Solar, Wildlife, & Ecosystem Research Priorities for the Southeastern United States

Version 1.0

Prepared by the Solar, Wildlife, & Ecosystem Research Prioritization Initiative

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REWI
Renewable Energy Wildlife Institute

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This document provides an overview of priority research questions on photovoltaic solar development, wildlife, the environment, and ecosystems in the Southeastern United States to support responsible operations and future buildout efforts. The identified research priorities were informed by multi-stakeholder analyses. This document was created with the support and input of a variety of organizations, including those depicted below and in the listed acknowledgments.

Argonne NATIONAL LABORATORY

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Executive Summary

The Southeastern United States is notable for its rich biodiversity, numerous threatened and endangered species, and the recent rapid deployment of large, ground-mounted, photovoltaic (PV) solar installations. PV solar expansion in the Southeastern United States has raised important ecological questions, particularly given the **lack of scientific studies on its effects on wildlife, habitats, and ecosystems** in the region. This information gap poses challenges for stakeholders and others who need to make informed management decisions.

To address these challenges, the Renewable Energy Wildlife Institute (REWI), in collaboration with the University of Georgia's Carl Vinson Institute of Government, conducted workshops and surveys to identify and prioritize region-specific research questions regarding PV solar development in three topic areas: Wildlife Interactions, Onsite Action & Mitigation, and Environment & Ecosystem. This initiative engaged a diverse, multistakeholder group of experts and interested parties from academia, government agencies, the solar industry, and non-governmental organizations. To identify the research most needed to inform decision-making, participants' opinions on various research questions were gauged along three metrics (Relevance, Magnitude, and Reducibility of uncertainty) using a Qualitative Value of Information framework. The results highlight areas of consensus and disagreement regarding the research efforts most needed to understand the multifaceted effects of PV solar facilities in the Southeastern United States and to promote effective management practices that support both renewable energy goals and biodiversity conservation. Scores across the three metrics differed greatly among participants within each topic area, **indicating a lack of general agreement on the relative importance and feasibility** of different research questions.

The following research questions had broad support (i.e., highest scored) as priorities to inform decision-making related to solar energy, wildlife, and ecosystems in the Southeastern United States.

Priorities

Wildlife Interactions - What are the long-term effects of large-scale PV solar facilities on populations of conservation-focused wildlife and their habitat?

> Example**:** Monitor gopher tortoise abundance, survival, reproduction, and movement within and near solar developments for over 10 years.

Onsite Action & Mitigation - What is the direction and magnitude of species, biodiversity, and ecosystem responses to various construction practices at different stages of post-construction?

Example: Compare the ecological effects of various construction practices (e.g., grading, limited grading vs. non-grading; pre-seeding vs. post-seeding) at solar facilities during the first 5 years after construction.

Environment & Ecosystem - How does soil health on PV solar facilities of various ages compare with prior land use?

Example: Measure soil characteristics (such as carbon content, water infiltration rate, pH, and microbial biomass and activity) at solar energy facilities and nearby areas representing prior land use.

Introduction

The United States Fish and Wildlife Service (USFWS) Region 4 ("Southeast"; Figure 1) is recognized for its exceptional biodiversity, especially within the North American Coastal Plain (Noss et al. 2015). This region supports **high species richness and endemism** compared to other USFWS regions (Jenkins et al. 2015) and hosts **358 threatened and endangered species** (Costante et al. 2023).

The Southeast is highly heterogeneous and complex, shaped by a variety of geological, topographic, soil, and land-use factors. Human activities have significantly transformed the landscape, resulting in a mosaic of land uses that include agriculture, silviculture, wetlands, forests, grasslands, and urban areas (Li et al. 2023). Large-scale renewable energy production, particularly ground-mounted photovoltaic solar installations (hereinafter, PV solar), has recently become a significant land-use type in this region.

There has been rapid growth of PV solar in the United States over the last decade, with approximately 225,357 hectares **(**ha) of PV solar installed across the country as of 2025 (Fujita et al. 2023). Of this, **51,476 ha (22.8%) has occurred in the Southeast**, comparable to PV solar development in the Pacific Southwest (USFWS Region 8: 59,805 ha) and Southwest regions (USFWS Region 2: 56,329 ha) (Fujita et al. 2023). Within the Southeast, Florida, North Carolina, Georgia, South Carolina, and Arkansas lead in land area converted into PV solar with 18,227 ha (0.11% of the total area), 12,967 ha (0.09%), 9,126 ha (0.06%), 3,592 ha (0.04%), and 2,377 ha (0.02%), respectively.

This rapid land-use change raises concerns for protecting natural resources. Decision-makers have limited scientific information regarding PV solar's influence on ecological interactions in the Southeast. **Only one peer-reviewed article** has been published that specifically focused on ecological interactions with PV solar in the Southeast (Leskova et al. 2022). The lack of scientific data can impede the identification of appropriate or effective management actions, which may result in undesirable outcomes (Regan et al. 2005, Doremus 2010) including negative impacts on natural resources, unnecessary financial burdens on solar developers, missed opportunities to support biodiversity, and local misinformation. However, with many unanswered questions and limited time and resources to address them, identifying the most impactful research questions that can be feasibly tackled is key to making timely progress.

This initiative consisted of a structured process to identify and prioritize research needs regarding PV solar's interactions with wildlife and ecosystems in the Southeast. This process was a collaborative, multistakeholder effort. It included online surveys and virtual workshops to develop and refine pertinent research questions, collect participants'

opinions on the importance and feasibility of answering these questions (Qualitative Value of Information *sensu* (Lawson et al. 2022, Stantial et al. 2023, Martin et al. 2025). The overall objective was to identify research questions that are **feasible to address** and, if answered, will **fill important information gaps** that directly **influence management decisions**. Additionally, the initiative assessed levels of agreement and disagreement among participants and their affiliation categories. The affiliation assessment helped identify areas of alignment and opportunities for collaborative research between industry and non-industry groups.

Process & Design

The Renewable Energy Wildlife Institute (REWI) and the University of Georgia's Carl Vinson Institute of Government (hereafter, the Project Team) partnered to assess priority research questions on PV solar, wildlife, their habitats, and ecosystems. The general process of prioritizing research questions involved several steps (Figure 2):

1. Eliciting stakeholders' views on important research topics and species groups of interest (online "**Scoping Survey**");
2. Developing a candidate list of pertinent research questions within three topic areas, based on Scoping Survey responses and Southeast Solar Symposium participant feedback;
3. Conducting topic-specific virtual workshops ("**Virtual Workshop**") to discuss, refine, and score the candidate questions on Qualitative Value of Information (QVoI) (Lawson et al. 2022, Stantial et al. 2023, Martin et al. 2025); and
4. Administering an online survey ("Online Prioritization Survey") targeting a larger stakeholder audience to score the final research questions on QVoI.

The Project Team convened a Planning Committee comprising 15 representatives and decision-makers from organizations interfacing with solar, wildlife, and ecosystems. The members included scientists and researchers from non-government organizations (the Association of Fish and Wildlife Agencies, Theodore Roosevelt Conservation Partnership, Quail Forever, The Nature Conservancy, National Audubon Society, and Georgia Wildlife Federation), trade associations (American Clean Power and the Solar Energy Industries Association), federal entities (U.S. Department of Energy, U.S. Fish and Wildlife Service, Tennessee Valley Authority, and Argonne National Laboratory), and environmental and permitting specialists from energy companies that operate solar assets in the Southeast (Southern Company and NextEra). The Planning Committee convened virtually several times and provided valuable input and guidance on topics, research questions, and regional experts to participate in the workshops.

Scoping Survey

The Scoping Survey (Appendix A) aimed to elicit stakeholders' views on research topics and species groups associated with PV solar buildout and operation. This survey was conducted online via an emailed link to individuals (n = 426) from a wide range of affiliation categories (Table 1), yielding 90 responses (21.1% response rate).

Question Development & Initial Filtering

The Project Team developed an initial list of approximately 90 research questions related to solar, wildlife, and ecosystems. This list was informed by responses to the Scoping Survey, along with other sources: a literature review, REWI's National Solar Research Plan, input from participants in REWI's Southeast Solar Power and Wildlife/Natural Resources Regional Workshop (Atlanta, Georgia, June 12-13, 2024), content from prior Solar Wildlife & Ecosystems Research Meetings, and other recent presentations and discussions with stakeholders, including the Planning Committee.

We grouped questions into three main topic areas:

1. Interactions between solar facilities and wildlife at all spatial scales ("**Wildlife Interactions**");
2. Effectiveness of specific design, construction, site-management, conservation, and mitigation practices ("**Onsite Action & Mitigation**"); and
3. Interactions between solar facilities and vegetation, abiotic environment, or ecosystems ("**Environment & Ecosystem**").

The Project Team identified 5-6 candidate research questions (based on data gathered from the Scoping Survey) for each topic area to discuss, refine, and prioritize in a virtual workshop (Table 2). Throughout the text, we refer to these questions in an abbreviated shorthand within the text, which are bold and in parentheses (Table 2).

Virtual Workshops

We conducted three 90-minute workshops in August 2025, each focusing on the 5-6 research questions from one topic area (Wildlife Interactions, Onsite Action & Mitigation, or Environment & Ecosystem). Each workshop consisted of 12 participants representing various stakeholder groups, who discussed, refined, and scored each candidate research question. The Planning Committee helped to identify individuals with relevant expertise to participate in the workshops. Participants received email invitations and were assigned to at least one of the three workshops based on their expertise and availability. Leigh Elkins of the University of Georgia's Carl Vinson Institute of Government facilitated the workshops, drawing on extensive experience designing and implementing public engagement

processes. The facilitator introduced each question individually, asked participants whether each needed modification, and encouraged them to discuss the relevance, magnitude, and reducibility of uncertainty related to each question.

The Environment & Ecosystem workshop was held on August 18, 2025, and had 12 participants representing academia and research (n = 3), federal agencies (n = 2), conservation non-governmental organizations (n = 4), and energy companies, utilities, and trade associations (n = 3). The Onsite Action & Mitigation workshop was held on August 18, 2025, and had 12 participants representing academia and research (n = 4), federal (n = 3) and state agencies (n = 2), conservation non-governmental organizations (n = 2), and energy companies, utilities, and trade associations (n = 1). The Wildlife Interactions workshop was held on August 20, 2025, and had 12 participants representing academia and research (n = 2), federal (n = 1) and state agencies (n = 1), conservation non-governmental organizations (n = 5), and energy companies, utilities, and trade associations (n = 3).

At the end of the workshops, each participant was asked to independently score the candidate research questions specific to the topic area based on their relevance, magnitude of uncertainty, and reducibility of uncertainty. However, not all participants completed the scoring, which is reflected in the results section below. Participants scored the questions via an online survey using a standardized rubric (Appendix B) based on that of Stantial et al. (2023). Participants scored relevance and reducibility on a 0 to 3 scale, and magnitude on a 0 to 4 scale. Here, we explain these scales in non-technical terms for a general audience, but we refer more technical readers to the rubric for further details (Appendix B):

1) **Relevance**: How relevant is this research question to decision making? A score of 0 indicated that answering the question would not change the respondent's management, decisions, or mindset, whereas a score of 3 indicated that it would completely change them.
2) **Magnitude**: How much uncertainty exists regarding this research question? A score of 0 indicated that answering the question would provide no new knowledge (i.e., we already know the answer), whereas a score of 4 indicated that answering the question would provide much-needed knowledge.
3) **Reducibility**: How feasible is it to reduce the uncertainty related to this research question? A score of 0 indicated that answering the question would be very difficult (near impossible) due to a variety of reasons (e.g., cost-prohibitive, site-access requirements, or equipment needs), whereas a score of 3 indicated that answering the question would be feasible and easy (highly possible).

Following the workshop and completion of the participant scoring, we followed Stantial et al. (2023) to calculate QVoI for each participant and question (**magnitude × relevance; maximum value of 12**) and then calculated the mean, standard deviation (SD), and standard error (SE) of the QVoI and Reducibility values across all participants for each candidate research question. We then followed Lawson et al. (2022) to plot the data on a chart, partition the figure into four quadrants, and assign prioritization categories to candidate research questions that fell within each quadrant. First, we averaged the minimum and maximum of the individual participants' QVoI and Reducibility scores across all workshops to define the quadrants: a vertical line at QVoI = 6 and a horizontal line at Reducibility = 1.65. Following Stantial et al. (2023), we categorized the quadrants as "highest priority", "high priority", "medium priority", and "low priority". The highest-priority category encompassed questions with high QVoI and Reducibility values (upper right quadrant): questions that participants deemed highly feasible to answer and had the potential to yield the most knowledge, inform or change management, influence decisions, or alter mindsets.

The Project Team conducted a post-workshop Assessment Survey to gather information on participants' experiences in these workshops. Participants rated questions on a 1 to 5 scale, where 1 is "very low" and 5 is "very high" on the workshop's effectiveness ($\bar{x}$ = 3.57), convenience (x = 4.14), value for time ($\bar{x}$ = 3.57), facilitation ($\bar{x}$ = 4.14), and overall quality ($\bar{x}$ = 3.71). We received 7 responses to the Assessment Survey, and Appendix C provides the full results.

Online Prioritization Survey

The Online Prioritization Survey (Appendix D) was distributed to the broader stakeholder community to further assess the value of each candidate research question and the influence of participants' affiliations on scoring. A survey link was emailed to 429 people (recipients included those who had previously registered for REWI's Solar Wildlife & Ecosystems Research Meeting or received other solar energy-related communications from REWI; recipients were encouraged to share the survey with others in their professional networks), and we received 77 responses (18.1% response rate). After removing responses with insufficient data and those from individuals outside the Southeast, we analyzed 60 surveys, split across the three topic areas (Wildlife Interactions n = 26; Onsite Action & Mitigation n = 16; Environment & Ecosystem n = 18). These respondents did not attend a virtual workshop to discuss and refine research questions, which could have influenced their opinions and scores, so we analyzed the Online Prioritization Survey scores separately from the workshop scores. The Online Prioritization Survey used the same questions as the virtual workshops, and the rubric remained largely unchanged, except

that all variables were scored on a 0 to 4 scale (QVoI maximum of 16). In the Online Prioritization Survey, we asked respondents to indicate their affiliations using broad categories: Solar Industry, Electric Utility, State/Local Agency, Federal Regulatory, Researcher, Product Manufacturer, Consulting, Solar Trade Association, and Non-governmental organization.

We analyzed and visualized data from the online prioritization survey like workshop results. In addition, we conducted multivariate analysis (nonparametric, distance-based Welch *t*-tests for two samples) to test whether Reducibility and QVoI scores for each question within each topic area differed between stakeholder affiliation groups: industry and non-industry. We used two groups because certain affiliations had few respondents, and the affiliations naturally group into "industry" (i.e., Solar industry, Electric Utility, Product Manufacturer, and Solar Trade Association) and "non-industry" groups (i.e., State/Local Agency, Federal Regulatory, Researcher, and Non-government organization). Because consulting companies are often contracted by industry but also conduct independent research, we excluded the "consulting" group from the affiliation analyses, while retaining the data for visualizations.

Results: Southeast Solar, Wildlife, & Ecosystem Priorities

Definitions of Terms Used

Range: the difference between the highest and lowest values in a set of data.

Centroid: the center of a multi-dimensional distribution of data points, whose coordinates are found by averaging the values in each dimension. For two-dimensional data as we present here, the centroid of a group of (*x*, *y*) points is found by averaging all the *x*-values (i.e., $\bar{x}$) and all the *y*-values (i.e., $\bar{y}$).

Coefficient of Variation (CV): a measure of variability in a group of data, defined as the ratio of the standard deviation to the mean.

Qualitative Value of Information (QVoI): an elicited measure of the potential impact of research to answer a particular question, calculated by multiplying the elicited values of the magnitude of uncertainty (how little information is currently available) and the Relevance of that uncertainty (how strongly answering the question will affect future actions).

Topic Area: Wildlife Interactions with PV Solar

Individual scores varied widely across participants (Table 3). In the Virtual Workshop, the mean CV (averaged across questions) was 40% for reducibility and 40% for QVoI, and in the Online Prioritization Survey, the mean CV was 46% for reducibility and 65% for QVoI. The mean range in QVoI scores (averaged across questions) was 6.8 (maximum score = 12) and 15.7 (maximum score = 16) for the Virtual Workshop and Online Prioritization Survey participants, respectively. Notably, there was greater separation of the candidate questions' centroids (i.e., the average position of all points) and lower variation in scores among respondents in the Virtual Workshop than the Online Prioritization Survey.

Long-term Population was consistently **identified as a high priority in both elicitation methods** (Virtual Workshop and Online Prioritization Survey), whereas Demographics and Habitat Change were scored highly by workshop participants but received low priority scores from online survey respondents (Table 3, Figure 3). Response scores placed Long-term Population as High priority (Virtual Workshop) or Highest priority (Online Survey). Workshop participants' QVoI and Reducibility scores placed Habitat Change in the Highest priority quadrant (Figure 3), but their QVoI metrics were actually highest for Demographics, underscoring the potential management value of research on demographics of wildlife associated with PV solar. In contrast, Online Prioritization Survey responses placed Demographics and Habitat Change in the Low-priority quadrant (Figure 3). Both workshop participants and online survey respondents ranked Demographics lowest in Reducibility, indicating a consistent perception that rigorous demographic studies on wildlife can be difficult and lengthy.

Wildlife Interactions Affiliation Analysis

The Online Prioritization Survey responses differed between industry and non-industry affiliation groups for **Connectivity** ($t = 7.33$, $P = 0.03$), **Demographics** ($t = 10.19$, $P = 0.01$), and **Habitat Change** ($t = 5.63$, $P = 0.04$) (Figure 4, Table 4). Additionally, the difference between affiliation groups was marginally nonsignificant for Land Conversion ($t = 4.49$, $P = 0.06$). In general, non-industry groups scored these wildlife-focused questions higher along the QVoI axis than industry groups. For Connectivity, the centroids of scores from NGOs and State/Local Agencies were within the high-priority quadrant, whereas the centroids of various industry categories, along with Research and Federal Regulatory, were within the low- or medium-priority quadrant. Most centroids clustered into the non-industry and industry groupings, except for Federal Regulatory, which clustered within the medium-priority quadrant with the other industry affiliation groups in Habitat Change.

The lack of clear affiliation-group differences for Species Occupancy and Long-Term Population may indicate congruence between industry and non-industry stakeholders. For Species Occupancy, most affiliation centroids fell in the medium- and low-priority quadrants (i.e., low QVoI scores), except NGO and Federal Regulatory, which fell in the highest- and high-priority quadrants, respectively. For Long-Term Population, all affiliation centroids were in the high- or highest-priority quadrants (Figure 4).

Topic Area: Onsite Action & Mitigation at PV Solar Facilities

Results from both the Virtual Workshop and Online Prioritization Survey highlight a broad research need to understand how species or groups of species respond to various onsite actions and mitigation measures, but they do not clearly separate questions by priority. Most question centroids clustered near each other, and error bars overlapped considerably (Figure 5), obscuring clear prioritizations. The individual scores varied widely across participants, and (averaged across questions within this topic area) the CVs were 26% and 41% of the mean for reducibility and 46% and 57% of the mean for QVoI in the Virtual Workshop and Online Prioritization Survey, respectively. The mean range in QVoI scores across questions was 8.2 (maximum score = 12) and 14 (maximum score = 16) for the Virtual Workshop and Online Prioritization Survey, respectively.

In general, Fencing, Movement Passages, Vegetation & Management, and Construction Practices consistently **clustered within or near the highest-priority quadrant** (Figure 5); whereas Biodiversity Enhancements generally scored low (especially in QVoI) in both the priority elicitations. Virtual Workshop participants indicated that Construction Practices was the clearest research priority and Biodiversity Enhancements the lowest (Table 5; Figure 5). Results from the Online Prioritization Survey indicated Fencing and Vegetation & Management were essentially tied for highest research priority (Table 5; Figure 5), though only Aquatic Features stood out as a low priority. Given its high scores in both priority elicitation rounds, we considered Construction Practices the highest priority in this topic area.

Onsite Action & Mitigation Affiliation Analysis

Online Prioritization Survey responses did not differ significantly between industry and non-industry affiliation groups for any question, although three questions were marginally nonsignificant (Biodiversity Enhancement, $t = 6.26$, $P = 0.054$; Movement Passages, $t = 4.06$, $P = 0.07$; and Construction Practices, $t = 3.57$, $P = 0.09$) (Figure 6, Table 6).

For these questions, the centroids of non-industry affiliations were within the highest- and high-priority quadrants, except for State/Local Agencies. The centroids of industry affiliations fell within the medium- and low-priority quadrants, except for Industry Trade

Associations (Movement Passages) and Utility (Construction Practices). In general, most affiliation centroids fell within the highest-priority quadrant for Fencing, potentially indicating agreement among affiliation groups.

Topic Area: Environment & Ecosystem Interactions with PV Solar

The individual scores varied widely across participants for each question, with mean (averaged over questions) CV of 34% and 46% for reducibility and 55% and 68% for QVoI in the Virtual Workshop and Online Prioritization Survey, respectively. The mean range of QVoI scores was 8.4 (maximum score = 12) and 12.8 (maximum score = 16) for the Virtual Workshop and Online Prioritization Survey, respectively.

In general, participants in both elicitation methods **consistently scored Soil Health** and, to a lesser extent, Hydrology & Erosion higher than the other questions (Table 7; Figure 7). Although Virtual Workshop participants indicated that Carbon Sequestration was a high-priority question, Online Prioritization Survey responses ranked it as low priority. Across both elicitation methods, participants consistently indicated that Nutrient Cycling and Microclimate were low or medium priority. During the discussion of this topic in the Virtual Workshop, participants noted that the questions were not mutually exclusive and that common methodologies and techniques could address them simultaneously.

Environment & Ecosystem Affiliation Analysis

The Online Prioritization Survey responses did not differ between industry- and non-industry-affiliation groups for any question (Figure 8, Table 8), with most centroids consistently clustered. For example, industry and non-industry groups consistently scored Hydrology & Erosion within or near the highest- or high-priority quadrant, and consistently scored Nutrient Cycling, Microclimate, and Carbon Sequestration within or near the low-priority quadrant.

Conclusions

This report identifies research priorities focused on Wildlife Interactions, Onsite Action & Mitigation, and Environment & Ecosystem in the Southeast United States (Table 9).

The highest priority research questions identified under each topic area are as follows:

- ***Wildlife Interactions* -** What are the long-term effects of large-scale PV solar facilities on populations of conservation-focused wildlife and their habitat?

- ***Onsite Action & Mitigation -*** What is the direction and magnitude of species, biodiversity, and ecosystem responses to various construction practices at different stages post-construction?
- ***Environment & Ecosystem*** - How does soil health on PV solar facilities of various ages compare with prior land use?

Overall, we found that Wildlife-Solar Interactions had the **strongest separation** of candidate research questions by priority, as well as the **strongest evidence of disparate priorities** between participant affiliation groups. Participants' scores varied widely within each topic area, which may reflect genuine disagreement among stakeholders about which research questions are most important to answer to inform management decisions. Nevertheless, at least one question within each topic area received consistent scores indicating it as a priority. If addressed, these research priorities could accelerate our understanding of the impacts and benefits of PV solar buildout on species, biodiversity, and ecosystems in the Southeastern United States.

A salient aim of this initiative was **collaboration**. The workshop and surveys, along with the Planning Committee, gathered experts, researchers, and decision-makers to ensure representation of all values, opinions, and needs. This report's findings reflect the views of the broader stakeholder community in the Southeast United States, rather than those of individual organizations or companies. This collaborative effort aims to help funding agencies and industry use these findings to inform their r**esearch need statements** and goals, requests for proposals, and environmental and sustainability goals.

Wildlife Interactions Conclusions

Participants provided the most consistent support for Long-Term Population, which focuses on population dynamics of sensitive species (i.e., species of concern and conservation-focused species), across both the Virtual Workshop and Online Prioritization Survey.

Additionally, industry and non-industry participants consistently scored Long-Term Population as highest- or high-priority in the Online Prioritization Survey. In general, non-industry participants consistently scored wildlife interaction questions higher than industry participants did, including Connectivity, Demographics, Habitat Change, and Land Conversion.

Wildlife Interactions Priority Research Question

What are the long-term effects of large-scale PV solar facilities on populations of conservation-focused wildlife and their habitat?

A project designed to address this priority would need **two or more solar facilities** for replication and multiple years with **high-intensity sampling**. Such projects are often expensive; depending on the response variable, they may require multiple years of funding, high labor costs, and replicate solar facilities to account for site effects or different onsite actions or mitigation practices.

Onsite Action & Mitigation Conclusions

Participants' scoring of questions clustered more tightly than in the other topic areas (i.e., Wildlife Interactions and Environment & Ecosystem) because of similar mean QVoI values, suggesting stakeholders generally agree on the importance of addressing these types of questions. Construction Practices was ranked as the highest-priority question in the Virtual Workshop and Online Prioritization Survey. Although Fencing and Vegetation & Management were not the highest-priority questions, they received relatively high QVoI scores in both the Virtual Workshop and Online Prioritization Survey, and broad agreement between industry and non-industry respondents on their importance.

Onsite Action & Mitigation Priority Research Question

What is the direction and magnitude of species, biodiversity, and ecosystem responses to various construction practices at different stages of post-construction?

An ideal project to address this priority would require upwards of **10 solar facilities**, various construction-related practices, and multiple years of **high- to low-intensity sampling**, depending on the response variable of interest. Researchers might also struggle to isolate the effect of a single construction practice because of confounding factors (e.g., varying vegetation management practices across sites). Depending on the response variable, these projects could be relatively inexpensive but still require multiple years of funding. However, species-level responses (e.g., movement and resource use) would require high-intensity sampling, which could increase labor costs.

Environment & Ecosystem Conclusions

Participants scored Environment & Ecosystem questions lower on QVoI than questions within Wildlife Interactions and Onsite Action & Mitigation topic areas. In general, across the Virtual Workshop and Online Prioritization Survey, Soil Health and Hydrology & Erosion were consistently scored higher, and industry and non-industry participants generally scored these questions as the highest or high priority. Notably, common methodologies and techniques could simultaneously address most questions in this topic area.

Environment & Ecosystem Priority Research Question

How does soil health on PV solar facilities of various ages compare with prior land use?

A project designed to address this priority would need **at least five solar facilities** of various ages and require **moderate- to low-intensity sampling** (relative to Wildlife Interactions questions). Of note, solar-induced microclimates and plant responses influence numerous soil health metrics. The project would require multiple samples across the various microclimates, which would increase costs, especially if abiotic sensors are deployed to characterize them. Additionally, vegetation type and its management (e.g., mowing, grazing, and herbicide) can influence soil outcomes. To understand these factors' effects, the project would need multiple solar facilities that isolate each factor.

Tables & Figures

Table 1. Count and percentage of individuals who received and responded to the scoping survey by stakeholder group. The "Other" affiliation category included land manager/owner and agriculture.

Affiliation Category	Surveyed		Responding	
	Count	%	Count	%
Researcher (university or national lab)	26	6.1	15	16.7
Consulting firm	104	24.4	22	24.4
Federal agency	70	16.4	6	6.7
State agency	23	5.4	8	8.9
Non-government conservation organization	46	10.8	16	17.8
Energy company, utility, or trade association	138	32.4	19	21.1
Other	19	4.5	4	4.4
Total	426	100	90	100

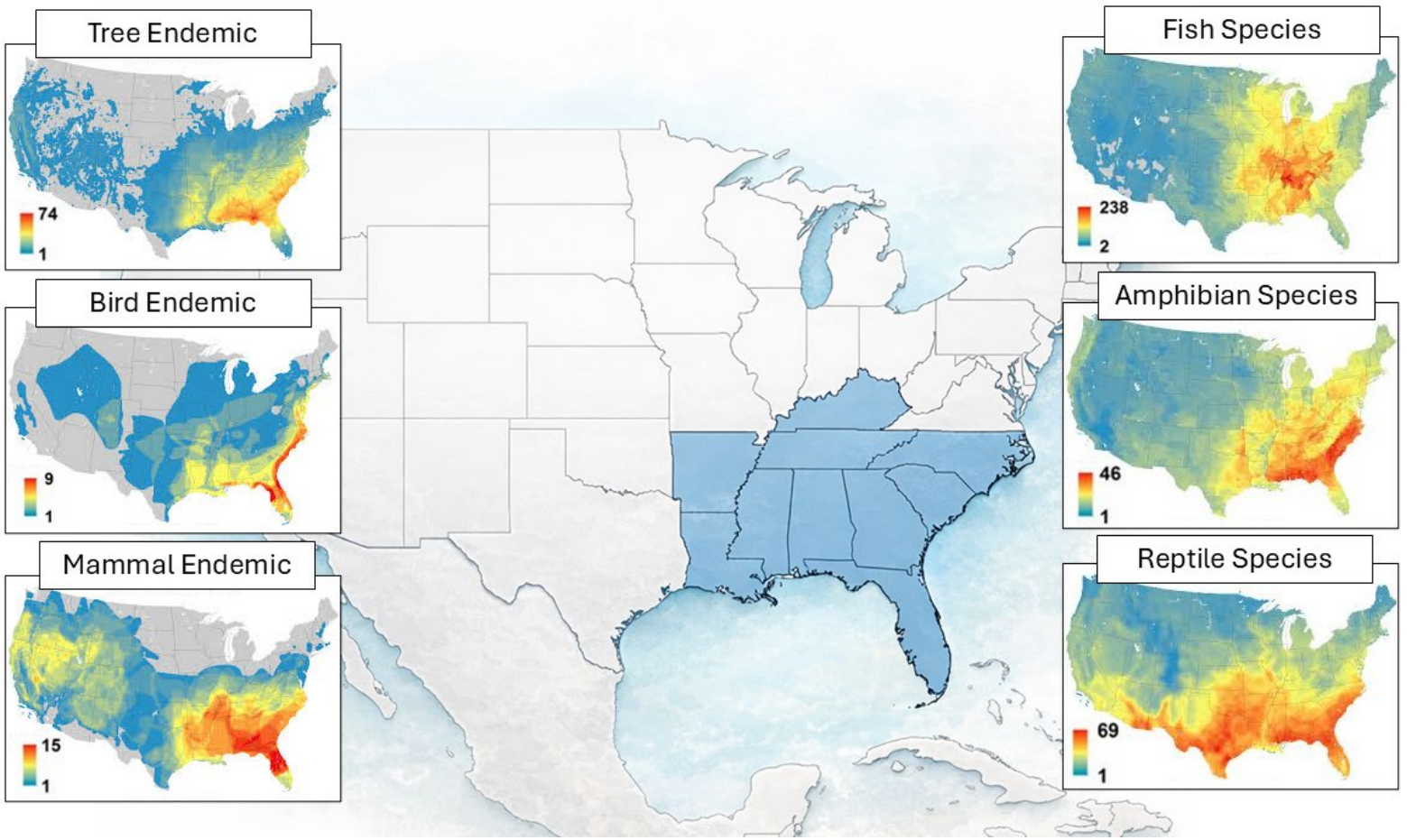


Figure 1. United States Fish and Wildlife Service Region 4 ("Southeast"; shaded blue) consists of 10 biodiversity-rich states. Inset maps represent endemism (left) and species richness (right) using a color gradient. These maps are from Jenkins et al. (2015) and were used with permission from Clinton Jenkins.

Figure 2. A conceptual diagram summarizing the design and process of identifying priority research questions. A Scoping Survey informed the initial set of candidate research questions. The project team and planning committee sorted these questions into three topic areas (i.e., Wildlife Interactions, Onsite Action & Mitigation, and Environment & Ecosystem) and then distilled them into 5 to 6 questions for the Virtual Workshops, where stakeholders discussed, refined, and scored them. Additionally, the project team created the Online Prioritization Survey to increase sample size and retain stakeholder affiliations. Finally, the project team summarized the scoring from both the Virtual Workshops and Online Prioritization Survey to identify research priorities.

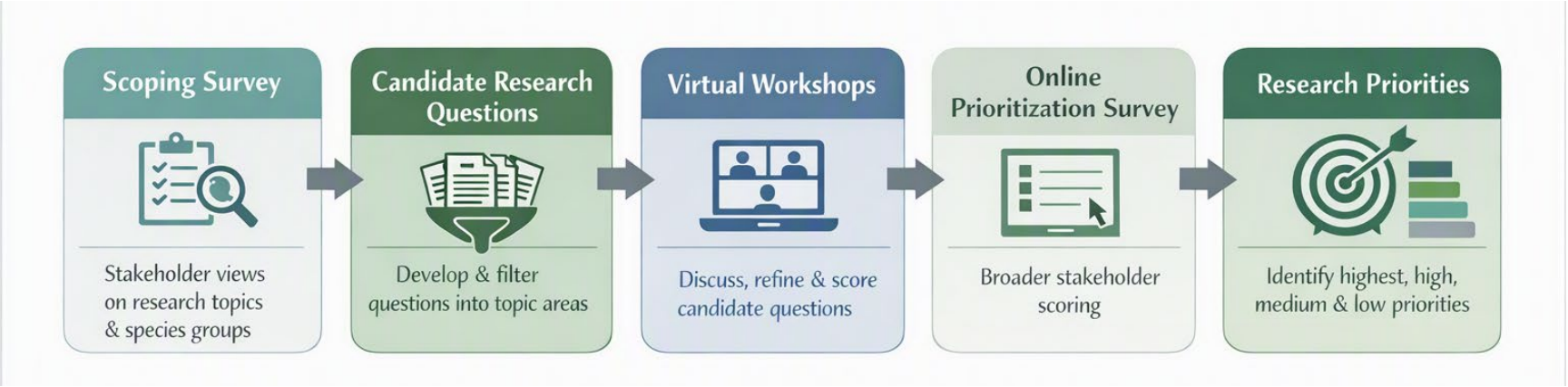


Table 2. Research questions used in the workshop and survey. The abbreviated descriptions in parentheses refer to the questions throughout the text.

Topic Area	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
Wildlife Interactions	How do solar facilities influence landscape connectivity and movement for vertebrate species that typically cannot access the solar footprint? (**Connectivity**)	How do species occupancy and detection rates at PV solar farms compare to prior/surrounding land use types? (**Species Occupancy**)	How are demographic rates and population structure (e.g., sex ratio, age class, etc.) of species of concern affected by PV solar facilities, including facility-specific variables or landscape variables? (**Demographics**)	How do solar farms affect habitat change (including loss and creation), fragmentation, and connectivity in landscapes with existing anthropogenic disturbances (e.g., roads, agriculture, oil/gas, urban development)? Do they amplify or mitigate these issues, and at what magnitude? (**Habitat Change**)	What are the long-term effects of large-scale PV solar facilities on populations of conservation-focused wildlife (particularly keystone species [e.g., gopher tortoise] and species of concern) and their habitat (vegetation community)? (**Long-term Population**)	What landcover types (agriculture/silviculture/pasture lands, native pine plantations, native grasslands, native scrublands) are being converted to PV solar facilities in the Southeast and how does this compare to other anthropogenic conversions (e.g., housing/urbanization, agricultural, etc.)? (**Land Conversion**)
Onsite Action & Mitigation	What is the direction and magnitude of species (or groups of species) responses to specialized habitat enhancements (bee boxes, bird nesting boxes, artificial burrows, log and stone piles or hedgerows along the fence) and what is the return on investment? (**Biodiversity Enhancements**)	What is the direction and magnitude of species (or groups of species) responses (occupancy and behavior) to semi-permeable fencing (i.e., wildlife-friendly fencing) and what is the return on investment? (**Fencing**)	What is the direction and magnitude of species (or groups of species) responses to various dimensions of wildlife movement passages (i.e., site layout) and what is the return on investment? (i.e., testing the most effective dimensions of wildlife movement passages) (**Movement Passages**)	What is the direction and magnitude of species (or group of species) and ecosystem function responses to seed mix (native vegetation, turfgrass, or a combination of both) and vegetation management (mowing or grazing practices) on PV solar facilities, and what is the return on investment? (**Vegetation & Management**)	What is the direction and magnitude of species, biodiversity, and ecosystem responses to various construction practices (grading, removing topsoil, pre-seeding, etc.) at different stages post-construction? (**Construction Practices)**	What is the direction and magnitude of wildlife, biodiversity, and ecosystem function response to incorporating wetlands (permanent or ephemeral) and/or streams (permanent or intermittent) within the footprint of a solar facility, and what is the return on investment? (**Aquatic Features**)
Environment & Ecosystem	How do nutrient cycling rates on PV solar facilities of various ages & construction practices compare with prior land use? **(Nutrient Cycling)**	How do water infiltration rates and erosion on PV solar facilities of various ages and construction practices compare with prior land use? **(Hydrology & Erosion)**	How do PV solar farms modify microclimates onsite and offsite in the Southeastern United States? **(Microclimate)**	How does soil health (compaction, organic matter, microbial processes) on PV solar facilities of various ages compare with prior land use? **(Soil Health)**	How does carbon sequestration in labile and recalcitrant pools on PV solar facilities of various ages and construction practices compare with prior land use? **(Carbon Sequestration)**	

Table 3. The scoring results (mean and standard deviation) and prioritization of the six research questions focused on Wildlife Interactions with photovoltaic solar development and operation. Values are based on a workshop with 12 respondents and an online survey with 26 respondents. Please see Appendix E for this table with full details (i.e., magnitude and relevance).

Workshop (n =12)				Survey (n = 26)			
Question	Reducibility	QVoI	Priority Rank	Question	Reducibility	QVoI	Priority Rank
Long-Term Population	1.50 (0.80)	6.08 (2.47)	High	Long-Term Population	2.35 (1.09)	9.46 (4.28)	Highest
Demographics	1.09 (0.83)	9.27 (1.62)	High	Demographics	1.81 (1.06)	5.27 (4.56)	Low
Habitat Change	1.75 (0.45)	7.33 (2.99)	Highest	Habitat Change	2.15 (1.12)	6.85 (4.36)	Low
Land Conversion	2.25 (0.45)	5.17 (2.25)	Medium	Land Conversion	2.88 (0.95)	7.50 (4.69)	Medium
Species Occupancy	1.82 (0.40)	4.73 (2.10)	Medium	Species Occupancy	2.46 (1.07)	5.96 (4.06)	Medium
Connectivity	1.70 (0.67)	3.30 (1.83)	Medium	Connectivity	2.16 (0.94)	6.88 (4.50)	Low

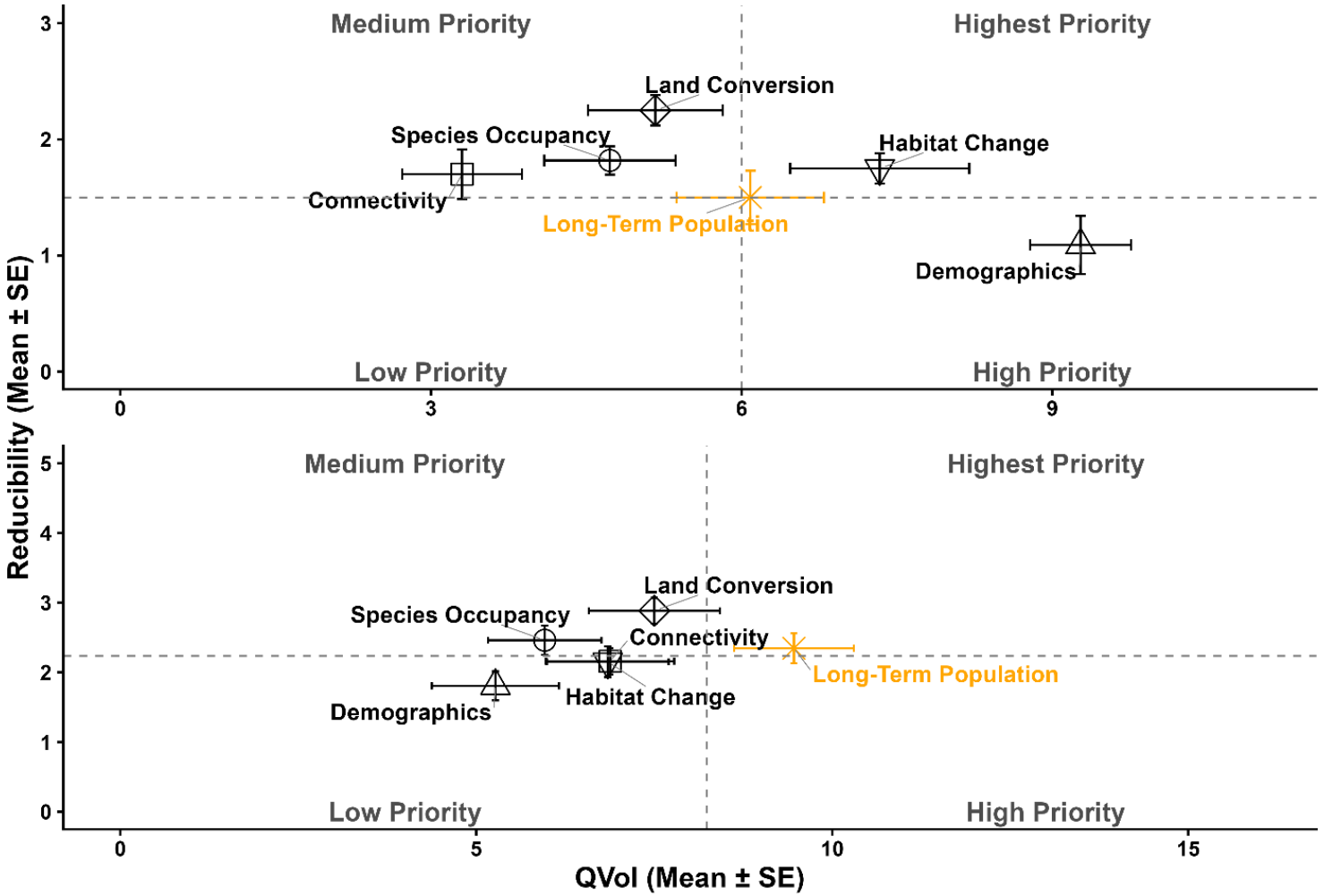


Figure 3. (Top) For the virtual workshop, the relationship between the qualitative value of information (QVoI) and reducibility scores (n = 12) for six research questions related to Wildlife Interactions in the Southeastern United States. (Bottom) For the Online Prioritization Survey, the relationship between QVoI and reducibility scores (n = 26) for six research questions related to Wildlife Interactions in the Southeastern United States. Symbols represent mean values, and error bars are standard errors (SE). The labels correspond to the candidate research questions in Table 2. The orange label represents the highest research priority. The vertical and horizontal dashed lines separate the four prioritization categories: low, medium, high, and highest.

Table 4. The scoring results (mean and standard deviation) of the six research questions focused on Wildlife Interactions separated by affiliation categories (i.e., consulting, industry, and non-industry). Values are based on an online survey with 26 respondents. Bold text represents significant scoring differences between industry and non-industry at alpha = 0.05.

Question / Variable		Consulting (n = 5)	Industry (n = 6)	Non-Industry (n = 15)	t-value / P-value
Long-Term Population					t = 0.63, P = 0.83
	Reducibility	2.60 (1.14)	2.50 (0.84)	2.20 (1.21)	
	QVoI	7.40 (4.16)	9.83 (4.4)	10.00 (4.36)	
Connectivity					**t = 7.33, P = 0.03**
	Reducibility	2.60 (1.14)	2.33 (0.82)	1.93 (0.92)	
	QVoI	6.80 (4.09)	4.33 (0.82)	8.00 (5.26)	
Species Occupancy					t = 1.70, P = 0.24
	Reducibility	2.40 (1.52)	2.83 (0.41)	2.33 (1.11)	
	QVoI	5.40 (3.29)	4.67 (2.07)	6.67 (4.85)	
Demographics					**t = 10.19, P = 0.01**
	Reducibility	1.40 (1.34)	1.33 (0.82)	2.13 (0.99)	
	QVoI	2.60 (2.41)	2.00 (1.79)	7.47 (4.69)	
Habitat Change					**t = 5.63, P = 0.04**
	Reducibility	2.00 (1.58)	1.67 (1.21)	2.40 (0.91)	
	QVoI	6.20 (4.6)	3.67 (3.39)	8.33 (4.12)	
Land Conversion					t = 4.49, P = 0.06
	Reducibility	2.20 (1.3)	3.00 (0.00)	3.07 (0.96)	
	QVoI	6.60 (3.91)	4.50 (3.67)	9.00 (4.86)	

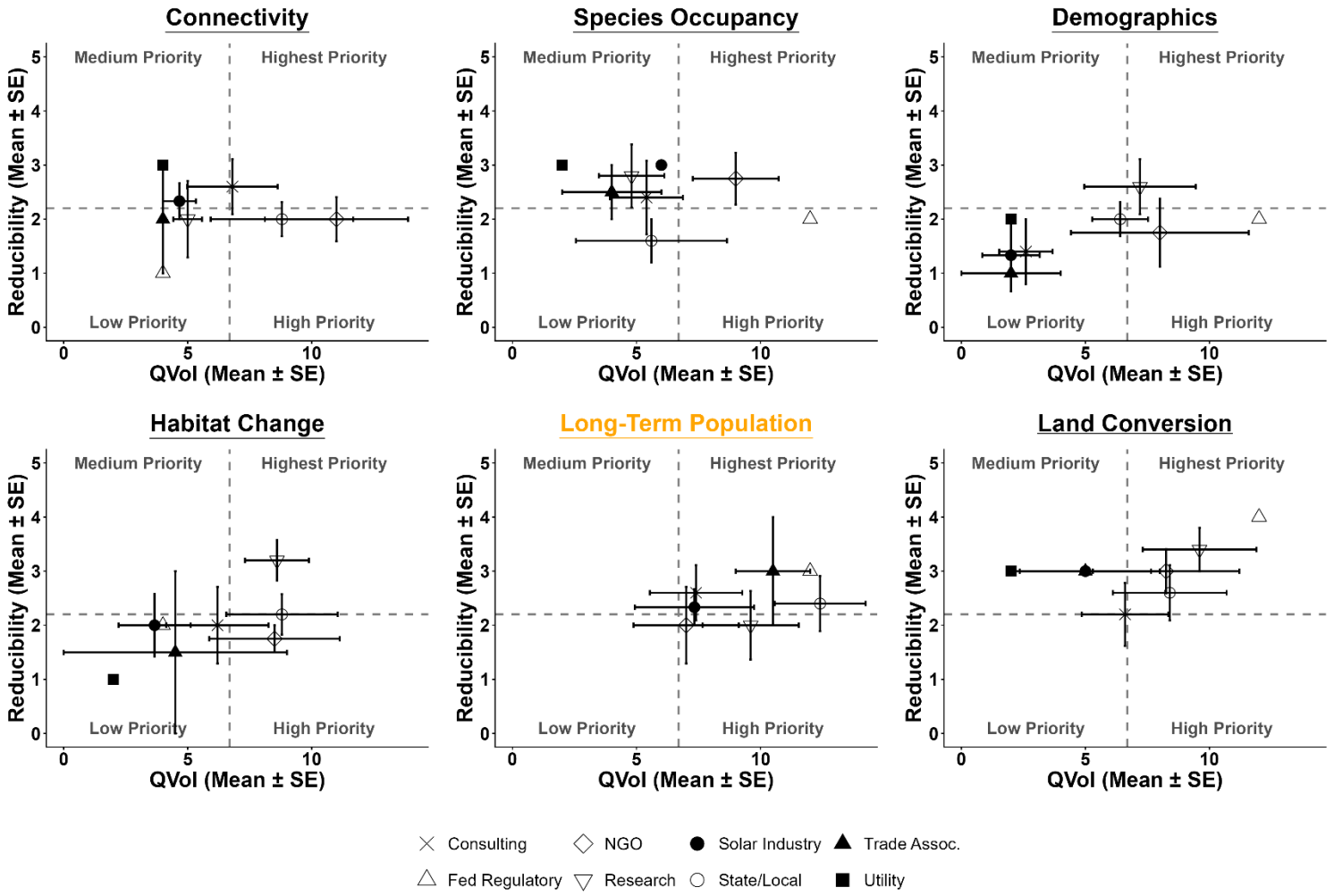


Figure 4. The relationship between the qualitative value of information (QVoI) and reducibility scores (n = 26) among affiliation groups (industry – solid, non-industry – open, and consulting – "X") for Wildlife Interactions. The orange label represents the highest research priority.

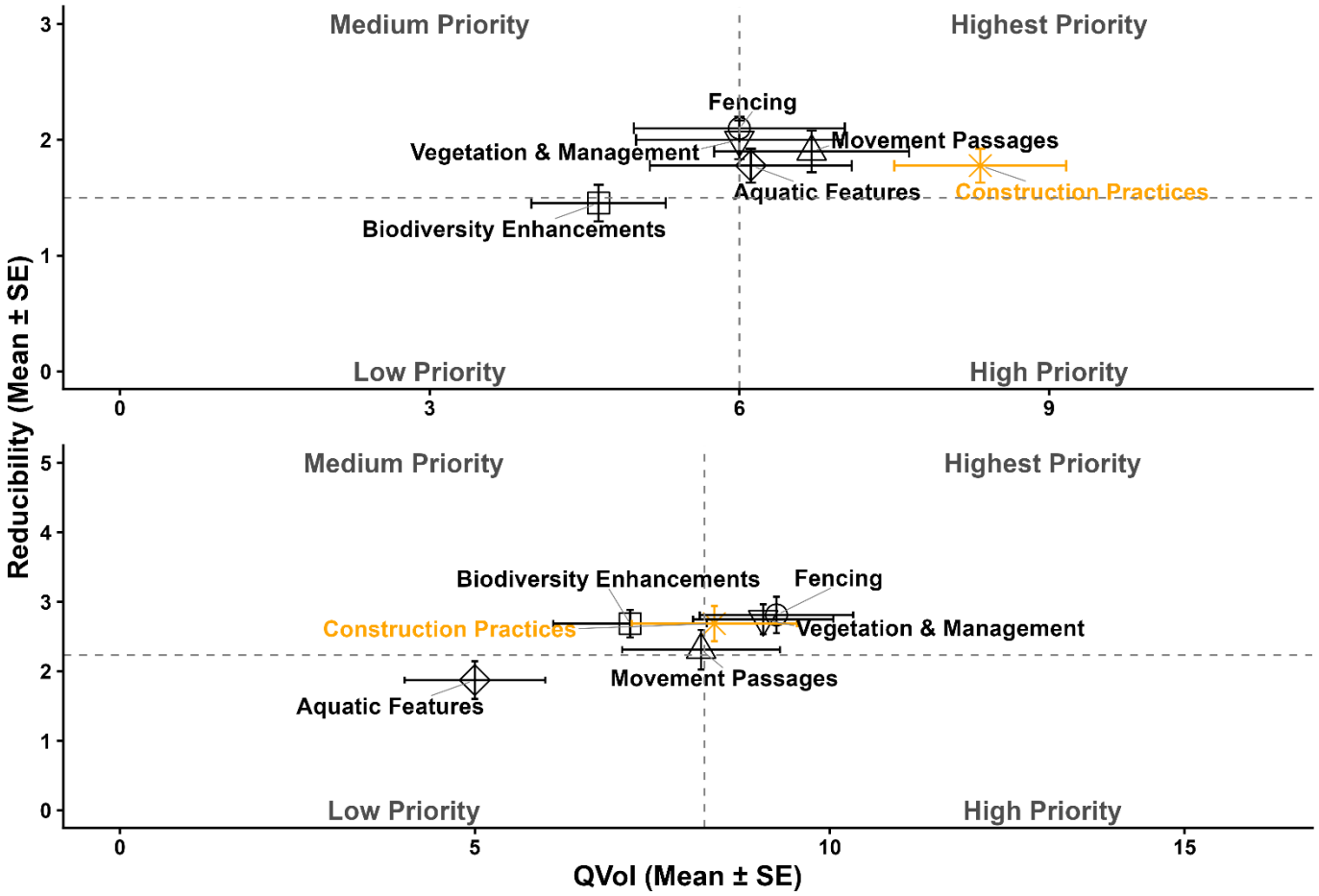


Figure 5. (Top) For the virtual workshop, the relationship between the qualitative value of information (QVoI) and reducibility scores (n = 11) for six research questions related to Onsite Action & Mitigation in the Southeastern United States. (Bottom) For the online prioritization survey, the relationship between QVoI and reducibility scores (n = 16) for six research questions related to Onsite Action & Mitigation in the Southeastern United States. Symbols represent mean values, and error bars are standard errors. The labels correspond to the candidate research questions in Table 2. The orange label represents the highest research priority. The vertical and horizontal dashed lines separate the four prioritization categories: low, medium, high, and highest.

Table 5. The scoring results (mean and standard deviation) and prioritization of the six research questions focused on Onsite Action & Mitigation associated with photovoltaic solar development and operation. Values are based on a workshop with 11 respondents and an online survey with 16 respondents. Please see Appendix E for this table with full details (i.e., magnitude and relevance).

Workshop (n =11)				Survey (n = 16)			
Question	Reducibility	QVoI	Priority Rank	Question	Reducibility	QVoI	Priority Rank
Construction Practices	1.78 (0.44)	8.33 (2.50)	Highest	Construction Practices	2.69 (1.01)	8.38 (4.66)	Highest
Movement Passages	1.90 (0.57)	6.70 (2.98)	Highest	Movement Passages	2.31 (1.14)	8.19 (4.45)	Medium
Aquatic Features	1.78 (0.44)	6.11 (2.93)	Highest	Aquatic Features	1.88 (1.09)	5.00 (3.97)	Low
Fencing	2.10 (0.32)	6.00 (3.23)	Medium	Fencing	2.81 (1.05)	9.25 (4.33)	Highest
Vegetation & Management	2.00 (0.50)	6.00 (3.00)	Medium	Vegetation & Management	2.75 (0.86)	9.06 (3.96)	Highest
Biodiversity Enhancements	1.45 (0.52)	4.64 (2.16)	Low	Biodiversity Enhancements	2.69 (0.79)	7.19 (4.32)	Medium

Table 6. The scoring results (mean and standard deviation) of the six research questions focused on Onsite Action & Mitigation, separated by affiliation categories (i.e., consulting, industry, and non-industry). Values are based on an online survey with 16 respondents.

Question / Variable	Consulting (n = 5)	Industry (n = 5)	Non-Industry (n = 6)	t-value / P-value
Construction Practices				t = 3.57, P = 0.09
Reducibility	2.80 (1.10)	2.20 (0.84)	3.00 (1.10)	
QVoI	6.40 (2.51)	5.60 (3.51)	12.33 (4.46)	
Fencing				t = 2.74, P = 0.15
Reducibility	3.40 (0.89)	2.40 (0.89)	2.67 (1.21)	
QVoI	9.40 (4.77)	7.00 (3.08)	11.00 (4.65)	
Movement Passages				t = 4.06, P = 0.07
Reducibility	3.20 (0.84)	1.40 (0.55)	2.33 (1.21)	
QVoI	9.60 (5.13)	5.20 (4.15)	9.50 (3.39)	
Vegetation & Management				t = 0.03, P = 0.92
Reducibility	3.00 (0.71)	2.80 (0.45)	2.50 (1.22)	
QVoI	10.40 (3.13)	8.80 (4.55)	8.17 (4.45)	
Biodiversity Enhancements				t = 6.26, P = 0.054
Reducibility	2.80 (1.10)	2.60 (0.55)	2.67 (0.82)	
QVoI	9.40 (4.77)	4.40 (1.67)	7.67 (4.76)	
Aquatic Features				t = 0.79, P = 0.45
Reducibility	2.00 (1.22)	2.00 (1.00)	1.67 (1.21)	
QVoI	3.80 (1.79)	3.80 (3.03)	7.00 (5.44)	

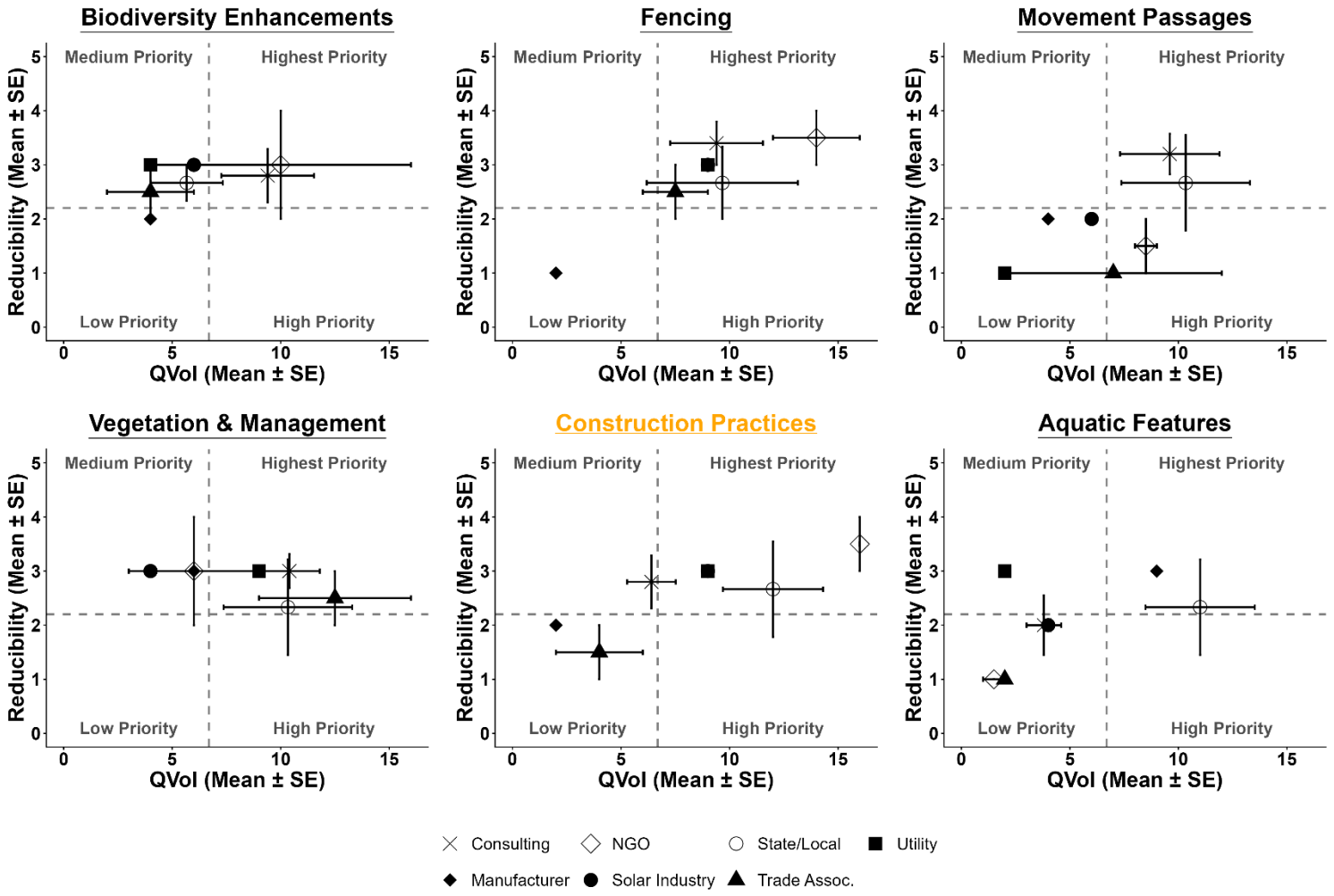


Figure 6. The relationship between the qualitative value of information (QVoI) and reducibility scores (n = 16) among affiliation groups (industry – solid, non-industry – open, and consulting – "X") for Onsite Action & Mitigation. The orange label represents the highest research priority.

Table 7. The scoring results (mean and standard deviation) and prioritization of the five research questions within the Environment & Ecosystem topic. Values are based on a workshop with 9 respondents with complete data and an online survey with 18 respondents. Please see Appendix E for this table with full details (i.e., magnitude and relevance).

Workshop (n =9)				Survey (n = 18)			
Question	Reducibility	QVoI	Priority Rank	Question	Reducibility	QVoI	Priority Rank
Soil Health	2.00 (0.50)	6.56 (3.09)	Highest	Soil Health	2.33 (0.97)	7.17 (4.15)	Medium
Carbon Sequestration	1.44 (0.53)	6.89 (3.18)	High	Carbon Sequestration	1.59 (0.94)	4.18 (3.86)	Low
Hydrology & Erosion	1.89 (0.33)	5.33 (2.50)	Medium	Hydrology & Erosion	2.28 (0.75)	7.78 (3.10)	Medium
Microclimate	1.78 (0.44)	3.67 (3.12)	Medium	Microclimate	1.76 (0.90)	4.18 (3.17)	Low
Nutrient Cycling	1.33 (0.87)	5.44 (2.65)	Low	Nutrient Cycling	1.94 (0.87)	4.72 (2.97)	Low

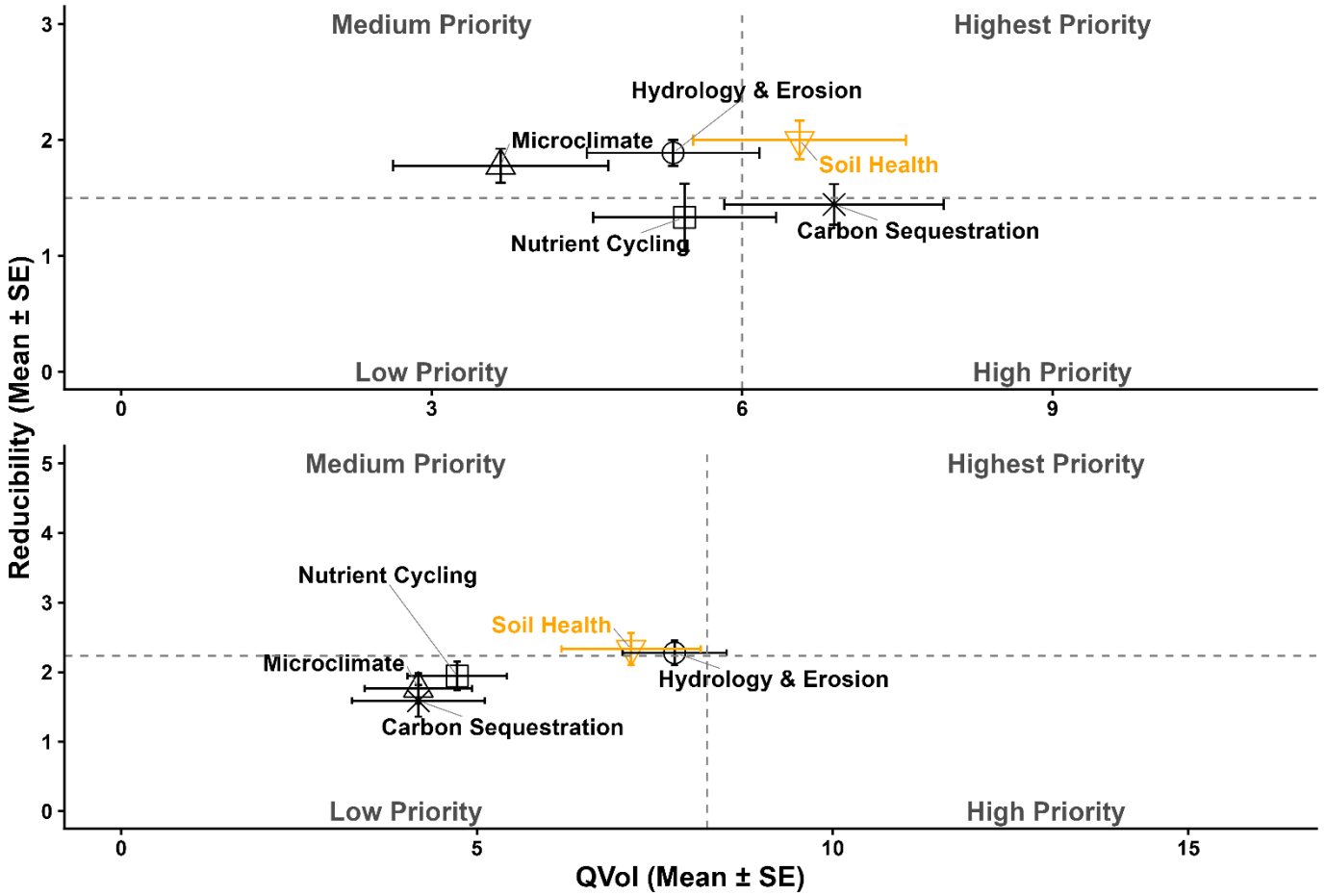


Figure 7. (Top) For the virtual workshop, the relationship between the qualitative value of information (QVoI) and reducibility scores (n = 9) for five research questions related to Environment & Ecosystem interactions with solar facilities in the Southeastern United States. (Bottom) For the Online Prioritization Survey, the relationship between QVoI and reducibility scores (n = 18) for five research questions related to Environment & Ecosystem interactions with solar facilities in the Southeastern United States. Symbols represent mean values, and error bars are standard errors. The labels correspond to the questions in Table 2. The orange label represents the highest research priority. The vertical and horizontal dashed lines separate the four prioritization categories: low, medium, high, and highest.

Table 8. The scoring results (mean and standard deviation) of the five research questions focused on Environment & Ecosystem, separated by affiliation categories (i.e., consulting, industry, and non-industry). Values are based on an online survey with 18 respondents.

Question / Variable	Consulting (n = 4)	Industry (n = 5)	Non-Industry (n = 9)	t-value / P-value
Soil Health				t = 0.18, P = 0.70
Reducibility	3.50 (1.00)	1.80 (0.84)	2.11 (0.60)	
QVol	9.50 (5.51)	6.80 (3.63)	6.33 (3.87)	
Hydrology & Erosion				t =1.54, P = 0.26
Reducibility	3.00 (0.82)	2.40 (0.55)	1.89 (0.60)	
QVol	7.00 (3.46)	9.00 (2.12)	7.44 (3.50)	
Microclimate				t = 1.52, P = 0.23
Reducibility	1.75 (0.96)	1.40 (0.89)	2.00 (0.93)	
QVol	3.25 (3.30)	3.00 (2.00)	5.38 (3.46)	
Nutrient Cycling				t = 0.40, P = 0.60
Reducibility	2.00 (0.82)	1.60 (0.89)	2.11 (0.93)	
QVol	5.75 (4.65)	4.20 (2.05)	4.56 (2.79)	
Carbon Sequestration				t = 1.95, P = 0.21
Reducibility	2.25 (1.50)	1.20 (0.45)	1.50 (0.76)	
QVol	7.00 (6.98)	2.80 (1.30)	3.63 (2.39)	

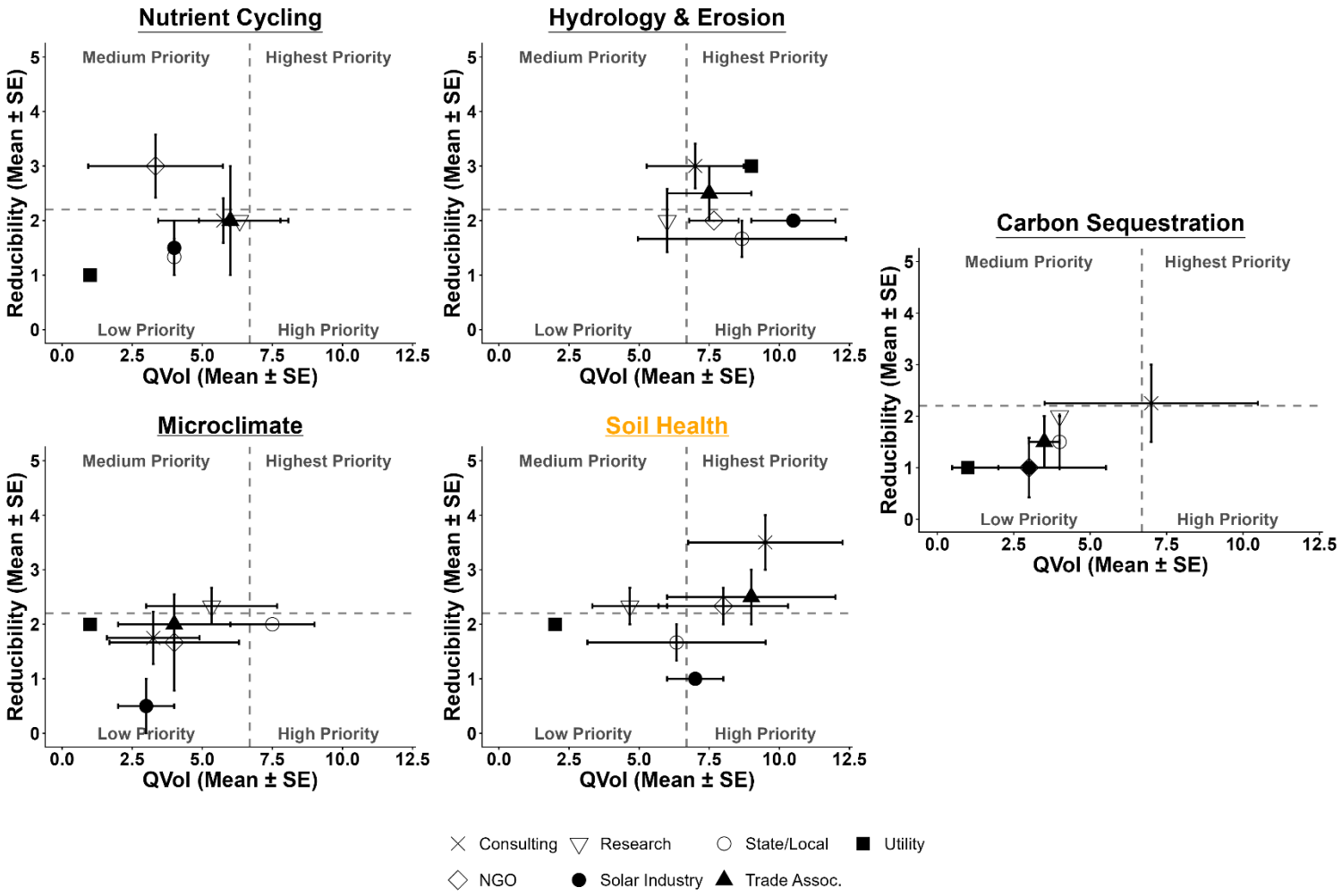


Figure 8. The relationship between the qualitative value of information (QVoI) and reducibility scores (n = 18) among affiliation groups (industry – solid, non-industry – open, and consulting – "X") for Environment & Ecosystem. The orange title represents the highest research priority.

Table 9. Summarized results and final priority ranking for each question under the three topic areas. The orange text represents the highest priority research question for each topic area.

Summary of the priority research questions evaluated under each topic area			
Topic	**Research Question**	**Priority Ranking**	
		Workshop	Survey
Wildlife Interactions			
Long-Term Population	**What are the long-term effects of large-scale PV solar facilities on populations of conservation-focused wildlife (particularly keystone species [e.g., gopher tortoise] and species of concern) and their habitat (vegetation community)?**	**High**	**Highest**
Habitat Change	How do solar farms affect habitat change (including loss and creation), fragmentation, and connectivity in landscapes with existing anthropogenic disturbances (e.g., roads, agriculture, oil/gas, urban development)? Do they amplify or mitigate these issues, and at what magnitude?	Highest	Low
Demographics	How are demographic rates and population structure (e.g., sex ratio, age class, etc.) of species of concern affected by PV solar facilities, including facility-specific variables or landscape variables?	High	Low
Land Conversion	What landcover types (agriculture/silviculture/pasture lands, native pine plantations, native grasslands, native scrublands) are being converted to PV solar facilities in the Southeast and how does this compare to other anthropogenic conversions (e.g., housing/urbanization, agricultural, etc.)?	Medium	Medium
Species Occupancy	How do species occupancy and detection rates at PV solar farms compare to prior/surrounding land use types?	Medium	Medium
Connectivity	How do solar facilities influence landscape connectivity and movement for vertebrate species that typically cannot access the solar footprint?	Medium	Low
Onsite Action & Mitigation			
Construction Practices	**What is the direction and magnitude of species, biodiversity, and ecosystem responses to various construction practices (grading, removing topsoil, pre-seeding, etc.) at different stages post-construction?**	**Highest**	**Highest**
Fencing	What is the direction and magnitude of species (or groups of species) responses (occupancy and behavior) to semi-permeable fencing (i.e., wildlife-friendly fencing) and what is the return on investment?	Medium	Highest
Vegetation & Management	What is the direction and magnitude of species (or group of species) and ecosystem function responses to seed mix (native vegetation, turfgrass, or a combination of both) and vegetation management (mowing or grazing practices) on PV solar facilities, and what is the return on investment?	Medium	Highest
Movement Passages	What is the direction and magnitude of species (or groups of species) responses to various dimensions of wildlife movement passages (i.e., site layout) and what is the return on investment? (i.e., testing the most effective dimensions of wildlife movement passages)	Highest	Medium
Aquatic Features	What is the direction and magnitude of wildlife, biodiversity, and ecosystem function response to incorporating wetlands (permanent or ephemeral) and/or streams (permanent or intermittent) within the footprint of a solar facility, and what is the return of investment?	Highest	Low
Biodiversity Enhancements	What is the direction and magnitude of species (or groups of species) responses to specialized habitat enhancements (bee boxes, bird nesting boxes, artificial burrows, log and stone piles or hedgerows along the fence) and what is the return on investment?	Low	Medium
Environment & Ecosystem			
Soil Health	**How does soil health (compaction, organic matter, microbial processes) on PV solar facilities of various ages compare with prior land use?**	**Highest**	**Medium**
Carbon Sequestration	How does carbon sequestration in labile and recalcitrant pools on PV solar facilities of various ages and construction practices compare with prior land use?	High	Low
Hydrology & Erosion	How do water infiltration rates and erosion on PV solar facilities of various ages and construction practices compare with prior land use?	Medium	Medium
Microclimate	How do PV solar farms modify microclimates onsite and offsite in the Southeastern United States?	Medium	Low
Nutrient Cycling	How do nutrient cycling rates on PV solar facilities of various ages & construction practices compare with prior land use?	Low	Low

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Appendices

Appendix A – Scoping Survey

The purpose of the Solar Research Priorities Pre-survey was to gain an understanding of what topics, species, and pressing decisions need information to inform decision-making in the Southeastern United States.

1. What is your role related to solar/wildlife/ecosystems issues? Select all that apply:

- Industry
- Research
- Federal Agency
- State Agency
- Local Agency
- Regulator
- NGO
- Academia
- Land manager/owner
- Agriculture
- Consulting
- Community member
- Other: _____

2. What is the geographic scope of your work? Map of USFWS Region 4 for reference; note that the scope of this initiative only includes continental states. Select all that apply:

- Outside of the United States
- National (USA) in scope
- Primarily (>50%) within southeastern states (USFWS Region 4)
- Partially (less than 50%) within southeastern states (USFWS Region 4)

3. What southeastern state(s) do you primarily work in, or are especially concerned about? Select up to 3:

- Alabama
- Arkansas
- Florida
- Georgia
- Kentucky

- Louisiana
- Mississippi
- North Carolina
- South Carolina
- Tennessee
- My work is region-wide
- None of the above

4. For each research topic area, please indicate its level of importance or concern to you and/or your organization on a scale of 1 (not important) to 5 (most important):

- Constraints around Site Selection
- Effectiveness of site design and construction practices
- Quantifying the value of solar as wildlife habitat
- Population-level effects of solar on particular wildlife species (e.g., survival, reproduction, behavioral, etc.)
- Community-level effects of solar (e.g., biodiversity, species composition, etc.)
- Landscape-level impacts – habitat loss and fragmentation, connectivity
- Effectiveness of specific site management/conservation/mitigation practices (e.g., wildlife-permeable fencing, movement corridors, etc.)
- Ecosystem services (e.g., nutrient cycling)
- Soil health
- Erosion, sediment, and runoff
- Effects on abiotic environment – microclimate, photovoltaic heat island effects, etc.
- Incidental take
- Decommissioning

5. Please choose your top 2-5 research topic areas from question 4 and share your specific questions or concerns:

6. For each taxonomic group, please indicate its level of importance or concern to you and/or your organization on a scale of 1 (not important) to 5 (most important)

- Birds
- Bats
- Small mammals (non-volant)
- Large mammals
- Amphibians
- Reptiles

- Pollinators & other terrestrial invertebrates
- Soil invertebrates
- Fish
- Aquatic Invertebrates
- Plants

7. What decision(s) are you faced with re: solar/wildlife/ecosystems where you lack appropriate scientific knowledge/data to make a sound, informed decision?

8. If you are not already subscribed and would like to receive REWI updates on renewable energy and wildlife research, including webinars and events, please enter your email. You can update your subscription preferences or unsubscribe at any time.

9. If there is anybody in your professional network whose insights would be valuable to this initiative, please forward this survey to them or enter their names and email addresses below.

Appendix B – Scoring Rubrics

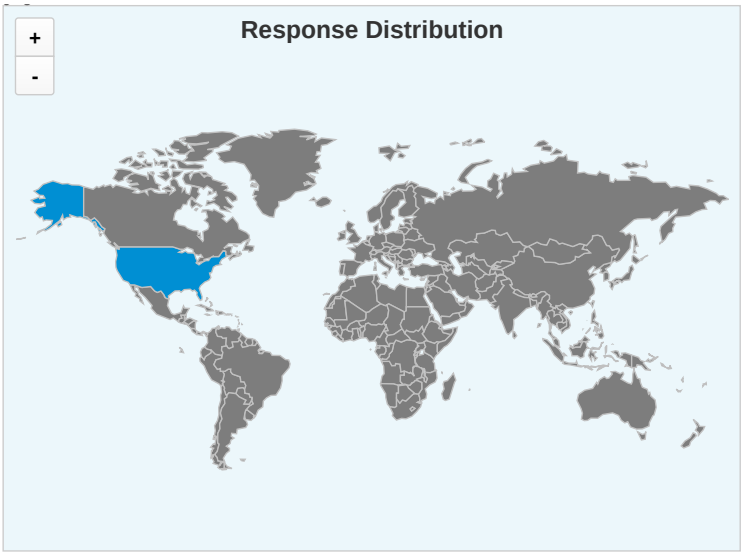
Category	Score				
	0	1	2	3	4
Magnitude	Firm theoretical foundation and a large number of empirical studies (> 3) that support theoretical predictions	Firm theoretical foundation with robust empirical support; OR Large number (> 3) of consistent empirical studies	Firm theoretical foundation with moderate empirical support; OR Moderate number (2-3) of consistent empirical studies	Firm theoretical foundation with no empirical support; OR Small number (< 2) of consistent empirical studies	Large disagreement between theory and empirical studies; OR No theoretical basis and inconsistent empirical studies
Relevance	Preferred management action will be favored regardless of whether hypothesis is true	Reducing uncertainty is predicted to improve management outcomes but range of outcomes will be swamped by natural variability and other uncertainties	Reducing uncertainty is predicted to improve management outcomes; a range of outcomes will be small to moderate compared to natural variability and other uncertainties	Reducing uncertainty is predicted to improve management outcomes and range of outcomes will be same order of magnitude as natural variability and other uncertainties	
Reducibility	Data necessary to reduce uncertainty does not currently exist and will be prohibitively difficult/expensive to collect given current technologies	Data to reduce uncertainty exist only for a limited taxonomic, geographic, or temporal scope but cannot resolve the specific mechanisms; collection of additional data needed to discriminate among alternative mechanisms will be difficult/expensive or cannot be collected in timeframe relevant to decision	Data to reduce uncertainty exist but only for a limited taxonomic, geographic, or temporal scope OR data only allow weak inference about mechanisms; collection of additional data needed to discriminate among alternative mechanisms is feasible given current technologies	Data to reduce uncertainty exist across a large taxonomic, geographic, or temporal scope AND credible inference can be made from these data	

Appendix C -Post-Workshop Assessment Survey

Included on following pages.

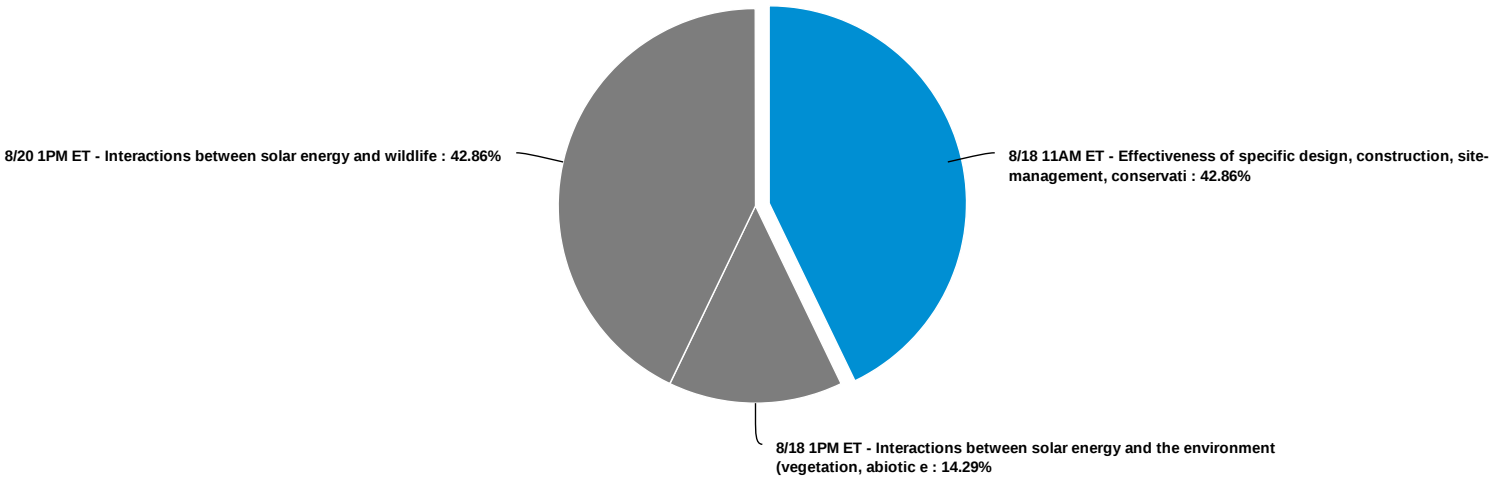
REWI Workshop Participant Feedback - Dashboard

25	10	7	70%	3	8 min
Viewed	Total Responses	Completed	Completion Rate	Dropouts	Average Time



Countries	Responses
US	100.00%
Total	100.00%

Which workshop(s) did you attend?



Answer	Count	Percent	20%	40%	60%	80%	100%
8/18 11AM ET - Effectiveness of specific design, construction, site-management, conservation, and mitigation practices at solar facilities	3	42.86%					
8/18 1PM ET - Interactions between solar energy and the environment (vegetation, abiotic environment, ecosystems)	1	14.29%					
8/20 1PM ET - Interactions between solar energy and wildlife	3	42.86%					
Total	**7**	**n = 7**					

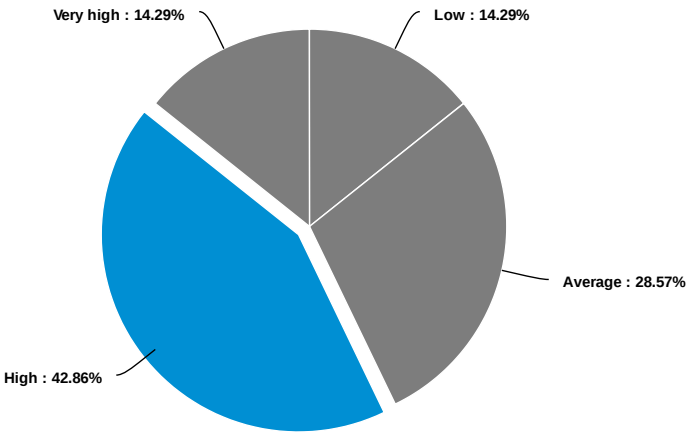
Rate the virtual workshop(s) on the following metrics:

Statement	Very low	Low	Average	High	Very high	Overall
Effectiveness	0 0%	1 14.29%	2 28.57%	3 42.86%	1 14.29%	7 n = 7
Convenience	0 0%	0 0%	2 28.57%	2 28.57%	3 42.86%	7 n = 7
Valuable use of time	0 0%	1 14.29%	3 42.86%	1 14.29%	2 28.57%	7 n = 7
Facilitation	0 0%	0 0%	1 14.29%	4 57.14%	2 28.57%	7 n = 7
Overall quality	0 0%	0 0%	1 14.29%	4 57.14%	2 28.57%	7 n = 7
Value of process and potential outcomes (prioritized research)	0 0%	1 14.29%	2 28.57%	2 28.57%	2 28.57%	7 n = 7

Min Max

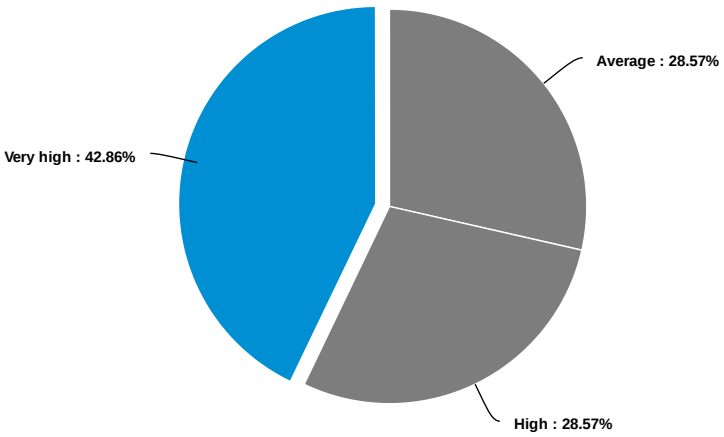
Question	Count	Score	Very low	Low	Average	High	Very high
Effectiveness	7	3.57					
Convenience	7	4.14					
Valuable use of time	7	3.57					
Facilitation	7	4.14					
Overall quality	7	4.14					
Value of process and potential outcomes (prioritized research)	7	3.71					
	Average	**3.88**					

Effectiveness



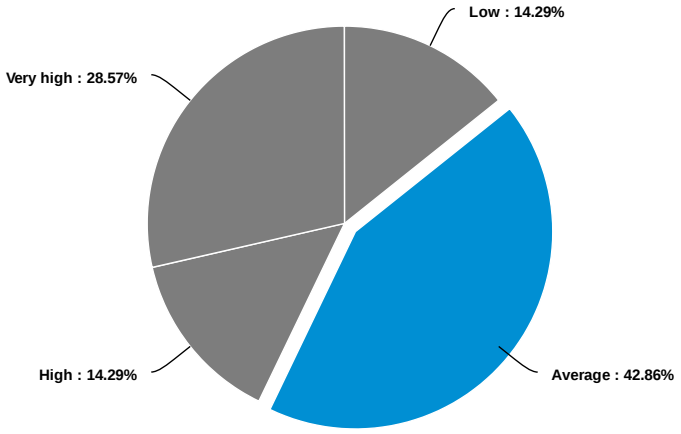
Answer	Count	Percent	20%	40%	60%	80%	100%
Very low	0	0%					
Low	1	14.29%					
Average	2	28.57%					
High	3	42.86%					
Very high	1	14.29%					
Total	**7**	**n = 7**					

Convenience



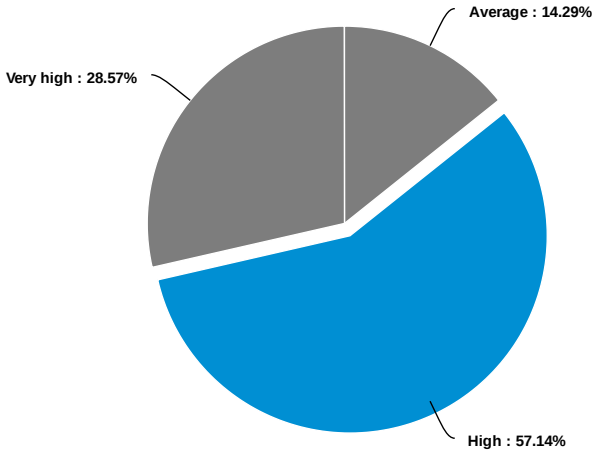
Answer	Count	Percent	20%	40%	60%	80%	100%
Very low	0	0%					
Low	0	0%					
Average	2	28.57%					
High	2	28.57%					
Very high	3	42.86%					
Total	**7**	**n = 7**					

Valuable use of time



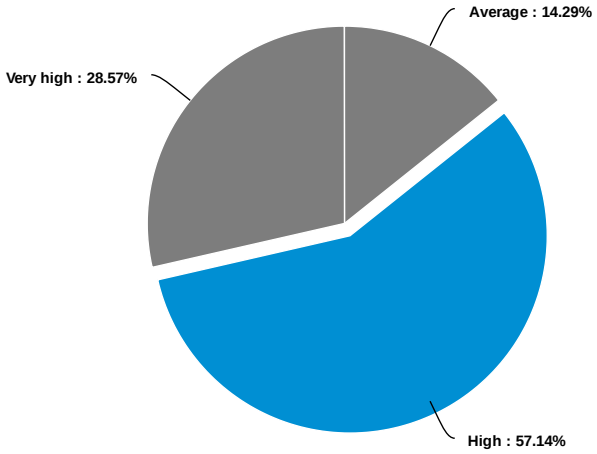
Answer	Count	Percent	20%	40%	60%	80%	100%
Very low	0	0%					
Low	1	14.29%					
Average	3	42.86%					
High	1	14.29%					
Very high	2	28.57%					
Total	**7**	**n = 7**					

Facilitation



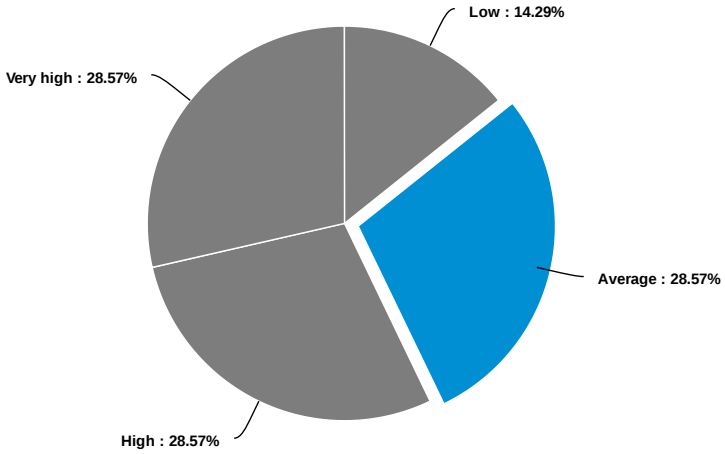
Answer	Count	Percent	20%	40%	60%	80%	100%
Very low	0	0%					
Low	0	0%					
Average	1	14.29%					
High	4	57.14%					
Very high	2	28.57%					
Total	**7**	**n = 7**					

Overall quality



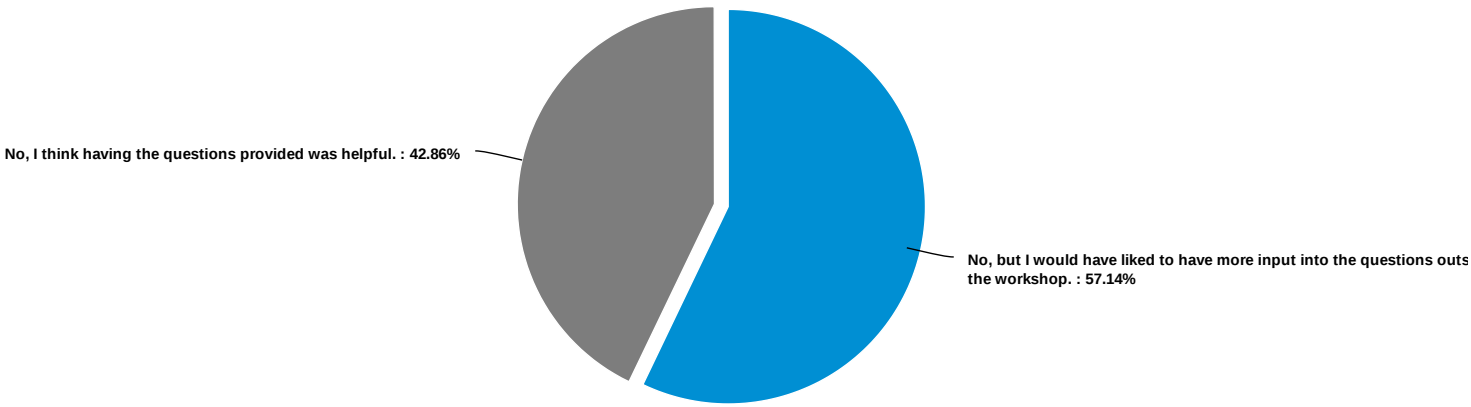
Answer	Count	Percent	20%	40%	60%	80%	100%
Very low	0	0%					
Low	0	0%					
Average	1	14.29%					
High	4	57.14%					
Very high	2	28.57%					
Total	**7**	**n = 7**					

Value of process and potential outcomes (prioritized research)



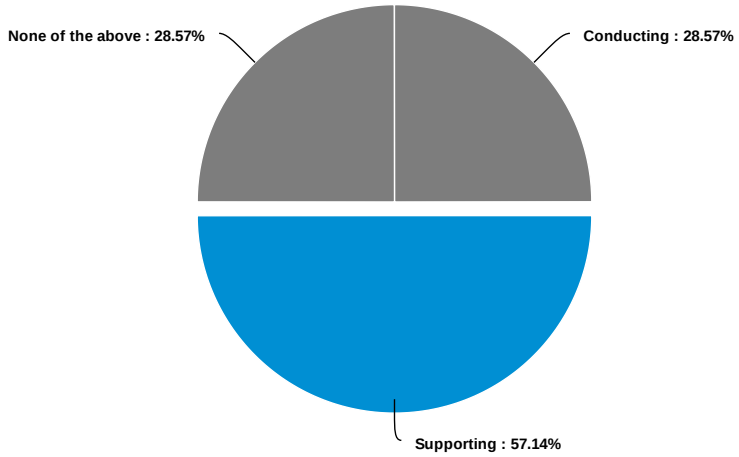
Answer	Count	Percent	20%	40%	60%	80%	100%
Very low	0	0%					
Low	1	14.29%					
Average	2	28.57%					
High	2	28.57%					
Very high	2	28.57%					
Total	**7**	**n = 7**					

Would you have preferred to have a longer workshop including time to develop the questions versus being provided the questions?



Answer	Count	Percent	20%	40%	60%	80%	100%
Yes, I would have strongly preferred more time to develop questions as a group first during the workshop.	0	0%					
No, but I would have liked to have more input into the questions outside of the workshop.	4	57.14%					
No, I think having the questions provided was helpful.	3	42.86%					
Total	**7**	**100 %**					

Are you interested in conducting, supporting, or funding any of the research identified through this process?

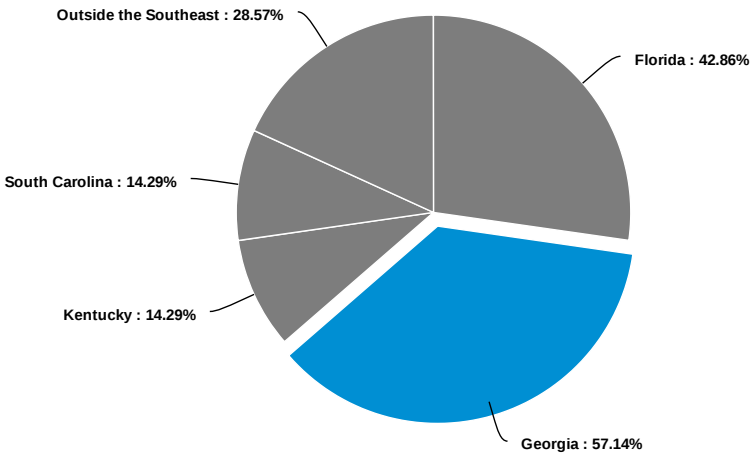


Answer	Count	Percent	20%	40%	60%	80%	100%
Conducting	2	28.57%					
Funding	0	0%					
Supporting	4	57.14%					
None of the above	2	28.57%					
Total	**8**	**n = 7**					

Which topics or specific research questions are you interested in conducting research for, supporting, or funding?

09/04/2025	186344267	Site selection and wildlife benefits and connectivity.
09/04/2025	186343801	any
08/28/2025	185483209	Would be willing to discuss research ideas with others as we have a landowner with a large tract of conserved land next to a 3,000-acre solar facility.
08/28/2025	185480302	I am interested in a broad range of solar-biodiversity questions.
08/28/2025	185472231	Any related to herpetofauna

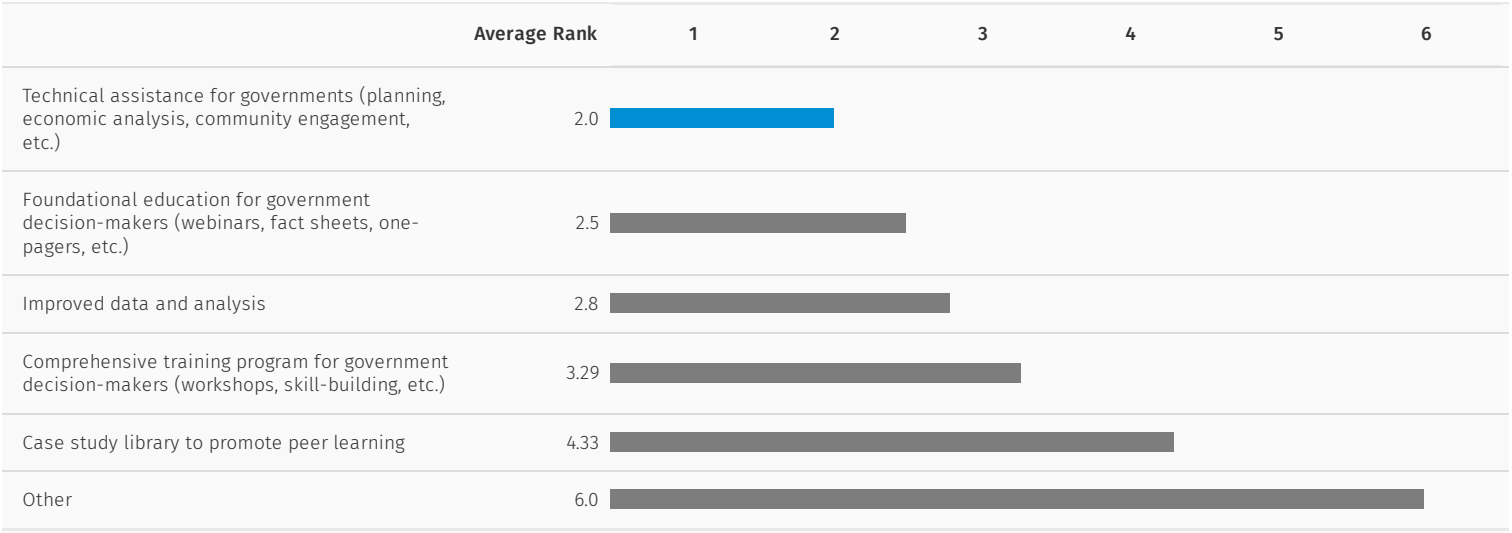
What state(s) is your work focused in? Select all that apply.



Answer	Count	Percent	20%	40%	60%	80%	100%
Alabama	0	0%					
Florida	3	42.86%					
Georgia	4	57.14%					
Kentucky	1	14.29%					
Mississippi	0	0%					
North Carolina	0	0%					
South Carolina	1	14.29%					
Tennessee	0	0%					
Outside the Southeast	2	28.57%					
Total	**11**	**n = 7**					

The Carl Vinson Institute of Government is developing education and outreach materials and programming for local and state government to make informed decisions regarding solar projects. To assist in guiding that effort, please answer the following additional question: Please rank at least the top three (1 being highest) potential resources you feel would be most helpful for county governments when making decisions regarding solar projects? If there is a resource not listed here that you'd like to rank, please rank "Other" in that place and you will be able to enter the corresponding text in the next question.

Average Rank



Data Table	Average Rank	1		2		3		4		5		6	
		Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Technical assistance for governments (planning, economic analysis, community engagement, etc.)	2.0	4	66.67%	0	0%	2	28.57%	1	20%	0	0%	0	0%
Foundational education for government decision-makers (webinars, fact sheets, one-pagers, etc.)	2.5	0	0%	4	57.14%	1	14.29%	1	20%	0	0%	0	0%
Improved data and analysis	2.8	1	16.67%	1	14.29%	1	14.29%	2	40%	0	0%	0	0%
Comprehensive training program for government decision-makers (workshops, skill-building, etc.)	3.29	1	16.67%	2	28.57%	1	14.29%	1	20%	1	20%	1	50%
Case study library to promote peer learning	4.33	0	0%	0	0%	2	28.57%	0	0%	4	80%	0	0%
Other	6.0	0	0%	0	0%	0	0%	0	0%	0	0%	1	50%

If you selected "Other" in the question above, please enter the other challenge here:

Please share any other feedback you have on the REWI workshop or specific ideas related to needs for government decision-making regarding solar projects.

Appendix D – Online Prioritization Survey

The Online Prioritization Survey was split into three Topic Areas. Below is the full text of each survey.

Topic Area 1: Evaluation of research questions under the theme: "Wildlife Interactions"

1. What is your primary role as a stakeholder related to solar/wildlife/ecosystems?
    - Research (Academia, USGS, National labs, etc.)
    - Federal Regulatory or land management Agency (USFWS, USDA, BLM, etc.)
    - State/Local Agency
    - NGO/Environmental non-profit
    - Consulting
    - Solar Industry
    - Industry Trade Association
    - Landowner/Agriculture
    - Community Member
2. What is the geographic focus of your work? Note that the focus of this initiative is the Southeastern United States (USFWS Region 4)
    - Primarily (>50%) within Southeastern states (USFWS Region 4)
    - Partially (<50%) within Southeastern states (USFWS Region 4)
    - US States outside of the Southeast (USFWS Region 4)
    - Outside of the United States
3. How comfortable would you be explaining issues related to solar energy/wildlife interactions to someone with no related professional experience?
    - Very uncomfortable
    - Somewhat uncomfortable
    - Neither comfortable nor uncomfortable
    - Somewhat comfortable
    - Very comfortable
4. Please evaluate the importance of each of the following topic areas of research questions to you and your organization. Note: If you are filling out this survey for multiple topic areas, please only answer this question once. Scale: Not Important; Somewhat Important; Very Important; Top Priority
    - "Onsite Action & Mitigation": Effectiveness of specific design, construction, site-management, conservation, and mitigation practices
    - "Wildlife Interactions": Interactions between solar energy and wildlife at all spatial scales
    - "Environment and Ecosystem": Interactions between solar energy and the environment (vegetation, abiotic environment, ecosystems)

5. Research Question: "How do solar facilities influence landscape connectivity and movement for vertebrate species that typically cannot access the solar footprint?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
6. Research Question: "How do species occupancy and detection rates at PV solar farms compare to prior/surrounding land use types?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
7. Research Question: "How are demographic rates and population structure (e.g., sex ratio, age class, etc.) of species of concern affected by PV solar facilities, including facility-specific variables or landscape variables?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
8. Research Question: "How do solar farms affect habitat change (including loss and creation), fragmentation, and connectivity in landscapes with existing anthropogenic disturbances (e.g., roads, agriculture, oil/gas, urban development)? Do they amplify or mitigate these issues and at what magnitude?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making

    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
9. Research Question: "What are the long-term effects of large-scale PV solar facilities on populations of conservation-focused wildlife (particularly keystone species [e.g., gopher tortoise] and species of concern) and their habitat (vegetation community)?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
10. Research Question: "What landcover types (agriculture/silviculture/pasture lands, native pine plantations, native grasslands, native scrublands) are being converted to PV solar facilities in the Southeast and how does this compare to other anthropogenic conversions (e.g., housing/urbanization, agricultural, etc.)?" Please evaluate the following research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
11. What would you identify as your highest priority research question related to solar, wildlife, and ecosystems in the southeastern United States?

Topic Area 2: Evaluation of research questions under the theme: "Onsite Action & Mitigation"

1. What is your primary role as a stakeholder related to solar/wildlife/ecosystems?
    - Research (Academia, USGS, National labs, etc.)
    - Federal Regulatory or land management Agency (USFWS, USDA, BLM, etc.)
    - State/Local Agency
    - NGO/Environmental non-profit
    - Consulting
    - Solar Industry
    - Industry Trade Association
    - Landowner/Agriculture

- Community Member

2. What is the geographic focus of your work? Note that the focus of this initiative is the Southeastern United States (USFWS Region 4)
    - Primarily (>50%) within Southeastern states (USFWS Region 4)
    - Partially (<50%) within Southeastern states (USFWS Region 4)
    - US States outside of the Southeast (USFWS Region 4)
    - Outside of the United States
3. How comfortable would you be explaining issues related to solar energy/wildlife interactions to someone with no related professional experience?
    - Very uncomfortable
    - Somewhat uncomfortable
    - Neither comfortable nor uncomfortable
    - Somewhat comfortable
    - Very comfortable
4. Please evaluate the importance of each of the following topic areas of research questions to you and your organization. Note: If you are filling out this survey for multiple topic areas, please only answer this question once. Scale: Not Important; Somewhat Important; Very Important; Top Priority
    - "Onsite Action & Mitigation": Effectiveness of specific design, construction, site-management, conservation, and mitigation practices
    - "Wildlife Interactions": Interactions between solar energy and wildlife at all spatial scales
    - "Environment and Ecosystem": Interactions between solar energy and the environment (vegetation, abiotic environment, ecosystems)
5. Research Question: "What is the direction and magnitude of species (or groups of species) responses to specialized habitat enhancements (bee boxes, bird nesting boxes, artificial burrows, log and stone piles or hedgerows along the fence) and what is the return on investment?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
6. Research Question: "What is the direction and magnitude of species (or groups of species) responses (occupancy and behavior) to semi-permeable fencing (i.e., wildlife-friendly fencing) and what is the return on investment?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:

- Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
- Relevance: Answering this question will change management and decision making
- Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)

7. Research Question: “What is the direction and magnitude of species (or groups of species) responses to various dimensions of wildlife movement passages (i.e., site layout) and what is the return on investment? (i.e., testing the most effective dimensions of wildlife movement passages)" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
8. Research Question: "What is the direction and magnitude of species (or group of species) and ecosystem function responses to seed mix (native vegetation, turfgrass, or a combination of both) and vegetation management (mowing or grazing practices) on PV solar facilities, and what is the return on investment?"
   Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
9. Research Question: "What is the direction and magnitude of species, biodiversity, and ecosystem responses to various construction practices (grading, removing topsoil, pre-seeding, etc.) at different stages of post-construction?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)

10. Research Question: "What is the direction and magnitude of wildlife, biodiversity, and ecosystem function response to site layout decisions to incorporate wetlands (permanent or ephemeral) and/or streams (permanent or intermittent) within the footprint of a solar facility, and what is the return on investment?" Please evaluate the following research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
11. What would you identify as your highest priority research question related to solar, wildlife, and ecosystems in the southeastern United States?

Topic Area 3: Evaluation of research questions under the theme: "Environment and Ecosystems"

1. What is your primary role as a stakeholder related to solar/wildlife/ecosystems?
    - Research (Academia, USGS, National labs, etc.)
    - Federal Regulatory or land management Agency (USFWS, USDA, BLM, etc.)
    - State/Local Agency
    - NGO/Environmental non-profit
    - Consulting
    - Solar Industry
    - Industry Trade Association
    - Landowner/Agriculture
    - Community Member
2. What is the geographic focus of your work? Note that the focus of this initiative is the Southeastern United States (USFWS Region 4)
    - Primarily (>50%) within Southeastern states (USFWS Region 4)
    - Partially (<50%) within Southeastern states (USFWS Region 4)
    - US States outside of the Southeast (USFWS Region 4)
    - Outside of the United States
3. How comfortable would you be explaining issues related to solar energy/wildlife interactions to someone with no related professional experience?
    - Very uncomfortable
    - Somewhat uncomfortable
    - Neither comfortable nor uncomfortable

- Somewhat comfortable
- Very comfortable

4. Please evaluate the importance of each of the following topic areas of research questions to you and your organization. Note: If you are filling out this survey for multiple topic areaa, please only answer this question once. Scale: Not Important; Somewhat Important; Very Important; Top Priority
    - "Onsite Action & Mitigation": Effectiveness of specific design, construction, site-management, conservation, and mitigation practices
    - "Wildlife Interactions": Interactions between solar energy and wildlife at all spatial scales
    - "Environment and Ecosystem": Interactions between solar energy and the environment (vegetation, abiotic environment, ecosystems)
5. Research Question: "How do nutrient cycling rates on PV solar facilities of various ages and construction practices compare with prior land use?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
6. Research Question: "How do water infiltration rates and erosion on PV solar facilities of various ages compare with prior land use?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
7. Research Question: "How do PV solar farms modify microclimates onsite and offsite in the Southeastern United States?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)

8. Research Question: "How does soil health (compaction, organic matter, microbial processes) on PV solar facilities of various ages compare with prior land use?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
9. Research Question: "How does carbon sequestration in labile and recalcitrant pools on PV solar facilities of various ages and construction practices compare with prior land use?" Please evaluate this research question on a scale of 0 (Not at all) - 4 (Extremely) based on the following metrics:
    - Amount of Uncertainty: Answering this question will fill gaps in our knowledge and information
    - Relevance: Answering this question will change management and decision making
    - Feasibility: Answering this question will be feasible and practical (cost, methodology, timing, etc.)
10. What would you identify as your highest priority research question related to solar, wildlife, and ecosystems in the southeastern United States?

Appendix E – Data Tables with Full Detail

Table 3. The scoring results (mean and standard deviation) and prioritization of the six research questions focused on Wildlife Interactions with photovoltaic solar development and operation. Values are based on a workshop with 12 respondents and an online survey with 26 respondents.

Workshop (n =12)						Survey (n = 26)					
Question	Magnitude	Relevance	Reducibility	QVoI	Priority Rank	Question	Magnitude	Relevance	Reducibility	QVoI	Priority Rank
Long-Term Population	2.17 (0.83)	2.83 (0.39)	1.50 (0.80)	6.08 (2.47)	High	Long-Term Population	3.15 (0.88)	2.92 (0.93)	2.35 (1.09)	9.46 (4.28)	Highest
Demographics	3.09 (0.54)	3.00 (0.00)	1.09 (0.83)	9.27 (1.62)	High	Demographics	2.38 (1.06)	1.88 (1.14)	1.81 (1.06)	5.27 (4.56)	Low
Habitat Change	2.67 (0.98)	2.75 (0.45)	1.75 (0.45)	7.33 (2.99)	Highest	Habitat Change	2.50 (0.95)	2.42 (1.14)	2.15 (1.12)	6.85 (4.36)	Low
Land Conversion	2.08 (0.79)	2.50 (0.52)	2.25 (0.45)	5.17 (2.25)	Medium	Land Conversion	2.73 (0.96)	2.42 (1.21)	2.88 (0.95)	7.50 (4.69)	Medium
Species Occupancy	2.18 (0.87)	2.27 (0.79)	1.82 (0.40)	4.73 (2.10)	Medium	Species Occupancy	2.31 (1.05)	2.27 (1.04)	2.46 (1.07)	5.96 (4.06)	Medium
Connectivity	2.00 (0.94)	1.80 (0.79)	1.70 (0.67)	3.30 (1.83)	Medium	Connectivity	2.48 (0.87)	2.56 (0.92)	2.16 (0.94)	6.88 (4.50)	Low

Table 5. The scoring results (mean and standard deviation) and prioritization of the six research questions focused on Onsite Action & Mitigation associated with photovoltaic solar development and operation. Values are based on a workshop with 11 respondents and an online survey with 16 respondents.

Workshop (n =11)						Survey (n = 16)					
Question	Magnitude	Relevance	Reducibility	QVoI	Priority Rank	Question	Magnitude	Relevance	Reducibility	QVoI	Priority Rank
Construction Practices	2.78 (0.83)	3.00 (0.00)	1.78 (0.44)	8.33 (2.50)	Highest	Construction Practices	3.00 (0.82)	2.63 (0.96)	2.69 (1.01)	8.38 (4.66)	Highest
Movement Passages	2.40 (0.97)	2.50 (0.97)	1.90 (0.57)	6.70 (2.98)	Highest	Movement Passages	2.81 (0.83)	2.75 (1.00)	2.31 (1.14)	8.19 (4.45)	Medium
Aquatic Features	2.67 (0.87)	2.22 (0.83)	1.78 (0.44)	6.11 (2.93)	Highest	Aquatic Features	2.31 (0.87)	1.94 (0.93)	1.88 (1.09)	5.00 (3.97)	Low
Fencing	2.30 (0.95)	2.50 (0.53)	2.10 (0.32)	6.00 (3.23)	Medium	Fencing	3.00 (0.63)	2.94 (0.93)	2.81 (1.05)	9.25 (4.33)	Highest
Vegetation & Management	2.11 (1.05)	2.56 (1.01)	2.00 (0.50)	6.00 (3.00)	Medium	Vegetation & Management	2.94 (0.77)	3.00 (0.63)	2.75 (0.86)	9.06 (3.96)	Highest
Biodiversity Enhancements	2.82 (0.60)	1.64 (0.67)	1.45 (0.52)	4.64 (2.16)	Low	Biodiversity Enhancements	2.56 (0.81)	2.69 (0.95)	2.69 (0.79)	7.19 (4.32)	Medium

Table 7. The scoring results (mean and standard deviation) and prioritization of the six research questions within the Environment & Ecosystem topic. Values are based on a workshop with 9 respondents with complete data and an online survey with 18 respondents.

Workshop (n =9)						Survey (n = 18)					
Question	Magnitude	Relevance	Reducibility	QVoI	Priority Rank	Question	Magnitude	Relevance	Reducibility	QVoI	Priority Rank
Soil Health	2.56 (0.88)	2.56 (0.73)	2.00 (0.50)	6.56 (3.09)	Highest	Soil Health	2.83 (0.99)	2.39 (0.92)	2.33 (0.97)	7.17 (4.15)	Medium
Carbon Sequestration	2.78 (0.67)	2.44 (0.88)	1.44 (0.53)	6.89 (3.18)	High	Carbon Sequestration	2.06 (1.03)	1.71 (0.92)	1.59 (0.94)	4.18 (3.86)	Low
Hydrology & Erosion	2.00 (0.87)	2.78 (0.67)	1.89 (0.33)	5.33 (2.50)	Medium	Hydrology & Erosion	2.94 (0.73)	2.61 (0.61)	2.28 (0.75)	7.78 (3.10)	Medium
Microclimate	1.78 (0.97)	1.78 (0.97)	1.78 (0.44)	3.67 (3.12)	Medium	Microclimate	2.24 (1.03)	1.71 (0.85)	1.76 (0.90)	4.18 (3.17)	Low
Nutrient Cycling	3.00 (1.00)	1.89 (0.78)	1.33 (0.87)	5.44 (2.65)	Low	Nutrient Cycling	2.22 (0.81)	1.94 (0.87)	1.94 (0.87)	4.72 (2.97)	Low