not at all

Appendix C: Detailed Findings from Additional Data Sources

AOP Data User's Survey, 2016

In January 2016, NEON staff supporting the airborne observation platform (AOP) sent a survey out to 82 AOP data users. Eighteen responded to the survey, a 22.5% response rate. Most respondents heard about the availability of the AOP data from a colleague (70%) but also through the NEON website (40%) and NEON staff attending conferences (30%).

Survey data showed that discrete return LiDAR point cloud data were the most likely to be used by respondents; whereas, water indices were the least likely to be used. Some respondents encountered challenges with the data, including the data being too large (30%), not having the needed software (45%), difficulties finding the metadata (30%), or trouble processing the data (25%). Some respondents complained about the length of time it took for them to receive their data, over three months in one case, as data were delivered by hard drives loaded with requested data at NEON headquarters and then shipped to the requestor. Many respondents wanted to see the data provided electronically to make it faster to acquire. Most respondents indicated that they had sought some technical support for obtaining and using these data.

Once data were obtained, more than 92% of respondents considered the data to have sufficient spatial resolution, LiDAR point density, and accuracy of surface reflectance. No respondents had data quality issues with the spectral resolution data, but approximately 21% found issues with the quality of data for geolocation accuracy and spatial coverage/extent.

Extending AOP data collection based on need was also mentioned. One respondent noted the importance of NEON taking flights over areas experiencing large scale, dramatic ecological events like the California drought. Workshops could be offered to continue to get feedback from the community and to provide skills training on the acquisition and processing of AOP data. Many respondents noted their interest in attending such a workshop.

Optimizing NEON Science Workshop, 2017

In February 2017, a three-day workshop was held at NEON headquarters with 34 national and international participants. From this meeting, several issues associated with engagement emerged.

Lack of Communications and Transparency. A primary concern for many attending the workshop was a lack of communications and project transparency. Attendees were unaware of specific changes that had occurred at NEON due to a lack of communication. For example, many in attendance were unaware the Science Technology and Advisory Committee (STEAC) had been assembled and who had been selected to serve on the committee. In this case, it was suggested that the NEON website provide complete transparency by providing the selection process and listing of members for all advisory groups as well as bylaws. NEON's website could also provide key updates on the status of the observatory, any major changes that have occurred, and why those changes needed to happen. Transparency needs to include changes that have occurred over time with sufficient information on who made these decisions and a justification. Notes from all advisory meetings should be posted to the website along with decisions made by those groups. Because NEON had become more central to Macrosystems funding, making all this information public would make it more efficient for the community to write proposals. Attendees showed a general concern that many decisions being made about the project had not included broader community members and that the ecological community was not aware of them.

Domain Staff Siloed. Some attendees felt that NEON field ecologists and domain staff are siloed and not engaging locally. There are some perceptions that engagement at NEON field sites only occurs with site owners and that local domain staff are not allowed to communicate directly with neighboring scientists. To improve these perceptions, the group recommended local scientific communities be included on a domain specific email list to facilitate communications. Additional recommendations included adding graduate students to the NEON budget as domain science staff for training and data collection. With limited budgets at universities, this would reduce pressure on funding for these students and build community relationships. Such cooperation would also increase budget efficiency for NEON and its partners. There could also be NEON domain committees that host town hall meetings open to anyone interested to maintain continuous feedback and collaboration.

Data Quality. Concern existed regarding the quality of data being produced by NEON, with attendees noting that no one will use the data if they are not of good quality. One participant noted a data product that provided nine significant figures for some datasheet rows but not others. These types of issues create skepticism among data users. Due to this, attendees felt procedures for data quality need to be made more transparent so the community can review them and provide input. For data quality checks, solutions included comparing data collected by NEON with other data that already exist. Technical working groups (TWGs) could also review data for each data product group or go out in the field with techs for better oversight of their work. For example, Konza Prairie has expert field techs that could be used to collect data at the NEON site. In addition, it was noted that a museum consortium could more efficiently manage bioarchive work due to their extensive experience.

Data Delivery. Another concern included data products not being delivered in a timely manner. Attendees stated that the reasons for delays in data delivery needed to be transparent to potential users along with information on when to expect the data. This is especially important for researchers dependent on data for a funded grant with specific deliverables and due dates. Data should be readily available and usable to support development of research proposals.

NEON Management. Moving forward, attendees wanted NEON management to recognize the need for more efficient operations (as opposed to addressing new research questions) in light of project budget cuts. A specific example was provided on a lack of efficiency: beetle specimens had been sent to a museum improperly pinned and those specimens had to be re-pinned at the museum. It would be more efficient to have museums do that work from the beginning. Additional feedback included changing the structure of the project in operations to be more flexible and allow adaptability to advances in technology and informatics. Science, not politics, should drive decisions being made. Some felt the NSF-led change in management of the project from NEON, Inc. to Battelle had been divisive and not transparent, eroding further support in the community.

Data Interoperability. There was some concern that NEON data are too difficult to obtain and understand so that no one will use them. Data produced by NEON should easily flow into modeling schemes with consistent references to ensure interoperability. DataOne currently has an MOU with Battelle, but the data they have received to date have been limited and not updated regularly. NEON, DataONE, and other similar programs need to work together to create a working consortium of data providers on interoperability. In addition, field measurements could be coordinated across field crews with these various programs to provide value added to NEON field measurements.

Relevancy of NEON to Broader Community. Due to the perceived lack of diverse community engagement and buy-in over time, attendees felt NEON's potential user community has felt isolated from the work being done by the project. This makes the project seem inaccessible to many who have not engaged or been asked to engage in the past. This includes federal, state, and local natural resource managers as well as the private sector, non-profit organizations, and educators. Similarly, attendees felt data standards required of these different user communities have been largely ignored. There is also a perception among some that NEON is taking money away from other grant opportunities, draining limited resources for scientists entering the field of ecology. Recommendations in this area included developing a better understanding of how NEON can contribute to other programs. NEON could interact with AmeriFlux when flying AOP over co-located sites. NEON could offer sensor calibration services to community at more reasonable price than other providers. Extra sensors could also be offered to the community when they are not being used. NEON could be made more visible to the community by offering graduate students the use of facilities or provide at-cost services for their research. The role of the TWGs for engaging with the broader community should be revisited.

In addition to the above highlighted concerns, attendees also provided some specific recommendations to NSF. They felt that the agency could play a role in sending important press releases out regarding the NEON project such as the selection of the STEAC. NSF also has a communication working group that could play a valuable role in NEON's communications with the broader community. NSF could provide cross cutting programs that fund graduate students as part of NEON with specific calls, fellowships, and postdoctoral opportunities.

Kuhlman et al. 2016

Battelle and NEON leadership published *A New Engagement Model to Complete and Operate the National Ecological Observatory Network* outlining a new engagement strategy for NEON in operations (Kuhlman et al. 2016). Success in engagement was defined as how well the community uses NEON data and to the extent use of that data advances continental-scale macrosystems ecology. This publication acknowledged NEON's lack of engagement during the construction phase of the project and hoped that new management during the transition into operations will change that direction (Kuhlman et al. 2016). The roles of the STEAC and TWGs were noted as being repurposed from previous years. The STEAC is to be positioned to advise on the transition to operations and the need to more broadly engage with stakeholder communities and ensure advisory input reaches its target. TWGs are to provide additional input from the community to inform operations. As part of construction, many instruments were designed to minimize operational costs but observational field work requires the same effort as needed during construction. The authors proposed that some of these efforts could be led by local universities to help educate graduate students while providing direct NEON services (Kuhlman et al. 2016). Science staff on the NEON project would continue participating in conferences, workshops and advisory boards. In addition, the authors stated plans to continue education programs like the undergraduate internship and citizen science programs while expanding to include postdoctoral and visiting scientist positions. However, since publication, the undergraduate internship and citizen science programs have been cut from the operations budget. Assignable Assets (i.e., externally funded instrumentation or sampling to support PI-driven research) offered by the program also hold promise to offer opportunities for researchers to engage directly with the project to support their research needs.

Interviews with NEON Headquarters Staff, 2017

A series of interviews (n=9) were conducted with NEON staff in 2017 to get feedback on audiences in which NEON should engage, ways staff currently engage, and opportunities to facilitate engagement moving forward.

Audiences to engage. Staff interviewed noted that engagement by NEON staff has previously focused on academic researchers and that engagement efforts should try to broaden this focus. When asked about additional audiences that NEON should engage, private companies were mentioned as a group that could potentially provide services that were originally in NEON's scope prior to the project's 2015 descoping. In the area of aquatics, engaging regulatory agencies and others involved in water quality issues (e.g., health departments, EPA, state water quality agencies) could be beneficial. Farmers and ranchers may also be interested in field sites that have intensely monitored data that can be useful in understanding water usage and availability. Staff proposed reaching out to the leadership of natural resource agencies and others doing more applied research and recommended more outreach with the geography and GIS communities. Geographers and GIS technicians are big consumers of data and, similar to applied researchers, would approach the use of NEON data differently than most ecologists do. It is important to note that, throughout these discussions, some staff interviewed felt that engagement with certain communities will likely not occur (nor should it occur) until data become more widely available through the data portal.

Ways staff currently engage. A primary way NEON staff support engagement is information dissemination provided on the NEON website and through its social media channels (e.g., Facebook, Twitter, LinkedIn). Additionally, staff members engage in direct engagement through presentations at conferences (e.g., ESA, AGU, Society for Freshwater Science, Limnology and Oceanography), tours of field sites, and presentations to local partners and research communities.

NEON staff are also engaging with other networks such as the International Long Term Ecological Research (ILTER) group and Climate Reference Network (CRN). For example, CRN wants to do collaborative research through co-location of sensors that facilitate data exchange and interoperability. The AOP team has significantly engaged with the remote sensing community and has worked extensively with ESRI to design a web service to display the NEON data online. AOP has also worked with ENVI because of NEON's regular use of their software products. Additional types of engagement include tutorials and training workshops that teach data skills for working with NEON data.

NEON staff also engage with the community via TWGs and other advisory groups. The level of engagement is dependent on the TWG, but during construction, many members supported protocol development and were contacted as questions arose. The AOS TWG membership, for example, includes representatives from federal agencies such as the EPA and the USGS. Both agencies have large national monitoring programs and NEON protocols were designed for data interoperability with these programs. More recently, groups have been re-engaged on how to modify protocols under existing funding constraints. Moving forward, communications with TWGs could shift from solely obtaining input to providing them with information about the project's status to share with the larger community.

Ways to improve engagement. Interviewees provided multiple ideas on ways to improve engagement as the project transitions into operations. Some science staff noted that it can be difficult to be proactive with communications because of their schedules. Established roles for all staff to engage with the community would be beneficial. It was also suggested that engagement activities be designed for the audience being targeted. For example, those

developed for scientists need to be more detailed and should be created to address research on specific themes. This will provide specific examples of how these groups can use NEON data for their specific purposes without needing to wade through all the data available through the data portal. As with other resources, NEON staff and external partners will need to be notified when these resources are finalized and where they can be found.

The communications team will also need to note current misconceptions about the project when identified through feedback mechanisms and address those continuously in external communications. For example, NEON had a STREON TWG before the program was descoped. Many in the community not part of the TWG assumed the entire aquatics program was cut. Getting word out to the community on what aquatics data products are still viable will be important moving forward.

For direct engagement with the scientific community, staff felt it is less effective to have information booths at conferences than for NEON scientists to have direct in-person communications with other scientists. Related, some NEON domains require more in-person engagement than others due to the nature of the research community at those sites. Therefore, engagement strategies need to be receptive of differences in engagement needs across domains.

Staff also provided methods of engagement with specific audiences. It was noted that NEON could potentially support sensor calibration for external groups as needed. Specifically, NEON could serve as a backup calibration facility for NASA's AERONET (Aerosol Robotic Network) program. Additional efforts need to be made to inform ecologists of the remote sensing data available through NEON. Twitter could be an effective communication tool by providing real time information on where the plane is currently located and the data it is collecting. Stories on the website could also provide information on the data products that are going out.

Staff and external advisors stated that NEON data can be too difficult for most end users to work with in its delivered format. Data processing will be important to support as the project moves into operations. Data skills training offered through NEON will ensure users can adequately access, process, and analyze the data. Staff could also support such efforts by developing a review process for external submission of code that could be utilized by the user community for data processing and analysis.

NEON Domain Staff Feedback, 2017

A NEON domain communications support survey was sent out to domain staff in February 2017 with responses from domain managers (N=7) and full-time field technicians (N=18). When asked if domain staff would be interested in pitching stories to local media organizations, 56% responded that they while 24% said they would not be willing to do this. Ninety-two percent would be interested in contributing content and images to the NEON website. When asked about priorities for communications, the NEON domain staff reported signage and coordination of media requests as top priorities closely followed by coordination of community requests.

When the survey was conducted, domain staff's level of community engagement with local stakeholders varied greatly. There seemed to be some confusion as to what engagement activities could be done as part of a typical work schedule and what was expected of domain staff to do on their own time. NEON leadership should develop objectives and guidelines for all staff around engagement so they know how much time and resources to allocate. Doing most

engagement activities outside of the busy field season may help balance the demands of field work with those of engaging directly with the local community.

Most domain staff acknowledged that engagement should be an important part of their work to increase awareness of the project in the region, with one person noting that this would be the best way to get folks to use the data. Domain staff provided multiple ideas for ways to engage locally with stakeholders: site tours for multiple audiences including school groups; “open house” events showcasing lab facilities and operations; proper signage to describe each site to visitors; visit local universities to give presentations and recruit staff; provide a yearly progress report to site hosts; attend local meetings; support a kids’ science day; contact local media to make them aware of the project; and create domain specific social media, like an Instagram account, to share local site images. Staff need to be encouraged and empowered to do these types of engagement activities locally. This can be supported by improving communication tools that not only supply the “what” but also the “why.” Domains that have attended local conferences to meet local scientists have been received positively but other noted that their requests to attend these types of events have been denied due to budget constraints.

Appendix D: Detailed Findings from 2018 Community Survey

We received a total of 929 survey responses in 2018, approximately two-thirds fewer than we received in 2009. Differences in distribution method likely resulted in a lower number of survey responses (2,485 in 2009 versus 929 in 2018) based on what we know regarding best practices for survey distribution (Dillman 2007). In addition, a response rate could not be calculated in 2018 due to the method for distributing the survey (the 2009 response rate was 22%). However, the proportion of respondents within each of the analyses segments were similar (Table 1).

Table 1. Number and percentage of respondents within each segment category for 2009 and 2018.

Segment	# of Respondents (2009)	Proportion of Respondents (2009)	# of Respondents (2018)	Proportion of Respondents (2018)
Engaged	1,449	58%	574	62%
Keen	242	10%	39	4%
Piqued	381	15%	101	11%
Uninterested	413	17%	215	23%

Demographics of Respondents

The demographics data between the 2009 and 2018 survey respondents were also similar (Table 2). The similarities in demographics across years support direct comparisons between years even though the number of responses was considerably lower in 2018 than in 2009. It is important to note that additional efforts to increase responses from individuals not affiliated with large research universities in 2018 did not generate additional feedback from targeted groups (Table 2). This included individuals affiliated with minority serving institutions, natural resource agencies, and the private sector. Therefore, these findings only represent a small portion of the potential NEON user community.

Table 2. Percentage of respondents within each demographic category for 2009 and 2018. Percentage of respondents for ethnic and cultural groups is above 100% due to multiple respondents choosing more than one category.

Demographic	Category	2009	2018
Age	18-24	3%	5%
	25-34	26%	22%
	35-44	24%	23%
	45-54	21%	18%
	55-64	19%	19%
	65+	7%	13%
Education	Some college, no degree	1%	N/A
	Associate's Degree	0%	N/A
	Bachelor's Degree	9%	N/A
	Masters or Professional Degree	19%	N/A
	Doctorate	71%	N/A
Ethnic or Cultural Group	Anglo / White / Caucasian	87%	90%
	Hispanic / Latino / Chicano	6%	5%
	African American / Black	1%	1%
	American Indian / Native American	1%	1%
	Asian / Pacific Islander	5%	4%

	Multi-racial	1%	2%
	Other	2%	1%
Time in Field	0 Years	1%	1%
	1-4 Years	18%	17%
	5-9 Years	22%	17%
	10-14 Years	15%	16%
	15-19 Years	11%	9%
	20-24 Years	10%	9%
	25-29 Years	8%	7%
	30+ Years	16%	24%
Type of Institution	Research University	86%	86%
	Four-Year College	12%	13%
	Minority Serving Institution (MSI)	3%	3%
	Community College	1%	1%
	Other	4%	3%
Affiliation	University / College Faculty	40%	39%
	University / College Student or Post-Doc	26%	24%
	University / College Researcher	16%	13%
	State / Federal Agency or Laboratory Researcher	10%	9%
	Non-profit	6%	9%
	Private Industry	5%	6%
	University / College Administrator	4%	3%
	Informal Science Institutions	2%	3%
	Education (non-University / College)	2%	2%
	State / Federal Agency or Laboratory Manager	3%	1%
	State / Federal Agency or Laboratory Technician	1%	<1%
	Other	6%	9%
Area of Expertise	Ecosystem Ecology	21%	27%
	Population / Community Ecology	24%	18%
	Conservation / Restoration Ecology	11%	11%
	Landscape Ecology / Biogeography	7%	8%
	Wildlife Ecology	4%	5%
	Education and Outreach	3%	4%
	Botany	3%	4%
	Physiological Ecology	6%	3%
	Evolution / Evolutionary Ecology	6%	2%
	Microbiology	2%	2%
	Zoology	1%	1%
	Other	13%	15%

These demographic data were further divided by segment (Table 3). These data, again, demonstrate similarities among respondents in both years of the survey. *Uninterested* respondents were older and later in their career. The *Keen* and *Piqued* segments were younger and at earlier stages in their careers while the *Engaged* segment fell between these three categories. Respondents' expertise fell primarily in the categories of population/community ecology, ecosystem ecology, and conservation/restoration ecology across all categories. As noted previously, a large portion of respondents were affiliated with research universities even though efforts were made to increase the diversity of respondents.

It was noted in 2009 and also found in 2018, that a high percentage of respondents affiliated with private industry fell within the *Piqued* category (Table 3). Moving forward, the NEON project may want to seek opportunities to engage with the private sector to identify potential uses of NEON data and infrastructure to meet those needs. Additional information should also be sought on how the project has tried to engage with the private sector over the past nine years to better understand how to best nurture these collaborations.

Table 3. Summary of key demographics across segments in 2009 and 2018.

	Engaged	Keen	Piqued	Uninterested
Definition	Interested, Aware, and Knowledgeable	Interested and Aware, but No Knowledge	Interested but Not Aware	Not Interested regardless of Awareness or Knowledge
2009				
Avg. Age	45	40	39	50
Top Expertise	Population / community ecology; Ecosystem ecology; Conservation / restoration ecology	Population / community ecology; Conservation / restoration ecology; Ecosystem ecology	Population / community ecology; Ecosystem ecology; Conservation / restoration ecology	Population / community ecology; Ecosystem ecology; Evolution / evolutionary ecology
Affiliation	University or College			
Type of University	Research University			
Years in Field	16	11	11	20
2018				
Avg. Age	44	37	41	54
Top Expertise	Ecosystem ecology; Population / community ecology; Other	Other; Population / community ecology; Conservation / restoration ecology	Ecosystem ecology; Other; Conservation / restoration ecology	Ecosystem ecology; Population / community ecology; Other
Affiliation	University / College Faculty (39%); University / College Student / Post Doc (23%);	University / College Student / Post Doc (38%); University /	University / College Student / Post Doc (37%); Private Industry (13%);	University / College Faculty (43%); Other (18%); State Agency/Federal Agency/Laboratory

	University / College Researcher (13%)	College Faculty (23%)	University / College Faculty (12%)	Researcher (10%); University / College Researcher (10%)
Type of University	Research University (75%)	Research University (69%)	Research University (68%)	Research University (85%)
Years in Field	17	11	14	24

Awareness of NEON

Awareness of NEON in both the 2009 and 2018 surveys was very high with only a slightly higher percentage of respondents aware of the project in 2018 (N=929; 86%) compared to 2009 (81%). In addition, most respondents who are aware of NEON have at least some knowledge of the project (Figure 1). The percentage of respondents very knowledgeable or moderately knowledgeable of NEON was greater in 2018 (55%) than in 2009 (34%). This could be the result of the age of the project or the growth in communications related to the project over the nine-year time span.

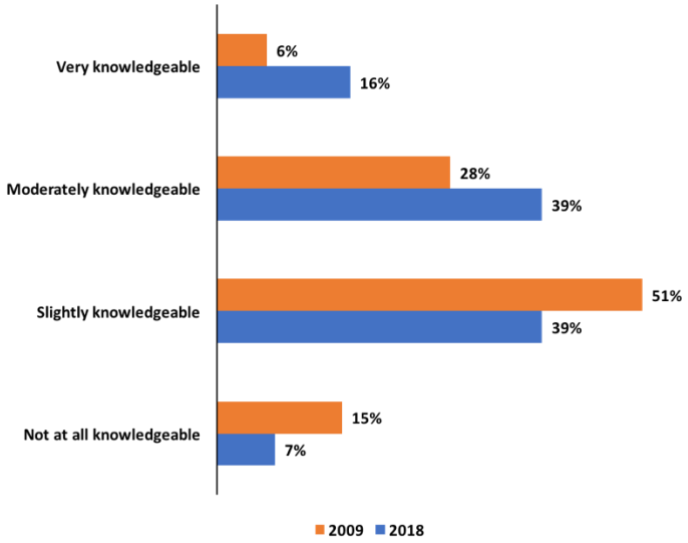


Figure 1. Percentage of respondents aware of NEON (N=799) and their perceptions of their knowledge of the project.

Among those responding to the survey, interest in using NEON was slightly stronger in 2009 (83% interested) than in 2018 (77% interested). The percentage of respondents stating they were “probably not interested” went from 15% in 2009 to 20% in 2018 and those stating they were “not at all interested” went from 1% in 2009 to 3% in 2018. Analyses of those individuals *Uninterested* demonstrated a variety of reasons for their lack of interest (Figure 2).

A large portion of *Uninterested* respondents (52%) indicated that the project could not be utilized for their type of research or within their field of work. These responses indicated that researchers with small-scale projects, working internationally, or working in marine, aquatic, or urban environments felt they could not use the data or infrastructure provided by the project. Although de-scoping has occurred due to budget cuts throughout various stages of observatory construction, there appears to be some confusion as to what aspects of the project were de-

scoped. Future communications should highlight what is still being offered by the project and should also include use cases that highlight uses of the observatory beyond research in macrosystems ecology. The “project not useful” responses (19%) tended to be more negative in tone. Common complaints included the project being redundant to other projects (e.g., LTER, Ameriflux) and that research should begin with specific hypotheses before data collection begins. Although a small percentage (<1%), the data skills program led by NEON could respond to those individuals lacking the skills to make use of NEON data. Responses were similar in the 2009 survey where respondents cited retirement, no longer working in the field, or the project not being related to their work most often.

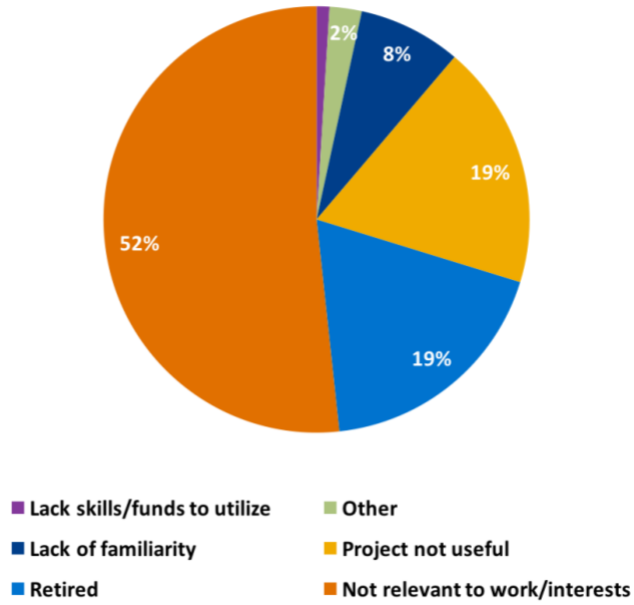


Figure 2. Percentage of respondents who provided various reasons for being uninterested in using NEON (N=205).

The “probably interested” respondents (47%) remain a key group that could likely be influenced to increase their interest in the project. Increasing knowledge of the project and the resources provided to potential users should be highlighted in future communications. The development of use cases will also contribute to a better understanding of how the observatory has been used or could be used for various purposes, including such purposes as natural resource management and education.

Perceptions Toward and Knowledge of NEON

Respondents in 2009 and 2018 were asked to indicate how strongly they agreed or disagreed with a series of statements to determine their perceptions of the NEON project. For those statements included in both years, there was a decline in the percentage of respondents that agreed with each one (Figure 3). No real change was found in the percentage of respondents agreeing that NEON data will support understanding of the impacts of climate change. However, there was a decline in those agreeing that the project is cost effective and a good use of funds (54% in 2009 to 49% in 2018). More significant, the percentage of respondents that disagreed with the statement grew from 4% to 10% (Figure 3). When asked to provide additional feedback or comments at the end of the survey, 39% of those providing negative comments (N=38) stated that they felt the project was a poor use of funding resources that were needed for other, more valuable projects in the ecological sciences. It will be important for the project’s leadership

to finds ways to continuously promote the value of NEON under limited funding opportunities across the ecological community.

There was also a decline in the percentage of respondents that agreed with the statements that NEON data are highly needed (93% in 2009 to 85% in 2018) and that the project fills a unique niche (90% in 2009 to 85% in 2018; Figure 3), but the responses show that a high percentage of respondents (85%) still find value in the data that will be provided by the project. These responses somewhat contradict concerns expressed by others that the project is redundant to other existing networks.

When requesting general feedback in the 2018 survey, we received 100 comments. Of those, 34% were positive and 28% were neutral. Of the 38 negative responses provided, in addition to the themes mentioned above, 18% of respondents cited the project not being collaborative and 11% cited the project not being responsive to community feedback.

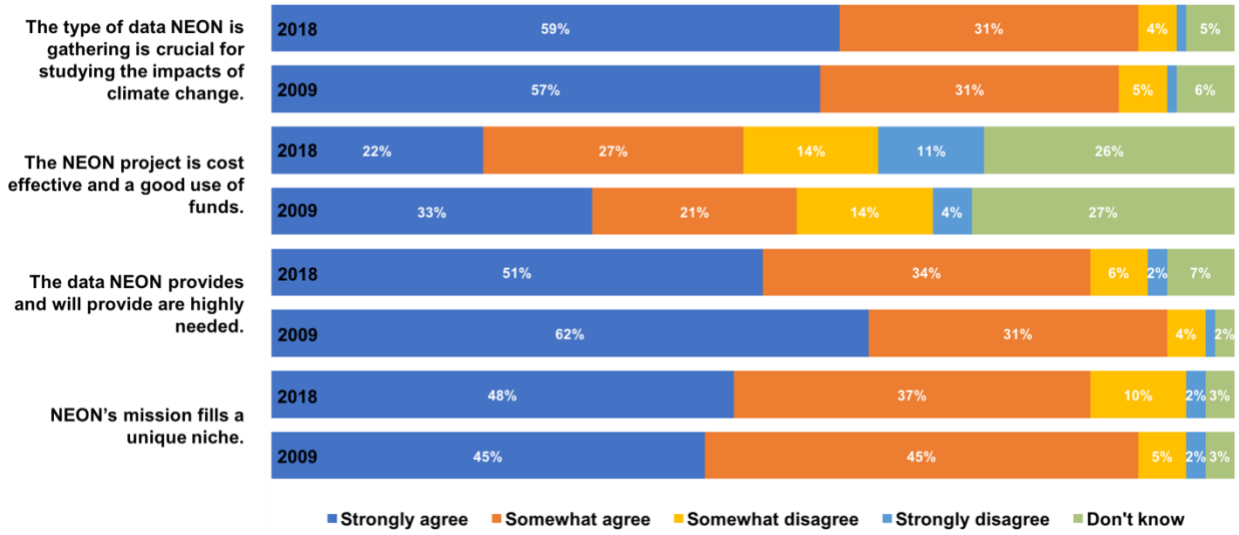


Figure 3. Percentage of *Engaged* respondents that responded to what degree they agreed with the following statements in 2009 (N=1449) and 2018 (N=541).

The survey also included additional statements not included in the 2009 survey based on concerns associated with use of the data (Figure 4). Large percentages of respondents did not know if the data are of good quality (38%) or if they are easy to discover and download (38%). Although considered a major issue among NEON leadership and project advisors, only 7% indicated that they felt NEON data were not of good quality.

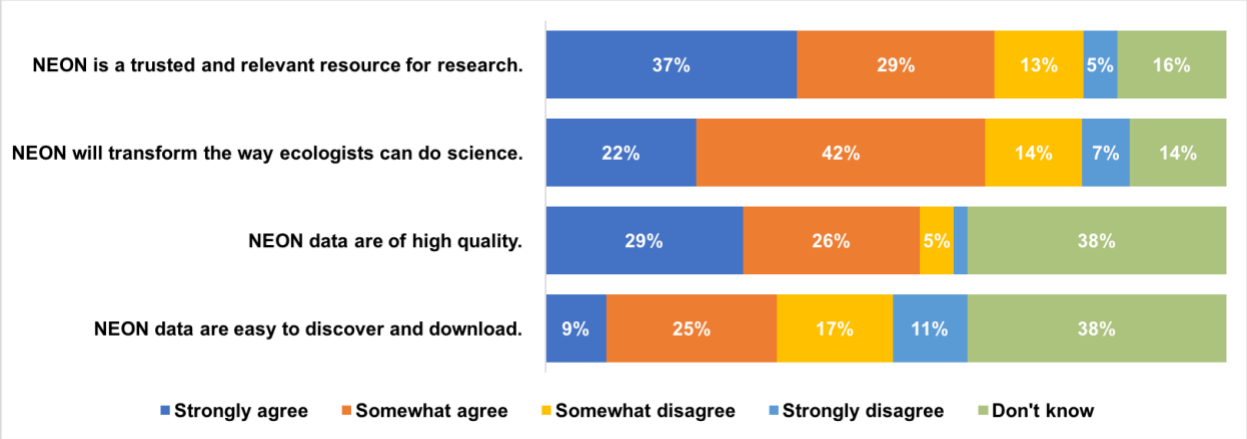


Figure 4. Percentage of *Engaged* respondents that responded to what degree they agreed with the following statements (N=541).

The survey listed a number of facts about NEON and asked respondents to indicate if they were aware of this fact and if the fact was helpful to them in their current position (Table 4). The drop in people aware of field sites from 2009 (91%) compared to 2018 (63%) may have resulted from the inclusion of the actual number of field sites in the statement in 2018. There may have also been misconceptions related to descoping of the project in the past several years. Not only was there a lack of awareness in the number of NEON field sites, there was also a decline in awareness related to the collection of aquatic data (81% in 2009; 70% in 2018). The number of field sites was reduced from 106 to 81 when relocatable sites were removed (urban, land use change) and permitting issues arose. Removing the Steam Experimental Observation Network (STREON) aspect of the project also resulted in confusion within the community on which aspects of the aquatic data collection had been removed.

Of significance to note is the lack of awareness that NEON data are open access and freely available. Only 69% of *Engaged* respondents were aware of this fact but 96% feel that this would be helpful for them in their current position. Communications need to continuously highlight this to raise awareness along with the types of data that are being collected (e.g., specimens, soils, remote sensing; Table 4) and the length of time those data will be collected. Only 47% of respondents were aware that NEON will be collecting data over a period of 30 years. Areas of NEON activities that were rated as not being very helpful (below 70%) were within an area of specialty for many researchers (i.e., soils, aquatics, specimen collections; Table 4).

Table 4. Percentage of *Engaged* respondents that were aware of facts about NEON (N=565) and those that considered each fact helpful in their current position (N=540). Brackets indicate additional information provided in a statement in 2018. N/A indicates that the statement was not included.

Statement	Aware (2009)	Aware (2018)	Helpful (2009)	Helpful (2018)
The NEON project collects ecological and climatic observations [from 81 sites] across the United States, including Alaska, Hawaii and Puerto Rico.	91%	63%	75%	82%
NEON has partitioned the US into 20 ecoclimatic domains, each of which represents different regions of vegetation, landforms, climate, and ecosystem	59%	66%	68%	69%

function, to sample continental-scale environmental change.				
NEON collects data about climate and the atmosphere.	94%	87%	80%	84%
NEON collects data about soils.	N/A	73%	N/A	68%
NEON collects data about a variety of organisms.	86%	81%	83%	77%
The NEON project will collect data over a period of 30 years.	36%	47%	86%	88%
NEON is currently managed and operated by Battelle.	N/A	48%	N/A	N/A
NEON is a National Science Foundation (NSF) large facility project managed by NEON, Inc.	62%	N/A	N/A	N/A
The NEON project is funded by the National Science Foundation (NSF).	91%	82%	N/A	N/A
NEON data are open access and freely available from the NEON data portal and via API.	74%	69%	90%	96%
NEON collects data about streams, rivers, and lakes.	81%	70%	74%	58%
NEON collects airborne remote sensing data from NEON field sites.	N/A	73%	N/A	77%
NEON samples and specimens will be archived for use by researchers.	N/A	58%	N/A	60%
NEON, Inc. was created to manage large-scale ecological observing systems and experiments on behalf of the scientific community.	91%	N/A	69%	N/A
NEON is a National Science Foundation (NSF) large facility project managed by NEON, Inc.	62%	N/A	N/A	N/A
The NEON web portal and educational activities will provide opportunities for students, educators, decision-makers, scientists and the general public to use NEON data and learn about continental-scale ecology.	59%	N/A	82%	N/A
NEON, Inc. itself does not distribute or grant funds for research.	48%	N/A	N/A	N/A
NEON, Inc. is a nonprofit 501(c)(3) organization.	42%	N/A	N/A	N/A
NEON is a facility, not a research network.	37%	N/A	N/A	N/A

Effective Communications

When looking at communications, the data from 2018 were assessed independently to inform strategic planning for communication priorities moving forward. All but the *Uninterested* respondents were asked to respond to these questions (N=714). When asked to select which methods respondents would like to learn about NEON, a large majority selected the NEON website (88%) and data portal (74%; Table 5). Direct communications between NEON scientists and external scientists through conference attendance and publications were also ranked highly (62% and 61%, respectively). Printed materials and an online discussion forum were the least likely strategies to engage participants (16% and 12%, respectively).

Table 5. Percent of respondents (N=675) who selected the communication strategy as a preferred method for NEON communications.

Strategy	Method to Engage	
	N	%
NEON's website	592	88%
NEON's data portal	498	74%
NEON's presence at conferences or workshops	417	62%
Articles in scientific journals	412	61%
Through my professional society	275	41%
Webinars	239	35%
eNewsletter	231	34%
NEON project staff talks	217	32%
Through my university, agency, or organization	207	31%
NEON's social media presence (e.g., Twitter, Facebook, LinkedIn)	195	29%
Personal communications with staff	196	29%
Reading online blogs	174	26%
An organized visit by NEON scientists to my organization	155	23%
Printed material, such as brochures or booklets	108	16%
Online community discussion forum	82	12%

Respondents also selected what type of information they would like to receive from NEON through these various engagement channels. Information related to data, including data product updates and data collection processes, were ranked the highest (>60% of respondents; Table 6). Data skills training and other learning opportunities were next with 49% of respondents interested in obtaining information on those opportunities. Field site information, use cases, and NEON related publications were also important types of information to relay. These data align with the percentage of respondents selecting how they plan to use the data. Ninety percent indicated research and 52% indicated education or teaching. Fewer were interested in using the data for decision making (20%) or management (19%).

Table 6. Percentage of respondents that indicated the types of information they would like to receive.

Type of Information	Percentage
Data product updates	68%
Data collection (protocols and training)	64%
Data skills training or other learning opportunities	49%
Information about specific field sites	48%
NEON-related publications	48%
How to access field sites or utilize field site infrastructure	45%
Use cases (i.e., how NEON data are being used)	45%
Career opportunities	36%
How to contact people at NEON to answer my questions	35%
Upcoming NEON-related events	33%
How to request use of Assignable Assets (e.g., mobile deployment platform, remote sensing flights)	26%
Archival samples	25%
How to participate in NEON advisory activities	23%
Other	2%