



# NEON Technical Working Groups

## *2024 Biannual Report Quarter 3 Quarter 4*



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## Introduction

Since its inception, NEON has relied on expertise within the science, education, and engineering communities to advise on key areas impacting the design, construction, and maintenance of the Observatory with the goal of optimizing its operation. Currently, two types of external advisory bodies support staff and leadership in making key decisions that guide all of NEON's activities: The Science, Technology & Education Advisory Committee (STEAC) and Technical Working Groups (TWG). Both bodies are comprised of experts nominated to serve in these roles who are selected by NEON staff following a rigorous selection process.

NEON currently relies upon input from 22 TWGs. These groups play an important role by providing input to NEON's data collection and processing methods and ensuring that NEON infrastructure, data, and programs are a valuable community resource. Working groups are participatory and advisory; they are often tasked with providing input on issues that have scientific, educational, engineering, or operational implications. This document includes a summary of activities, recommendations, and NEON's response to those recommendations for each TWG during the second half of the 2024 funding year (May 2024-October 2024).

# Airborne Remote Sensing TWG

The Airborne Remote Sensing Data Quality Technical Working Group provides expert input and advice regarding NEON's airborne sampling design, data collection requirements and constraints, campaign scheduling, data products and algorithms, and reported quality metrics.

## Summary of Activities

Q3: No meetings were held.

Q4: No meetings were held.

## TWG Recommendations

Q3: N/A

Q4: N/A

## NEON Response

Q3: N/A

Q4: N/A

## Aquatic Biogeochemistry TWG

The Aquatic Biogeochemistry Technical Working Group (ABTWG) provides experience and expert knowledge across the fields of Aquatic Biogeochemistry, including water chemistry, solute and sediment transport, nutrient cycling and metabolism. The scope of the NEON ABTWG includes both the Aquatic Observation System (AOS) and the Aquatic Instrument System (AIS). The expertise of this group is intentionally broad and is intended to represent the diverse set of data users interested in utilizing NEON data to address research questions within the various subfields of aquatic biogeochemistry.

### Summary of Activities

Q3: No meetings held, requested feedback on AIS cleaning tutorial.

Q4: Met to discuss improvements to continuous discharge.

### TWG Recommendations

Q3: Have not received any responses. Need to follow up.

Q4: TWG agreed with cleaning and gap filling methods being employed. Supported proposed move to 15-minute resolution.

### NEON Response

Q3: N/A

Q4: Change to 15-minute resolution being implemented through internal approval process.

# Aquatic Biology TWG

The Aquatic Biology Technical Working Group provides expert knowledge across the fields of organismal sampling in aquatic systems. The scope of the NEON Aquatic Biology Technical Working Group includes data products generated by the Aquatic Observation System (AOS). The expertise on this group is intentionally broad within the field of aquatic biology and ecology. The group is intended to represent a broad set of NEON data users and experts in various subfields of aquatic biology and ecology, who can:

- 1) take a broad and complete view of the aquatic program, and
- 2) provide scientific guidance on design, prioritization, and value of the components of the Project.

## Summary of Activities

Q3: Requested feedback on proposed change to aquatic plant sampling in lakes to add a field indicating how full that rake was during sampling to address concerns from D03 about plants falling off the rake.

Q4: Queried the TWG about zooplankton lab analysis methods and calculations via email. Asked TWG for advice regarding fishing barriers at NEON, the necessity of YOY or Juvenile in the App, and received input on the new data product structure.

## TWG Recommendations

Q3: The TWG agreed that we should add a new field indication the fullness of plants field to the data rather than changing the way sampling is conducted.

Q4: Regarding zooplankton, no one on the TWG had appropriate expertise; however, Andrew Rypel put Stephanie in touch with one of his post-docs who does work on zooplankton, recommendations were to follow the SOPs we are currently using. The TWG agreed with the updated barrier sampling approach, the removal of the YOY or Juvenile option, and approved of the new data format.

## NEON Response

Q3: NEON is advancing the recommendation through the internal approval process. Next steps will be to edit the data collection app, data ingest and add to the field sampling protocol.

Q4: No recommendations resulted from the zooplankton questions. The TWGs suggestions for the Fish in Q4 aligned with our decisions.

## Atmospheric Deposition TWG

The NEON Atmospheric Deposition Technical Working Group TWG focuses on the sampling of precipitation for chemical analysis and isotope concentrations as well as particulate size distribution. Input from the TWG will be requested, as needed, on the refinement of current procedures, algorithms, sensor obsolescence and replacement or the elimination, modification, or addition of data products, and infrastructure issues related to deposition.

### Summary of Activities

Q3: No meetings were held.

Q4: Email correspondence to TWG regarding finalization of NSF memo to move collectors to the ground.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

## Atmospheric Stable Isotope TWG

This group provides guidance regarding sensor designs and assemblies, data products, and field and lab procedures and protocols to measure atmospheric stable isotopes of  $^{13}\text{C}$  in  $\text{CO}_2$  and  $^{18}\text{O}$  and  $2\text{H}$  in water vapor and precipitation water.

### Summary of Activities

Q3: No meetings were held.

Q4: The TWG met to discuss data processing updates and reviewed and provided recommendations for our water isotope low humidity dependence (LHD) characterization.

### TWG Recommendations

Q3: N/A

Q4: The TWG recommended to explore conducting more frequent LHD characterization, as the current annual results show significant year to year changes that will make it difficult to apply an LHD correction to the data. The TWG suggested that these more frequent LHD characterizations be done at sites with low humidity, which would minimize loss of otherwise usable data.

### NEON Response

Q3: N/A

Q4: NEON developed a plan to conduct monthly LHD characterizations at 5 sites. This plan is being evaluated through the NEON internal approval processes.



## Biorepository TWG

The Biorepository Technical Working Group is comprised of curation, archival and museum collections experts as well as ecologists and others who would make use of the NEON Biorepository. The group advises NEON on curation best practices, and discoverability of and ready access to biological samples and specimens for future scientific research. A particular focus is to broaden the availability and use of museum assets for regional to continental-scale ecological research.

### Summary of Activities

Q3: No activities to report, as no issues or large sample requests that required input arose.

Q4: Email input requested on NEON Research Support Services request to consumptive use of every *Peromyscus leucopus* (small mammal) blood sample that we will collect in 2025 from one of the three pathogen plots at 13 NEON sites.

### TWG Recommendations

Q3: N/A

Q4: TWG members requested we consider whether the resulting data will be made publicly available and whether any remaining serum or DNA extracts would be able to be archived for future needs. Also, TWG members asked us to consider the similarity of the impacted sites to other sites to inform how distinctive the consumed samples would be relative to others collected in the Observatory. The TWG members also acknowledged the challenges of evaluating the short-term benefits with the risks to future research.

### NEON Response

Q3: N/A

Q4: NEON incorporated the feedback from the TWG in its response to PIs by indicating that 'In most cases, the Biorepository will be able to provide, at a minimum, the "acceptable" sample size requested (10 Males, 10 Females of each sample type per site); however, for some sites the NEON Biorepository may not be able to provide the "acceptable" amount due to low overall sample availability.'

## Breeding Landbird TWG

The Breeding Landbird Technical Working Group provides expert input and advice regarding the science design and protocols related to NEON breeding landbirds sampling.

### Summary of Activities

Q3: No meetings were held.

Q4: No meetings were held.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

## Data Standards TWG

The Data Standards Technical Working Group is tasked with making recommendations about effective ways to provide NEON's data products to the broader scientific, educational, and policy communities. Topics may include 1) principles, standards, and policies for open data and software; 2) data discovery, exploration, and delivery mechanisms; 3) improvement of data products to increase utility; and 4) monitoring impact of NEON data use on research.

### Summary of Activities

Q3: No meetings were held.

Q4: No meetings were held.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

# Ecological Forecasting TWG

The Ecological Forecasting TWG provides recommendations to NEON on how to best support ecological forecasting. This may include facilitating community discussions around forecasting needs, providing guidance for data product development, and identifying opportunities for NEON to engage with the forecasting community through workshops, educational materials, and code/data product development.

## Summary of Activities

Q3: No meetings were held.

Q4: We had a virtual meeting in March where we welcomed new TWG members (Freya Olsson and Kari Norman). Quinn Thomas provided highlights from the NEON Ecological Forecasting Challenge, which is run by the Ecological Forecasting Initiative Research Coordination Network (EFI RCN), from the past year. The TWG discussed how NEON should support future activities related to the challenge, including a NEON beetle forecasting workshop at ESA 2024 and the EFI RCN 2025 meeting. The TWG also discussed how ecological forecasting might be used to inform NEON operations, such as planning and prioritizing field work.

## TWG Recommendations

Q3: N/A

Q4: The TWG recommended NEON seek input from NEON science staff, including both HQ and Field Science staff, for ideas about use cases where forecasting might be informative.

## NEON Response

Q3: N/A

Q4: NEON staff are currently collecting use case ideas to bring to the TWG for discussion.

## Foliar Sampling TWG

The Foliar Sampling Technical Working Group provides expert input and advice related to sampling sunlit plant foliage, with a key goal of linking field measurements to remotely-sensed observations of vegetation chemical and physical properties.

### Summary of Activities

Q3: Over email, the TWG was asked for feedback on aspects of the canopy foliage sampling protocol, which is scheduled for revision. First, they were asked how to approach creation of crown polygons when NEON collects sunlit foliage from a tree sampled during the last bout that already had a crown polygon. Next, they were asked about image resolution for leaf mass per area (LMA) image scans, NEON uses 600 dpi and we wondered if that was excessive.

Q4: Over email, the TWG was asked for input on sample handling procedures for foliar chlorophyll samples (especially needles) and whether these were consistent with community best practice or if they had alternative methods to suggest.

### TWG Recommendations

Q3: The TWG felt that a previous polygon verification step would be needed, but that if a previous polygon still accurately described the position of the crown, then it was not necessary to make a new one when resampling a tree. One TWG member mentioned using algorithms to delineate crowns and having NEON staff select from those, instead of drawing digital crowns de-novo, however there was disagreement on the usefulness and accuracy of algorithmic vs human delineated crowns. Regarding LMA scans, many in the group mentioned using 300 dpi, but none saw an issue with using 600 dpi other than larger file sizes to work with. If NEON wishes to switch, the group recommended it tests to confirm lack of impact on the data.

Q4: One member of the TWG with expertise in measuring pigments concurred that it is very important to thoroughly homogenize the tissues, especially needles, although it is not clear if this needs to be done via mechanical grinding. Hand-chopping very finely with a razor blade, as NEON has always done, is likely an acceptable method. The TWG member confirmed that extractions often proceed for multiple days (up to 4) in the fridge at 4C and this should be fine from a data quality perspective, the pigments are stable for this duration.

### NEON Response

Q3: The polygon verification step has been included in the latest revision of the canopy foliage sampling protocol, to be released for use in the 2025 field season. Algorithmically delineated crowns are not being pursued at this time, but this idea will continue to be considered as the technology matures. NEON will stick to 600 dpi resolution for LMA scans, since file size limitations do not seem to be an issue, and this ensures data continuity.

Q4: NEON appreciates the feedback that our current method is likely doing a sufficient job in extracting chlorophyll from sunlit foliage. We may still explore method testing with the current contract lab to see if alternative homogenization methods affect pigment yield, but that is contingent on labor and resource availability.

## Ground Beetle TWG

NEON collects ground beetle observations and archival samples at all terrestrial field sites to capture how ground beetles (*Carabidae*) communities change in different habitats and ecosystems over time. This TWG determines targets for sampling that generate data that can reveal significant changes in beetle abundance, diversity, and community composition.

### Summary of Activities

Q3: No activities to report, as no beetle sampling issues arose.

Q4: No activities to report, as no beetle sampling issues arose.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

## Microbial TWG

The Microbial Ecology Sampling Program encompasses measurements of soil and aquatic microbial diversity, composition, and abundances that are deemed critical for understanding long-term changes in biodiversity and ecosystem function. The tools used for measuring microbial diversity in the environment develop and change rapidly. NEON relies on input and guidance from the Microbial Technical Working Group to advise on questions related to methods and analyses, as well as best practices for ensuring data quality, accessibility, and usability.

### Summary of Activities

Q3: No meetings were held.

Q4: Meeting held to review progress and go over newly developed analytic methods for generating the revised Microbial Community taxonomy data product.

### TWG Recommendations

Q3: N/A

Q4: TWG recommended to only use published methods and had suggestions for best approaches.

### NEON Response

Q3: N/A

Q4: TWG recommendations implemented in the newly published revised Microbial Community taxonomy data product.

## Mosquito TWG

The Mosquito Technical Working Group is comprised of researchers focused on topics including mosquito surveillance, public health, disease ecology, and phenology. The group advises NEON on sampling approaches that will generate data that reveal significant changes in mosquito abundance, diversity, and community composition. A focus of this group is to ensure compatibility of the mosquito dataset with other surveillance infrastructure used to monitor arboviruses in mosquito populations.

### Summary of Activities

Q3: We had 1 meeting to discuss the results of the mosquito pathogen testing survey on July 9, 2024. We also had an email conversation in May 2024 requesting advice on archiving large subsamples of mosquitoes.

Q4: Accepted 3 new TWG members to the mosquito TWG - Kathryn Hanley, Michael vonFricken and Lindsay Campbell. They will bring much needed expertise in RNA virus sequencing and NEON mosquito data products to the team.

### TWG Recommendations

Q3: Our conversation focused on a few themes related to moving forward with a metagenomics approach. The biggest future challenge is going to be having enough data users with the expertise to use the raw sequence data appropriately since it will not be processed through a bioinformatics pipeline by NEON (due to the complications and nuances associated with filtering and other decision making that can influence the outcomes). Nonetheless there may be time sensitivities associated with using the data before they are made obsolete by even more sensitive sequencing technologies. Lowering the bar for entry into using the data with suggested guidelines and/or tutorials may be a helpful way to resolve some of these concerns. Additionally, keeping an open mind and re-considering the methodology as the sequencing technologies evolve over time will be important. We also discussed whether to try to include sequencing blood fed mosquitoes to determine the hosts they fed on. We decided that it may be better to just preserve these blood fed mosquito individuals separately such that they can be requested by end users for their own processing. This reduces concerns about different methodologies yielding different results and challenges associated with the fact that the viruses we would be sequencing are RNA and the hosts are typically identified with DNA sequences. It was also suggested that we reach out directly to known users of large public mosquito datasets who may have useful guidance here. In the email conversation the TWG was asked if they thought that it was sufficient to save a maximum of 200 individuals from a given site-species-bout of collection, rather than spend extra money preserving huge samples of 1000s of replicate individuals when this already represents a subsample of individuals. Most TWG members felt that 200 individuals is a sufficient quantity for archive.

Q4: N/A

### NEON Response

Q3: We incorporated this TWG feedback into our NSF proposal to update the mosquito pathogen data product. I also followed the recommendation to convene a separate, more specialized group of individuals with expertise in mosquito sequencing to get additional feedback on the new data product



design and we had a meeting on Aug. 6 with 3 other experts in the field. We are still discussing the archiving of large mosquito samples with the impacted external taxonomy laboratories. The plan will be to approve the use of standardized 2 mL vials and use a maximum of 2 per species-sex-site-bout for archive if this is approved by external labs and OS IPT.

Q4: N/A

## Re-aeration TWG

The Re-aeration Technical Working Group provides feedback on NEON re-aeration sampling protocols. The TWG is helping to evaluate previously collected data and develop plans to reduce the frequency of re-aeration experiments by strategically targeting certain discharge ranges to complete k-Q rating curves which can be used by data users to estimate re-aeration. The goal is to phase out the use of sulfur-hexafluoride as tracer gas.

### Summary of Activities

Q3: No meetings held, as further potential modifications to sampling are awaiting additional data collection.

Q4: No meetings were held.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

## Site Management and Disturbance TWG

The Site Management and Disturbance Technical Working Group (SIM TWG) provides experience and expert knowledge related to Disturbance Ecology, particularly in reporting disturbance events and metadata. The scope of the NEON SIM TWG includes capturing disturbance events for all NEON Science subsystems (AIS, AOP, AOS, TOS, TIS). The group advises NEON on SIM data accessibility, quality, and usability as well as identifying areas of improvement within our budget. This group is also tasked with providing guidance on disturbance monitoring methods and best practices for reporting impacts to other ongoing data collection at our sites.

### Summary of Activities

Q3: We had 1 meeting to discuss possible methods of recording and reporting impacts of NEON sampling.

Q4: No meetings were held, 2 new members added from recruitment.

### TWG Recommendations

Q3: The TWG agrees that reporting on sampling disturbance impacts is important and called the topic the "elephant in the room" for other long term sampling networks. The TWG recommends reaching out to other groups and perhaps hosting a workshop. The TWG produced numerous ways to capture and report this data:

- 1) Add to field sites pages what sort of sampling impacts occur at a site,
- 2) Create AGOL layers of boardwalks and designated hiking paths (AOS especially),
- 3) Utilize AOP imagery to capture trampling changes,
- 4) Provide number of visits per year,
- 5) Write a paper to acknowledge this challenge,
- 6) Make sure all data products have a field that could capture sampling disturbance, and
- 7) Create a new mobile data entry app that records an ordinal rating of sampling disturbance impacts.

Q4: N/A

### NEON Response

Q3: Process initiated to discuss the TWG recommendations with NEON leadership.

Q4: N/A

## Small Mammals TWG

The Small Mammal Technical Working Group provides expert input and advice regarding the science design and protocols related to NEON small mammal abundance, diversity, and pathogen sampling.

### Summary of Activities

Q3: We had several emails asking for advice related to handling recurrent bear disturbance at GRSM and RMNP.

Q4: No meetings held, 1 email sent requesting feedback on our DNA plating procedures, but no response was received. Another email was sent requesting feedback on blood sample use requests via NRSS.

### TWG Recommendations

Q3: The TWG members acknowledged that bear populations can sometimes become high enough in an area that there is little that can be done to effectively deter or discourage bears from visiting trap lines. In these cases, it was approved that trapping be canceled at an entire site if sampling is repeatedly compromised by bears at more than half of the small mammal sampling grids. Additional precautions can also be taken in the face of bear disturbances such as moving grids or canceling sampling for a period until bear hazards are reduced.

Q4: The TWG members responded with additional pieces of information to consider when evaluating the request including whether any portion of the sample would remain after use, whether the data generated would be publicly available, and whether the DNA extractions would be returned for archive.

### NEON Response

Q3: This information was used during an OS-IPT meeting to address the future of small mammal sampling at GRSM where bear populations have become so high that they are disrupting most of the sampling at the site and causing a safety hazard for the field technicians. The decision in this case was to cease small mammal sampling at GRSM. We are still discussing whether a single early spring or very late fall bout will be possible. We will monitor bear populations at the site and resume sampling when they go below a threshold that is currently being determined.

Q4: This feedback was considered during the NRSS evaluation of the requests and ultimately used to refine the requests to ensure that the data generated would be made publicly available, and that additional blood samples would be collected for use by the project rather than relying solely on the samples that NEON already collects for archive to avoid depleting the entire set.

## Soil Sensor TWG

The Soil Sensor Technical Working Group, provides feedback on all aspects of sensor measurements made in the TIS soil plots, including soil temperature, soil moisture and salinity, soil CO<sub>2</sub> concentration, soil heat flux, throughfall, soil surface photosynthetically active radiation (PAR), net longwave radiation, and soil surface/litter/vegetation infrared temperature measurements. In addition, the Soil Sensor TWG provides recommendations on approving or disapproving requests for large amounts of soil from the NEON Megapit Soil Archive.

### Summary of Activities

Q3: Requested input on the 24th of June on switching to steel T-posts for soil plot fencing at cattle grazing sites because the PVC ones that NEON is currently using are not holding up as well as expected.

Q4: No meetings were held.

### TWG Recommendations

Q3: The TWG approved this change.

Q4: N/A

### NEON Response

Q3: This change is starting to be implemented on an as-needed basis.

Q4: N/A

## Surface Atmosphere Exchange TWG

NEON measures the surface-atmosphere exchange of momentum, heat, and several climate-relevant trace gases. This Technical Working Group advises on the operation of NEON's surface-atmosphere exchange assets, development of novel, scale-aware data products, adaptive algorithms, and usability tools, and active contribution to network science. The Technical Working Group accomplishes these tasks by working closely with NEON's Surface-Atmosphere Exchange Group. This includes prioritizing quarterly developments, pre-reviewing new resources, and bringing forward community input.

### Summary of Activities

Q3: No meetings were held.

Q4: No meetings were held.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

## Terrestrial Biogeochemistry TWG

The Terrestrial Biogeochemistry Technical Working Group provides expert input and advice regarding the science design and protocols related to measurements of plant and soil biogeochemistry within the NEON Observational System (e.g., not sensors).

### Summary of Activities

Q3: No meetings were held.

Q4: No meetings were held.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A

## Terrestrial Plant Diversity and Phenology TWG

Membership of the Terrestrial Plant Diversity and Phenology Technical Working Group includes researchers and practitioners from universities, federal and regional government agencies, and coordinated research networks. This group represents the community of plant diversity and phenology data users that NEON aims to serve; members provide expert input and advice regarding the science design, protocols, and data quality issues related to NEON plant diversity and phenology sampling.

### Summary of Activities

Q3: Discussed diversity QAQC approach and taxonomy backbone. Reviewed data availability and discussed future opportunities.

Q4: No meetings were held.

### TWG Recommendations

Q3: Some TWG members were hesitant to invest significant resources towards external review of taxon IDs given the benefits of that approach.

Q4: N/A

### NEON Response

Q3: NEON internal taxonomy working group will discuss taxonomy table options and QAQC recommendations with NEON leadership.

Q4: N/A



# Terrestrial Plant Productivity and Biomass TWG

The Terrestrial Plant Productivity Technical Working Group advises which methods, protocols, and equipment are employed to create robust ground-based estimates of live and dead woody biomass, woody and herbaceous productivity, coarse downed wood volume and density, fine and coarse litterfall, belowground plant biomass, and leaf area index across a suite of different vegetation types. The TWG also considers optimal spatial and temporal integration of ground-based measurements with remote-sensing hyperspectral and LiDAR datasets (i.e., the NEON AOP system), and with data streams generated by the NEON Terrestrial Instrument System. Finally, the TWG is also deeply invested in determining how NEON Plant Biomass and Productivity data products can be optimized to enhance usability and value for the NEON end-user community.

## Summary of Activities

Q3: No meetings were held.

Q4: Discussed Belowground Biomass fine root sampling optimization results with TWG in late September.

## TWG Recommendations

Q3: N/A

Q4: In the Report, we performed power analyses focused on detecting change in each of the three size categories that are provided in the data product. The TWG indicated that power analyses focused on a pooled 0-2 mm size category could be helpful, as most community members are familiar with thinking about roots in  $\leq 2$  mm diameter vs.  $> 2$  mm diameter categories. Detecting change in the 2-10 mm size category is not a high priority.

## NEON Response

Q3: N/A

Q4: We re-ran power analyses and other similar analyses with a pooled 0-2 mm diameter size category per TWG recommendations. Re-worked analyses were shared with the TWG again in Q1 AY25 and will be brought to the NEON internal approval process once additional TWG review is complete.

## Tick Sampling TWG

The Tick Technical Working Group provides expert input and advice regarding the science design and protocols related to NEON tick abundance, diversity, and pathogen sampling.

### Summary of Activities

Q3: No activities to report, as no tick sampling issues arose.

Q4: No activities to report, as no tick sampling issues arose.

### TWG Recommendations

Q3: N/A

Q4: N/A

### NEON Response

Q3: N/A

Q4: N/A