The American Solar Grazing Association

ASGA

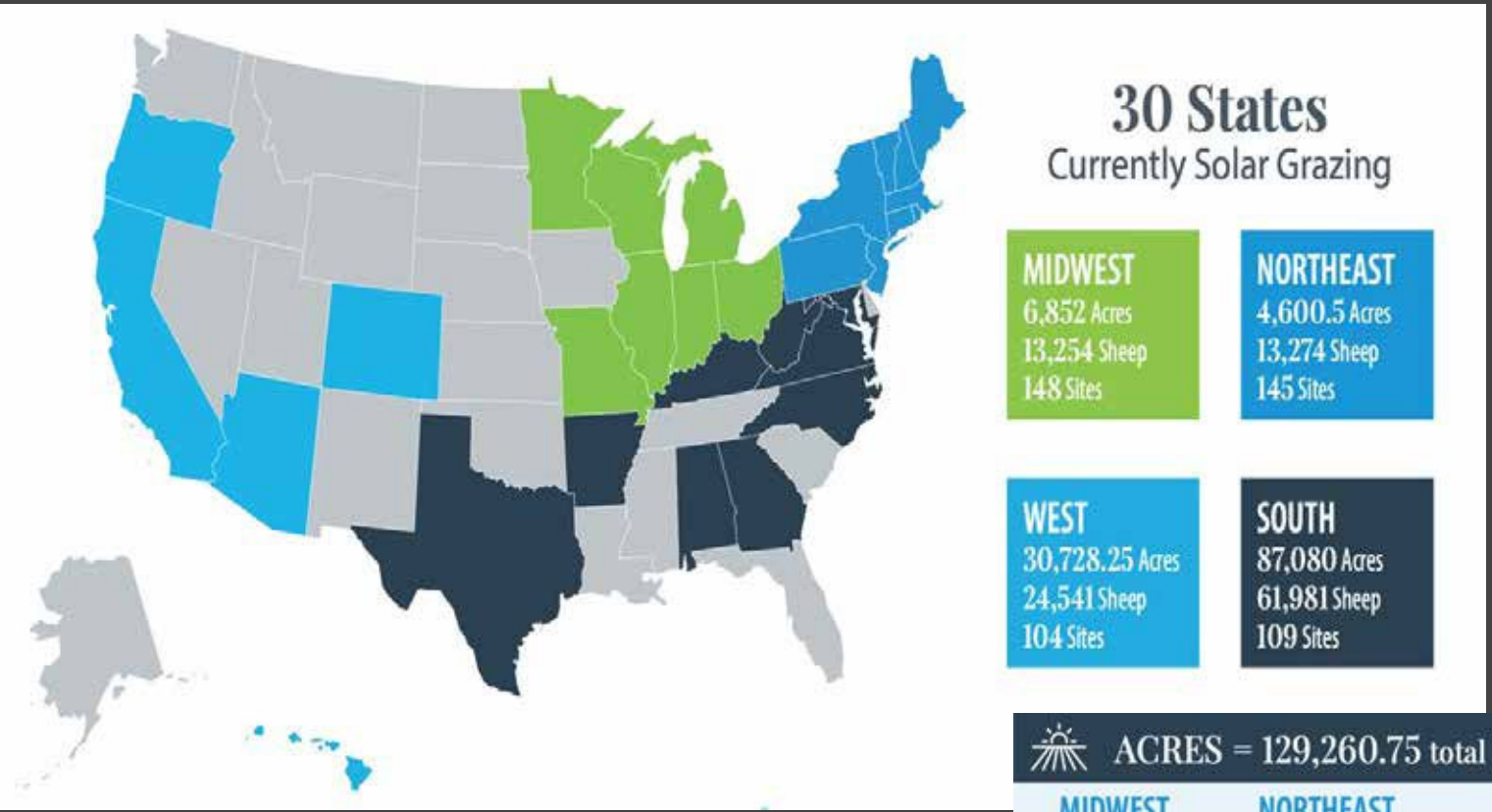
The American Solar Grazing Association

Farmer-founded and **farmer-led** organization with **1400+ members** and growing. Since 2008, we've provided:

- In-depth technical assistance & training for farmers and solar
- Set standards and best practices
- Help farmers and solar developers become effective partners
- Promote solar grazing
- A partner to groups, like The Nature Conservancy, NREL, American Farmland Trust, NYSERDA, Cornell, and Virginia Tech.
- Driving solar grazing workforce development, certifications, education, technical assistance, and outreach.

The world leader in solar grazing.

How Big Is It? Let's Talk Numbers…



30 States
Currently Solar Grazing

MIDWEST
6,852 Acres
13,254 Sheep
148 Sites

NORTHEAST
4,600.5 Acres
13,274 Sheep
145 Sites

WEST
30,728.25 Acres
24,541 Sheep
104 Sites

SOUTH
87,080 Acres
61,981 Sheep
109 Sites

ACRES = 129,260.75 total

MIDWEST	NORTHEAST	SOUTH	WEST
6,852	4,600.5	87,080	30,728.25
min: 7 | max: 2,000	min: 5 | max: 2,074	min: 2 | max: 32,650	min: .25 | max: 19,904
		Texas: 68,626 total	California: 21,750 total

RAPID GROWTH

129,000 ACRES
113,050 SHEEP
500 SOLAR SITES

The majority of active solar graziers are

30-59 YEARS OF AGE

40%

of respondents **graze utility-scale solar sites.**

1/3 of respondents **FEMALE**

2/3 of respondents responsible for **managing vegetation** via methods **additional to sheep grazing**

Largest movtivators = **Financial & Environmental Benefits**

Educational Programming

- Virtual workshops presented by solar graziers, experts, extension specialists, academics
- 6-year webinar library
- Example event series
  - USDA Lamb Board
  - Grazing with Cam
  - 1:1 Mentoring Calls

ASGA Training Programs: Graziers & Solar Firms

Solar Grazing Certification for Farmers

In-person orientation to solar grazing and safety standards.

ASGA Certification for Solar Firms

On-site training and mentoring provide a day-to-day picture of sheep grazing on a site.

MEANS AND METRICS:

The Standard Checklist for Solar Grazing

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Means and Metrics: The Standard Checklist for Solar Grazing

Research surrounding the science and practice of agrivoltaics and solar grazing systems continues to grow, and the need to understand the means of successful implementation and metrics for evaluating these multi-use systems compared to their single use counterparts is increasingly important for graziers, developers, and managers. The following comprehensive checklist is derived from a full report that describes in detail each checklist section. The purpose of the checklist is to provide useful record-keeping tools to support project planning, monitoring, and evaluation of solar grazing stakeholders. Each checklist section includes columns formatted for relevance to section subject matter, including space to log descriptive information, make note of the responsible party, or provide a time stamp of completion.

These checklists are not meant to be interpreted as "requirements" for solar grazing, rather, they are intended to offer a holistic suite of considerations, which can serve as a template that can be further prioritized at the discretion of the partners of a solar grazing project. We recommend that solar grazing stakeholders access the services of land grant universities, extension agencies, local Natural Resource Conservation Services (NRCS) offices, and conservation districts for further assistance.

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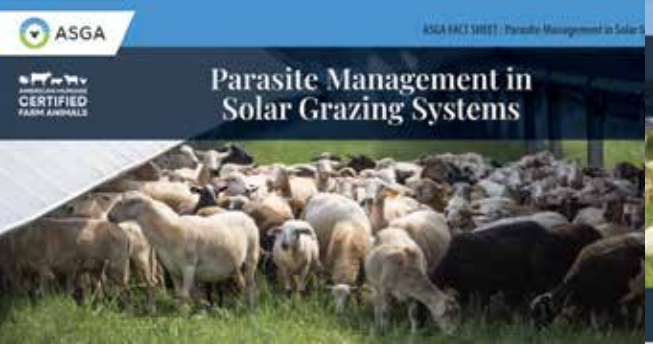
The American Solar Grazing Association (ASGA) provides educational programming and resources for farmers, establishes professional standards and best practices for solar grazing, and educates the general public and key stakeholders on the economic, social, and environmental benefits of solar grazing. A wide variety of resources are available for their membership network. For more information, please visit ASGA's website: solargrazing.org

Name of Site: _____ Solar Operator: _____

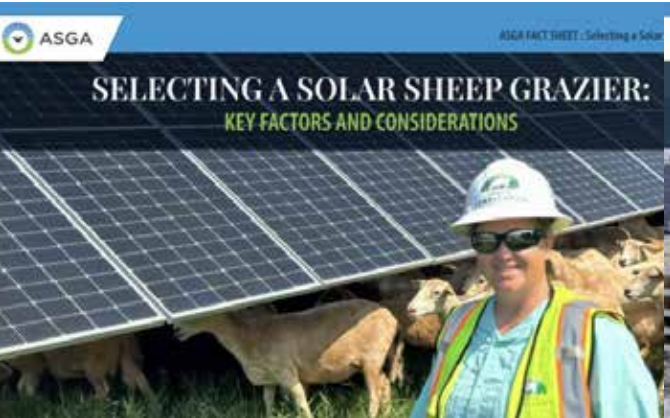
Grazier(s): _____ Date: _____

SOCIAL FACTORS

Item	Yes	No	Describe
Does the site provide economic opportunities for the local community and farmers?			
Is the site located on public property?			
Does the site and management plan maintain local interests?			
Does the management plan for the site promote a fair and just distribution of economic benefits across the local community?			
Will products be used/sold locally?			
Do local supply chains benefit from agrivoltaic products (e.g. honey, meat, wool, etc.)?			
Does the site incorporate multi-use?			
Are socio-geographic factors considered in the site design (e.g. viewshed obstruction, perimeter fence type)?			
Are cultural factors considered for site planning and management?			
Are there aesthetic issues that need to be addressed, like panel washing, fencing, tidiness, vegetation management, etc.?			
Are there plans to provide opportunities for community outreach and engagement before and during operations?			



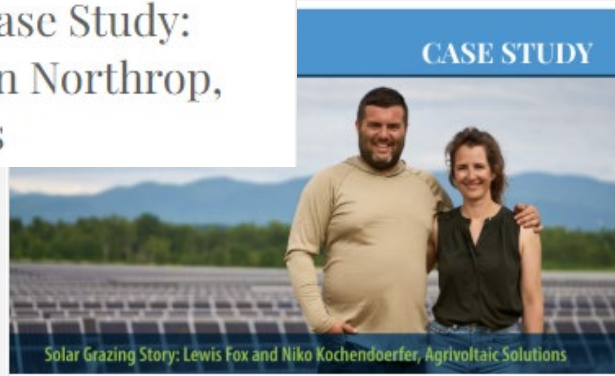
Solar Grazing Fact Sheets



Solar Grazing Case Study: Ryan Indart, Indart Solar Sheep Grazing

Solar Grazing Case Study: Jonathan and Jen Northrop, Northrop Farms

Solar Grazing Case Study: Chad Raines, Key Farms



Solar Grazing Case Study: Lewis Fox and Niko Kochendoerfer, Agrivoltaic Solutions

A Quick Guide to Agrivoltaics Monitoring & Research Design

This publication provides guidance for monitoring and research of the agricultural and ecological aspects of agrivoltaic systems. The goal is for data across space and time to be meaningful, usable, and comparable. Agrivoltaics co-locates agricultural and solar energy production. This field functions as a novel ecosystem and behaves differently from natural landscapes. Without standardization, disparate efforts to study the ecological impacts of agrivoltaics cannot be compared or synthesized into a cohesive source of understanding.[1]

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The Nature Conservancy

Monitoring and Research Importance

Monitoring and research for agrivoltaics builds upon a long lineage of biological and ecological sciences[2].

- **Monitoring** tracks change over time and provides continuous feedback.
- **Research** discovers new information and brings understanding to complex interactions.

Variables of Interest

Setting contextualized goals will help determine the variables of interest and the monitoring and research plan (Table 1).

1. Using Specific, Measurable, Achievable, Relevant, and Time-Bound (SMART[3]) goals is best practice. Then consider the following:
   - » What methods will be used to measure the variables of interest?
   - » Is laboratory analysis needed? Consider local options and available tests.
2. In 2024, The Nature Conservancy surveyed ranchers to better understand their interests for monitoring and provided recommendations to make monitoring more useful and meaningful for management and decision-making[4] (Table 1).
3. To assist with goal setting and determining variables of interest, refer to ASGA's ***Means and Metrics: The Standard Checklist for Solar Grazing***, for example questions on social, economic, ecological, livestock, grazing management, and site design factors[5].

Table 1. Common variables of interest in agrivoltaic ecosystem monitoring and research. Asterisks represent variables indicated by ranchers in The Nature Conservancy's study[4].

*SOIL	CROPS / *VEGETATION	*WATER	*WILDLIFE	LIVESTOCK
Inorganic / organic *carbon	Yield	*Infiltration / hydroconductivity	Ex. mammals, birds, invertebrates, amphibians, *pollinators	Weight gain
Nitrogen	Water stress	Soil moisture	Species presence	*Body condition
Microbiotic communities	Photosynthesis	Runoff / erosion	Species abundance	Disease incidence
Micronutrients	Ground cover	Irrigation efficiency	Indicators of reproduction	Shade impact
Organic matter	*Biodiversity	Evapotranspiration	Fatality patterns	Water consumption
*Stability	Species composition		Foraging behavior	Interaction with infrastructure
Aggregation	Species frequency		Agricultural services	*Feed supplement use
Compaction	*Forage quality			*Stocking Rate
Temperature	Bareground			Animal health and welfare
Metals	Productivity / biomass			Honey production
Residual chemicals				

Design Considerations

The five basic features of monitoring and research design described in the next section are needed to capture site diversity, for statistical significance, and to produce meaningful information. Consistency in sampling location, size, timing, spacing, depth, and plot design is paramount. Replication of monitoring and research methods on other solar sites, either within or beyond similar geographical regions, could greatly improve learning and applicability. *For further support and technical assistance, we recommend working with a soil health expert, and accessing the services of land grant universities, extension agencies, local Natural Resource Conservation Services offices, and conservation districts.*

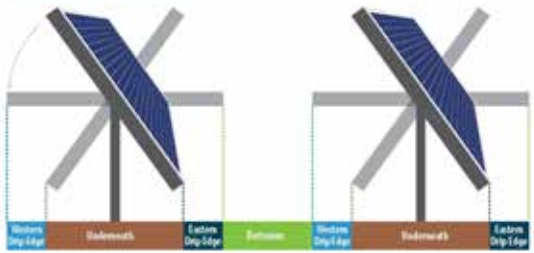
Solar Site & Sampling Safety

Before sampling, contact the asset management team for permission and to understand the location of buried cables and equipment. Contact the health and safety team for protocol and flagging, and call "811" before digging.

1 STRATIFICATION

On a solar module scale:
4 microzones (western drip edge, underneath, eastern drip edge, and between) characterize distinct areas where repeated and patterned sun-shade dynamics have a microclimatic effect on the vegetation and soil below (Figure 1). In the case of fixed tilt systems, drip edge configuration may be different and should be addressed appropriately.

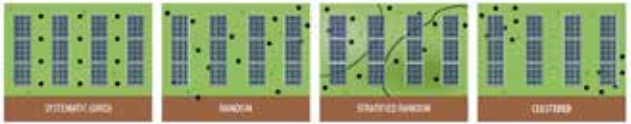
Figure 1. The four microzones in a solar array.



On a solar landscape scale:
This encompasses the area within the solar site. Spatial sampling designs of the solar landscape include systematic (grid), random, stratified random, and clustered (Figure 2).

For all cases:
Landscape ***and*** microzone stratification ensures that results are representative of the whole agrivoltaic ecosystem.

Figure 2. Examples of spatial sampling designs on a solar site.



2 PLOT DESIGN

Within what kind of plot design (linear transect, square, hoop, or key area) should each variable be sampled?
» Consider: Degree of heterogeneity, variables of interest, and solar infrastructure layout.

A **reference/control area** provides a comparison to baseline or reference case conditions, which facilitates interpretation.

4 SAMPLE SIZE

For monitoring: Enough samples are needed to capture the relevant landscape or herd/flock diversity across the area of interest.

For research: Statistical significance derived by a "power calculation"[6] is needed to define the sample size.

For all cases: Sample size is directly proportional to the degree of variability or diversity across space or sample population.

3 TIMING

Monitoring or research goals and variables of interest will dictate the appropriate temporal (time) and spatial (space) scales of design. Questions to consider include:

- **Frequency: How often will sampling be performed?**
  - » Consider: Timing of grazing, variables of interest, and long-term versus short-term effects.
- **Seasonality: During which season(s) will it be relevant to sample the variables of interest?**
  - » Consider: Grazing influences, season-sensitive variables, and climate zone.

5 SPACING AND SOIL DEPTH

Spacing: Should sample locations be more dense/frequent or dispersed?
» Consider: Spatial scale of inquiry, degree of variability, and macro-scale versus micro-scale variables.

Soil Sampling Depth: What sampling depth is appropriate for the variables of interest?
» Consider: Rate of change, root zone, and sensitivity to aboveground activities.

Please refer to https://solargrazing.org/agrivoltaics-monitoring-research-design/ for references, authorship, and updated information.

ASGA Solar Grazing & Soil Health Research

Purpose: collect in-field data on forage quality, soil health, and economics

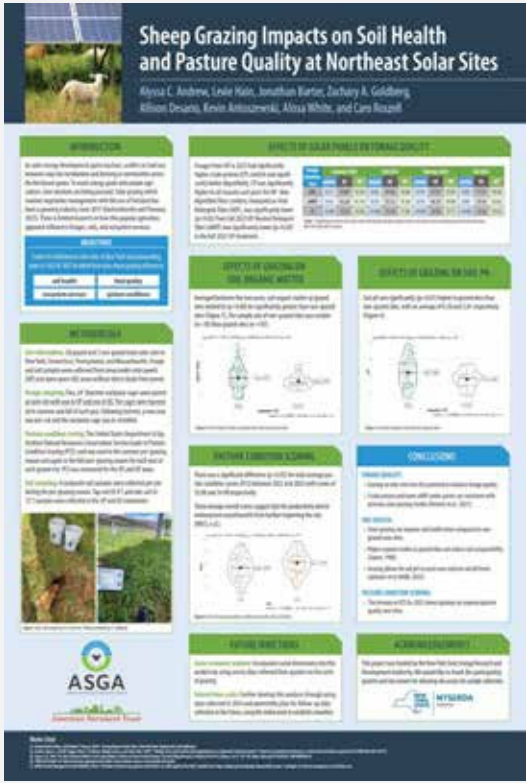
Results: Overall, solar sheep grazing helps to create a beneficial environment.

Solar-grazed sites tended to have higher soil organic matter.

Soil pH was significantly higher in grazed sites.

Crude protein significantly higher in under-panel areas for all seasons.

Pasture condition scores increased, suggesting that sheep grazing can improve solar site pasture quality over time.



Panel to Plate Recipes

Panel to Plate Recipe – Margarita Lamb Taco Salad with Mango Salsa

With short days and chilly weather ahead, it's the perfect time for a quick and fun meal. Try our new...

Panel to Plate Recipe – Mom's Lamb Stew

With Fall upon us, it's time for a comfort meal. Try out Mom's Lamb Stew, our latest Panel to Plate recipes...

Panel to Plate Recipe – Lamb Burgers

Looking for a new meal idea? Try our first Panel to Plate Recipe, Lamb Burgers! Thank you to Jess Gray for...

Solar Grazing: A New Opportunity. This 5-minute short film illustrates the incredible opportunities solar grazing is creating for farmers across the United States.

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