

# Appendix D

## **Comments and Responses to Comments (continued)**

# Appendix D.3

## Comment Letters

Comments Received from  
**Groups, Organizations, and Companies**

**Continued**

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122



# Multiagency Avian-Solar Collaborative Working Group: Stakeholder Workshop

## *Welcome and Overview of Workshop Objectives*

*Dan Boff*  
*U.S. Department of Energy*  
*SunShot Initiative*

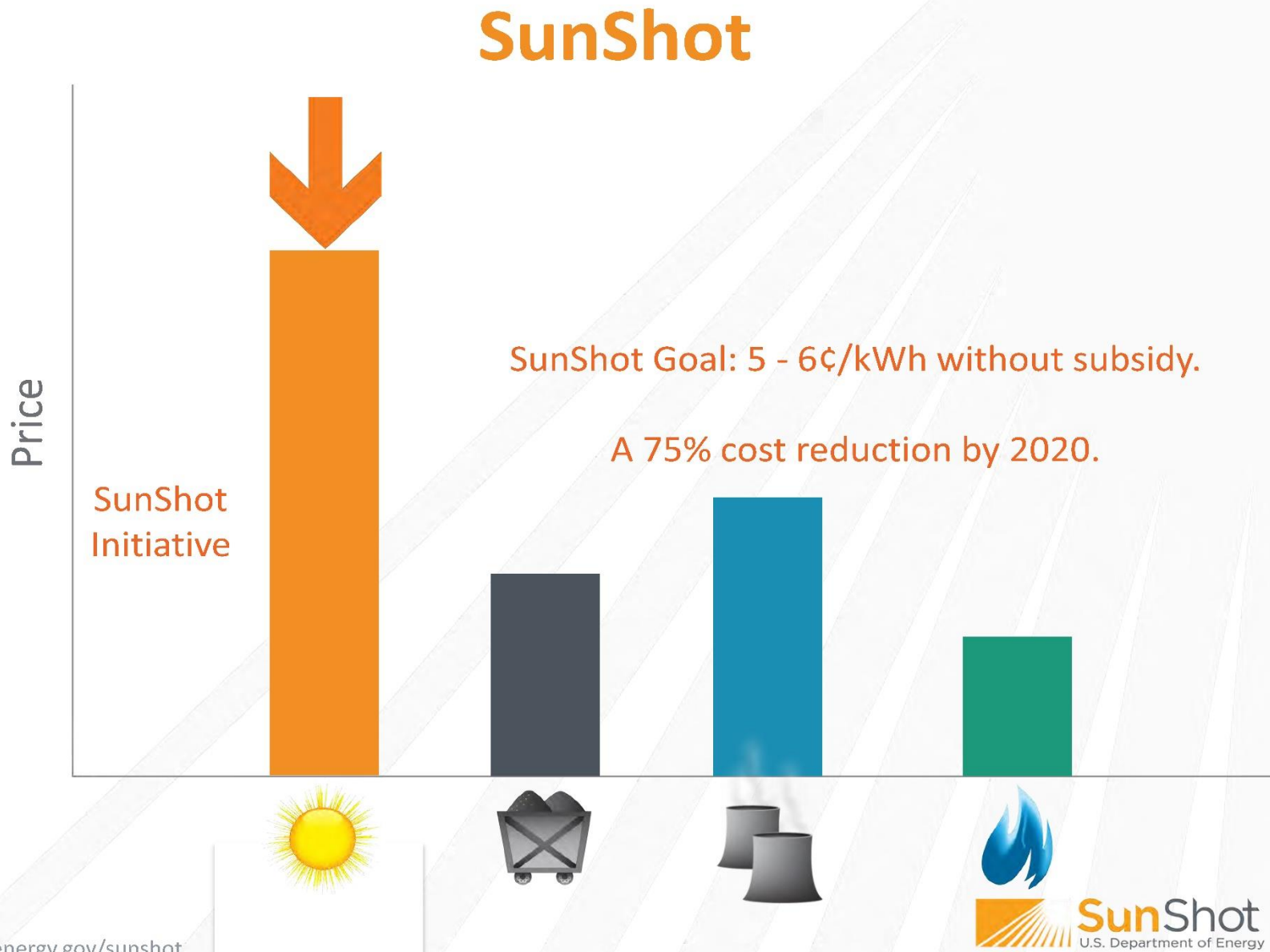
*May 10-11, 2016*  
*Sacramento, California*





Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

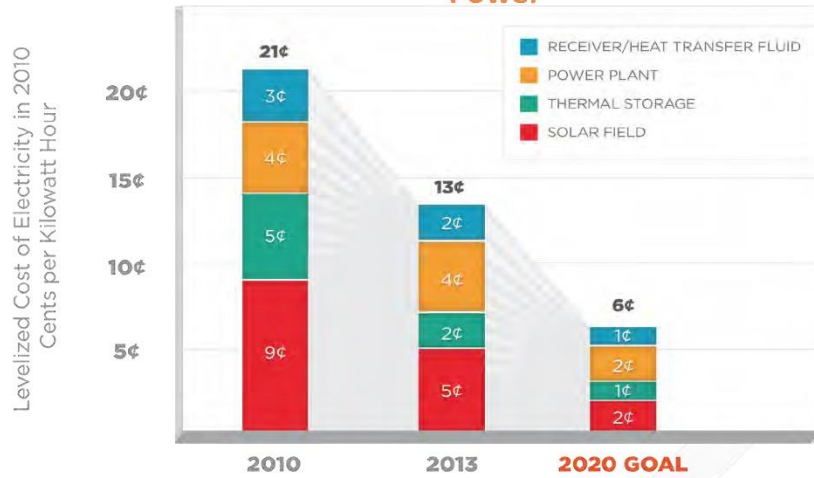
B5-122  
cont.



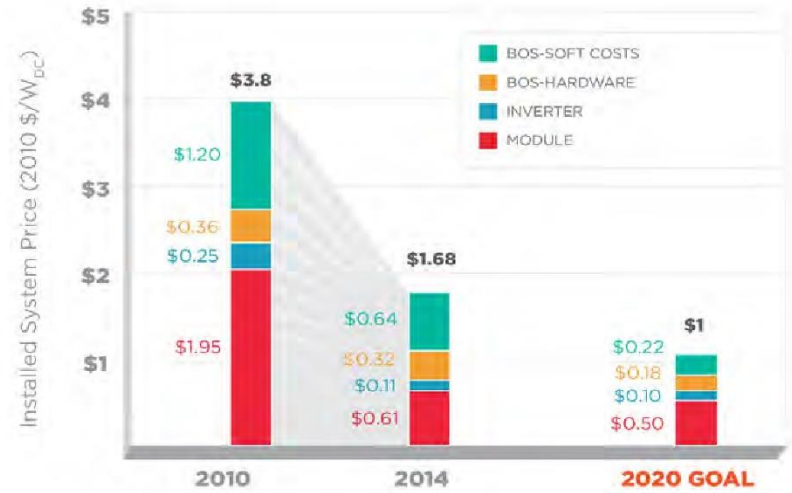
Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

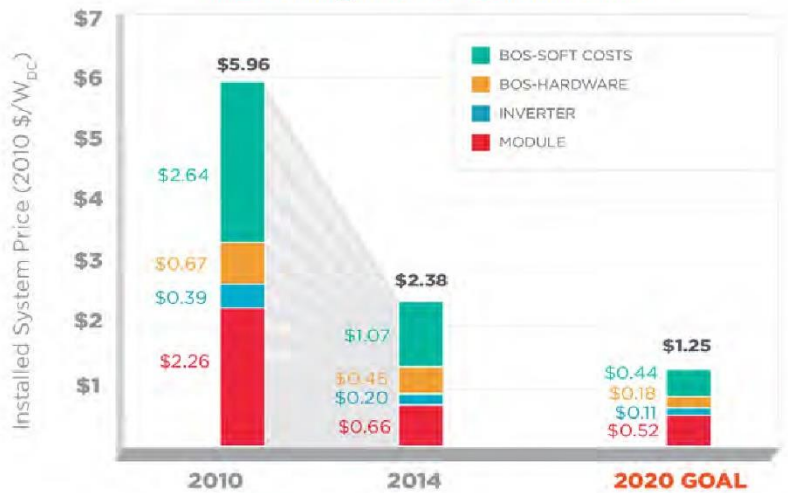
The Falling Cost of Concentrating Solar Power



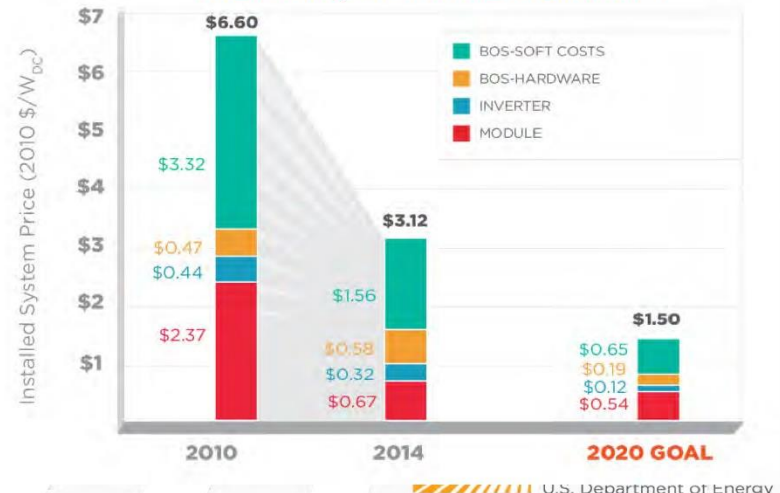
The Falling Cost of Utility PV



The Falling Cost of Commercial PV



The Falling Cost of Residential PV

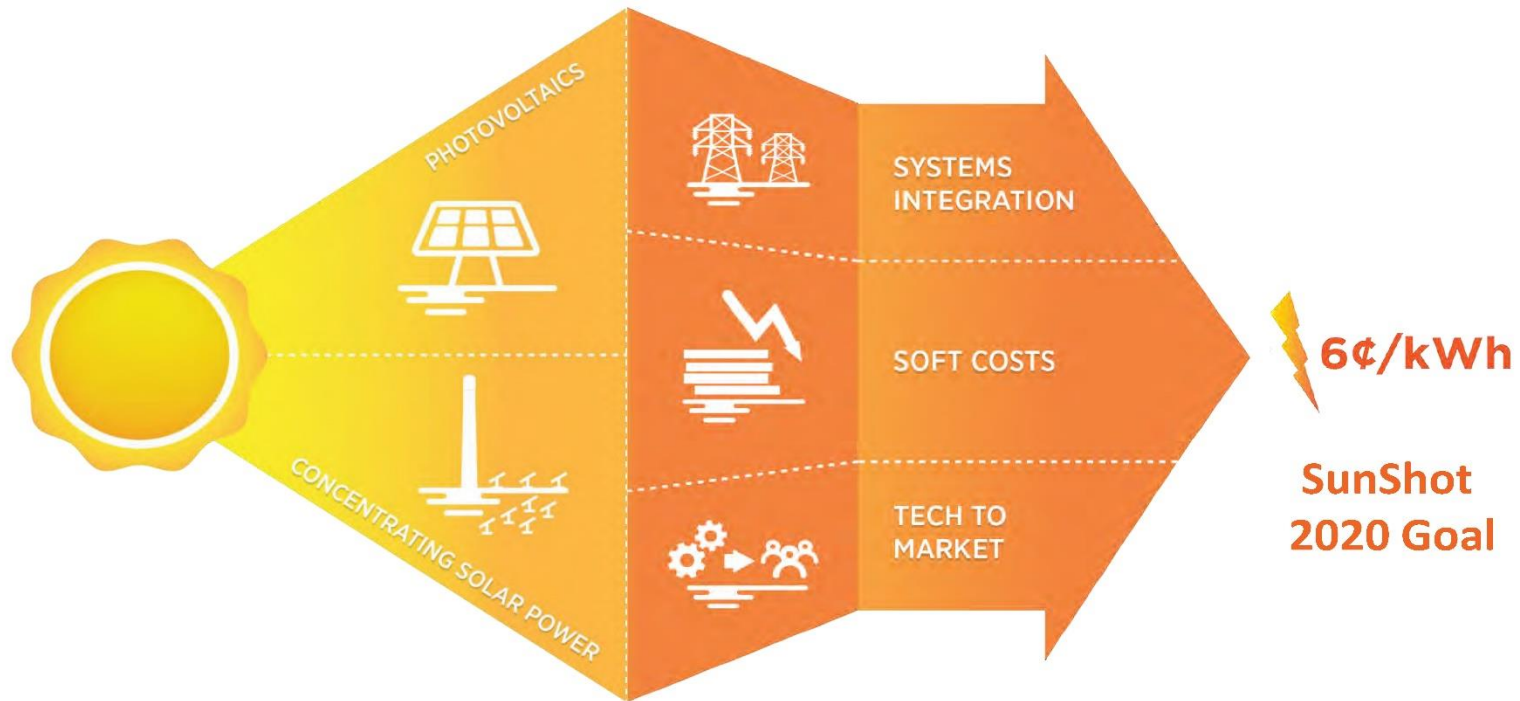


U.S. Department of Energy

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# SunShot Program Structure



[energy.gov/sunshot](http://energy.gov/sunshot)



## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

### Balance of Systems (Soft Costs)

#### BUSINESS INNOVATION

Developing solar finance and business solutions to expand access to capital and accelerate market growth



#### NETWORKING AND TECHNICAL ASSISTANCE

Empowering state and local decision-makers through timely and actionable resources, peer networks, and technical assistance

#### DATA ANALYSIS

Harnessing big data analysis and technical solutions to support the many stakeholders involved in solar deployment

#### TRAINING

Training an innovative solar workforce to enable the solar industry to meet growing demand

[energy.gov/sunshot](https://energy.gov/sunshot)





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Objectives of this Meeting

Bring together CWG members and stakeholders to:

- Share information about the CWG objectives, scope, activities, and timeline
- Provide a forum for stakeholders to provide comments relevant to the CWG efforts:
  - Concerns about avian-solar issues
  - Relevant existing data and studies
  - Understanding of avian-solar interactions
  - Focus of future research
  - Priorities for research needs
  - Future activities of the CWG



*Multiagency CWG Stakeholder Workshop, May 2016*


6

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Agenda - Day 1

Time Slot	Topic
9:30-10:00	Welcome & Workshop Objectives
10:00-10:30	Information About the Multiagency CWG
10:30-10:45	Break
10:45-11:00	Summary of Available Avian-Solar Information
11:00-12:30	Lunch
12:30-2:15	Ongoing Related Initiatives
2:15-2:30	Break
2:30-4:30	Break-out Discussions
4:30-5:00	Wrap Up



Multiagency CWG Stakeholder Workshop, May 2016

7

## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Agenda - Day 2

Time Slot	Topic
9:00-9:15	Recap of Day 1
9:15-9:45	Conceptual Framework of Avian-Solar Interactions
9:45-10:15	Agency Management Questions & Related Research Needs
10:15-10:30	Break
10:30-12:30	Break-out Discussions
12:30-1:00	Wrap Up & Next Steps



Multiagency CWG Stakeholder Workshop, May 2016

8

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Logistical Details

- All handouts and presentations will be available on the CWG webpage: <http://blmsolar.anl.gov/program/avian-solar/>
- If you want to continue to receive information about the CWG efforts, subscribe for email updates
  - Send request to [rollins@anl.gov](mailto:rollins@anl.gov)
- Using the microphone ensures everyone can hear you
- Identify yourself and your affiliation when you speak
- Please mute or turn off cell phones

B5-122  
cont.

Multiagency CWG Stakeholder Workshop, May 2016

9



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**



## **Information About the Multiagency Avian-Solar Collaborative Working Group (CWG)**

*Greg Helseth  
Bureau of Land Management*

*Multiagency CWG Stakeholder Workshop  
May 10-11, 2016*



B5-122  
cont.

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

## Background

- Avian-solar concerns that have emerged in the past 2-3 years present potential barriers to utility-scale solar development
- Existing data are inadequate to define the magnitude and extent of potential avian impacts and causal factors
- Research is underway by multiple parties, including federal and state agencies, industry, and academics
- There is a growing consensus regarding the value of collaborating on defining research objectives and data needs, and on allocation of funding

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Goal and Objectives

*To develop better information to support future agency decisions regarding potential avian impacts at utility-scale solar facilities*

### **OBJECTIVES**

- Establish collaborative working group among federal and state agencies
- Develop multiagency avian-solar science plan
  - Document current and planned research activities
  - Identify cost implications and information gaps
  - Identify agency roles in funding and oversight
  - Develop feasible mitigation measures, if warranted
- Prepare education and outreach materials

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## CWG Members

*Representatives of federal and state agencies with relevant missions and/or project authorization responsibilities*

Federal Agencies	State Wildlife and Energy Agencies *
DOE Solar Energy Technologies Office	AZ Game and Fish Dept.
Bureau of Land Management	CA Dept. Fish and Wildlife
U.S. Fish and Wildlife Service	CA Energy Commission
U.S. Geological Survey	NV Dept. Wildlife
DOI Solicitor's Office	
U.S. Department of Defense	

\* Other state energy agencies have been invited to participate

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Scope and Organization of the CWG

### Scope

- Utility-scale solar technologies
  - All technologies
  - All facility components
- Initial geographic focus: Arizona, California, and Nevada

### Organization

- CWG is led by a chair and co-chair
- Technical support and facilitation is provided by Argonne National Laboratory and the National Renewable Energy Laboratory



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## CWG Tasks, Deliverables, and Timeline

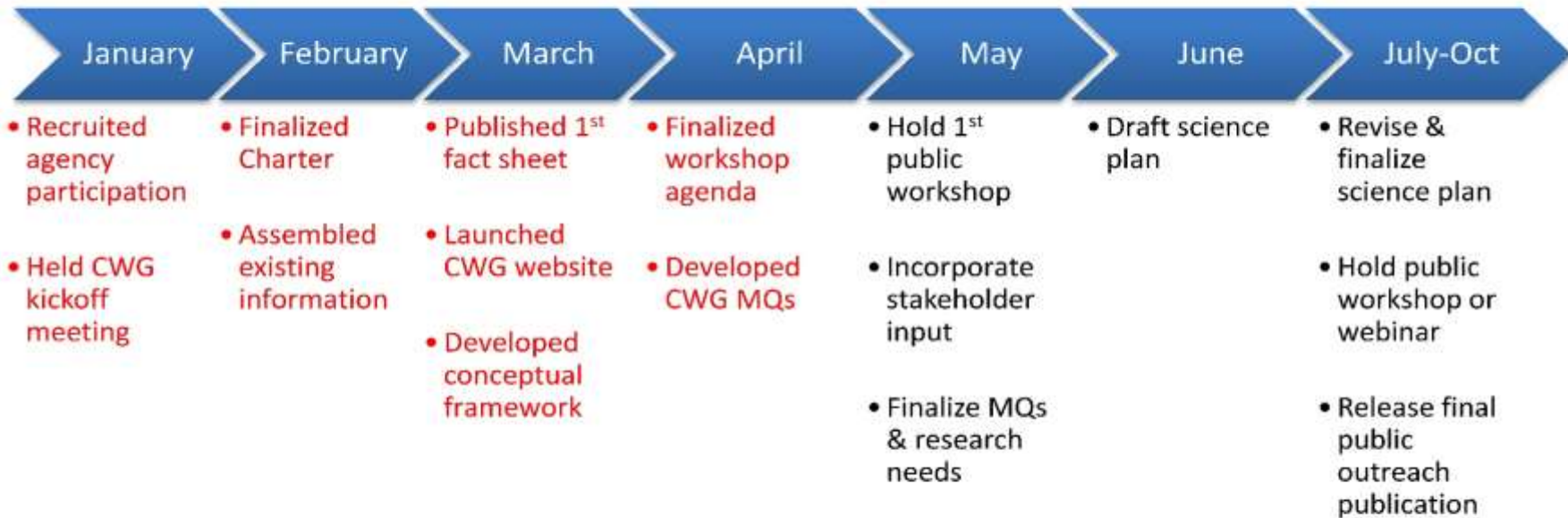
Task	Activities	Milestone(s) / Deliverable(s)
<b>1 Establish the CWG and conduct meetings</b>	Formalize CWG. Conduct quarterly CWG and stakeholder meetings.	Establish CWG charter, quarterly CWG meetings, and stakeholder events
<b>2 Develop an Avian-Solar Science Plan</b>	Summarize current activities, information gaps, and research needs; consolidate data and mitigation measures/BMPs. Develop hypothesis-based science plan applicable to all solar technologies and sites.	Avian-solar science plan by end of Oct. 2016
<b>3 Prepare education and outreach materials</b>	Prepare fact sheets or news items to inform the public of CWG activities, avian-solar data, and clarify information.	At least two in FY16: <ul style="list-style-type: none"> <li>• Fact sheet</li> <li>• News item</li> <li>• Public webinar</li> </ul>

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Timeline & Progress in 2016

Red – complete; Black - anticipated



CWG = collaborative working group, MQ = management question



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Avian-Solar Science Plan

Kirk LaGory, Argonne National Laboratory

***Purpose:*** Provide a consistent framework for research and monitoring of avian-solar interactions

### ***Objectives***

- Define research questions and future research needs;
- Support development of monitoring protocols, evaluation of avian risk, and development of effective mitigation measures;
- Qualitatively discuss potential associated costs; and
- Define agency roles and processes for implementation.



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

## Elements of an Avian-Solar Science Plan

- Executive Summary
- Introduction
  - Describe current solar energy development and trends, observed avian-solar interactions
  - Describe objectives of the plan, desired outcomes, CWG
  - Identify agency-specific management questions
- Conceptual Framework of Avian-Solar Interactions
  - Provides framework for science plan
  - Impacting factors
  - Technology-specific impacts
  - Direct, indirect, and cumulative effects
  - Factors that contribute to risk, including location, seasonality, type of birds
  - Local and population-level effects

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Elements of an Avian-Solar Science Plan (Cont.)

- **Summary of Existing Information**
  - High-level summary with focus on published DOE “rapid report” and subsequent findings, technical reports, and communications with researchers
  - Which portions of the conceptual model are best understood?
- **Information Gaps Related to Avian-Solar Interactions**
  - Identify the information gaps that impede development of effective avoidance, minimization, and mitigation strategies
  - Which portions of the conceptual model are poorly understood?

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Elements of an Avian-Solar Science Plan (Cont.)

B5-122  
cont.

- **Research and Monitoring Needs**
  - Based on management questions, conceptual model, and information gaps, identify research and monitoring that is needed to understand avian-solar interactions
  - Identify priorities for research and monitoring activities based on relative risk to birds
- **Program Implementation**
  - Identify best approaches to research and monitoring
  - Agency roles
  - Collaboration with ASWG and other stakeholders to ensure consistency and complementary activities
  - Role of adaptive management
  - Tiering from the plan
  - Approximate costs of activities

## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

### Stakeholder Engagement

- Agencies are seeking input from stakeholders on all matters relevant to the CWG objectives:
  - Concerns about avian-solar issues
  - Relevant existing data and studies
  - Understanding of avian-solar interactions
  - Focus of future research
  - Priorities for research needs
  - Future activities of the CWG
- Stakeholders can comment during this meeting and/or in writing following the workshop (target due date of June 1, 2016)
- A stakeholder webinar will be hosted to present and take comments on the draft avian-solar science plan (late summer 2016)
- For more information:
  - Subscribe for email updates: send request to [rollins@anl.gov](mailto:rollins@anl.gov)
  - CWG webpage: <http://blmsolar.anl.gov/program/avian-solar/>

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**QUESTIONS?**



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



## A Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities

**Lee Walston\***, Katherine Rollins,  
Karen Smith, and Kirk LaGory  
Environmental Science Division  
Argonne National Laboratory

Karin Sinclair, Craig Turchi,  
Tim Wendelin, and Heidi Souder  
National Renewable Energy Laboratory

\* [lwalston@anl.gov](mailto:lwalston@anl.gov)



B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## What is Utility-Scale Solar Energy Development?

- Large solar fields – 10+ megawatt (MW); requires 5-10 acres per MW
- Three main technologies: 1) photovoltaic (PV) and concentrated solar power (CSP) technologies – 2) parabolic trough and 3) power tower



### Desert Sunlight Solar Farm (PV)

- 550-MW project on over 4,000 acres of public land in southern California

Multiagency CWG Stakeholder Workshop, May 2016

24



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# What is Utility-Scale Solar Development? (cont'd)

B5-122  
cont.



**250 MW Genesis Parabolic Trough Facility**



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

## What is Utility-Scale Solar Development? (cont'd)

B5-122  
cont.



### **Ivanpah Solar Energy Generation Station (SEGS)**

- 3 Solar power towers (377 MW)
- >3,400 acres of public land



*Multiagency CWG Stakeholder Workshop, May 2016*

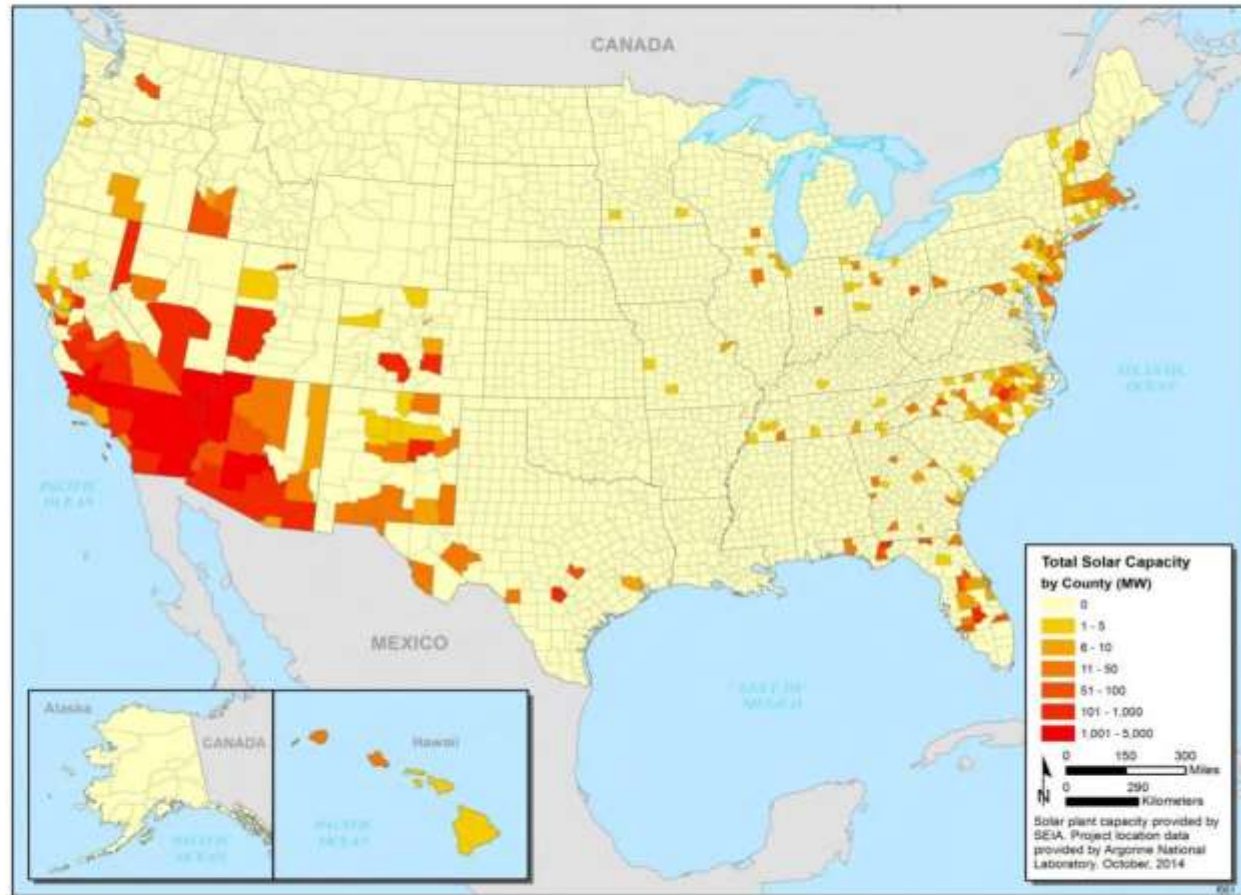
26

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Utility-Scale Solar Energy Development in the U.S.

- >14 GW utility-scale solar capacity (in operation or under construction)
- >1,200 facilities (>1 MW)
- >50% of this electric capacity in southern CA, NV, and AZ.



Source: Walston et al. 2015

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Avian Impacts of Solar Development

### 2 direct sources of solar-avian fatalities

- Collision-related: documented at solar projects of all technology types.
- Solar flux-related: resulting from the burning/singeing effects of exposure to concentrated sunlight. Observed only at facilities employing power tower technologies.



Photo Credit: Robert Sullivan, Argonne National Laboratory





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Factors that Affect Mortality Risk

- Project location
  - Near aquatic/riparian areas, stopover sites, etc.
- Project size
- Project technology / design
  - PV vs CSP
  - Evaporation ponds
  - Ancillary infrastructure



Copper Mountain PV facility in southern Nevada. Example for the "lake effect" hypothesis.  
Photo Credit: Robert Sullivan, Argonne National Laboratory



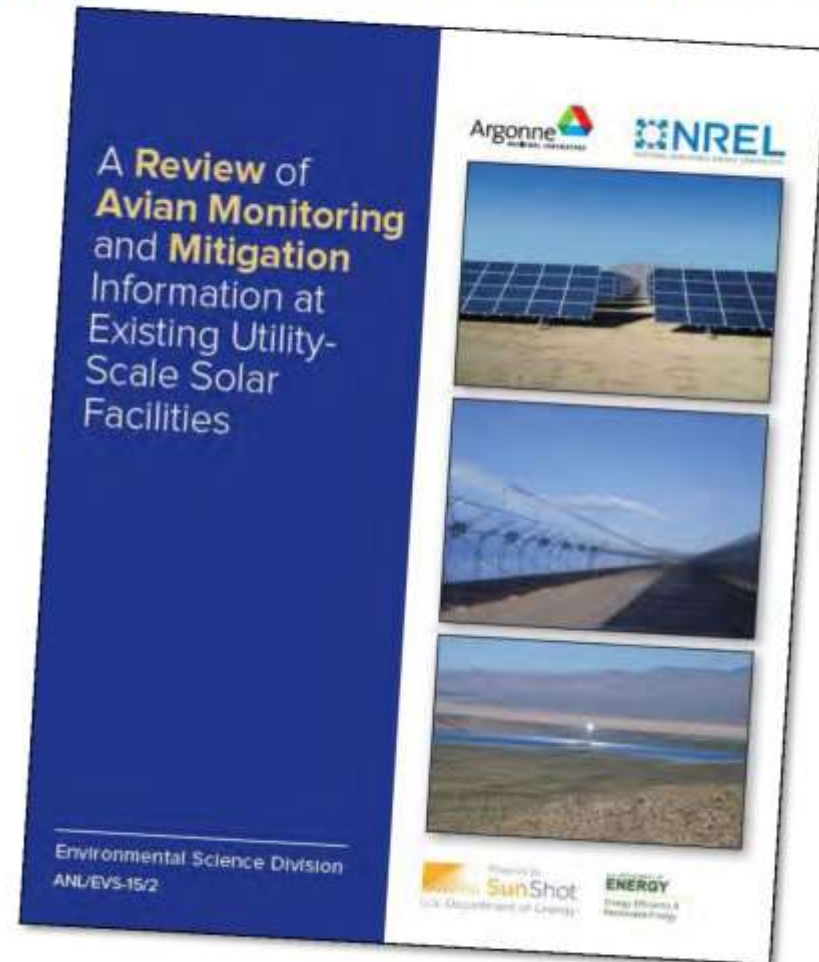
Multiagency CWG Stakeholder Workshop, May 2016

29

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## “A Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities”

- Objectives:
  - Summarize avian fatality issues at solar facilities
  - Summarize current monitoring and reporting activities
  - Evaluate mitigation measures and BMPs used for other industries
  - Examine solar technology-specific aspects of avian fatality
  - Identify information gaps and next steps

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Avian Fatality Information at Solar Facilities (updated)

- 16 Facilities with available avian monitoring information.
- Collection of avian fatality information:
  - Incidental or unknown survey effort at 6 facilities
  - Systematic survey effort at 10 facilities

Summary of Current Avian Monitoring Activities at Utility-Scale Solar Facilities as of May 2016

Project Name	Location	Technology Type and MW (in Parentheses)	Current Status	Land Type	Available Avian Monitoring Plan	Known Collection of Avian Fatality Data
Blythe Solar	Riverside County, CA	PV (485)	Under Construction	Public	Yes	Yes – Incidental and systematic
California Solar One	Daggett, CA	CSP – Power Tower (10)	Decommissioned in 1987	Private	NA	Yes – Systematic
California Valley Solar Ranch	San Luis Obispo County, CA	PV (250)	Operational – Oct 2013	Private	Yes	Yes – Systematic
Campo Verde	Imperial County, CA	PV (139)	Operational – Oct 2013	Private	NA	Yes – Incidental
Centinela Solar Energy	Imperial County, CA	PV (170)	Operational – August 2013	Private	Yes	NA
Crescent Dunes	Nye County, NV	CSP – Power Tower (110)	Construction completed	Public	Yes	Yes – Systematic



Multiagency CWG Stakeholder Workshop, May 2016

31

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Avian Monitoring at Solar Facilities

- Fatality monitoring (and reporting) at very few solar facilities
  - Not required at all facilities
- Differences in monitoring designs and survey effort
  - Affects the ability to compare and integrate data
- Systematic vs. incidental fatality information
  - Systematic information allows hypothesis testing
  - Incidental observations may still be useful in understanding patterns of fatalities



Barn swallow with singed feathers observed at the California Solar One demonstration facility (Source: McCrary et al. 1986).





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Avian Monitoring at Solar Facilities, Cont'd

- Variation in factors influencing mortality rate estimation and evaluation
  - **Search effort and searcher efficiency**
  - **Feather spots**
  - **Predation and scavenging**
    - Potential for predators to influence mortality rates by transporting carcasses to the project footprint from offsite locations
  - **Background mortality**
    - Mortality estimates at some solar facilities include adjustments for background mortality



Multiagency CWG Stakeholder Workshop, May 2016

33



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.

## Conclusions & Recommendations

- Avian monitoring
  - Not all utility-scale solar facilities are required to prepare and comply with project-specific avian monitoring protocols
- Existing avian fatality data
  - Standardization is important for integration and comparison
- Flux-related factors (power tower technologies)
  - Various approaches to heliostat standby aiming could significantly reduce flux levels and their impact on avian fatality
- Better collaboration among agencies, industry, and stakeholders to (1) collect scientifically rigorous and comparable data; (2) identify research priorities; and (3) identify appropriate mitigation measures.

*Multiagency CWG Stakeholder Workshop, May 2016*

34

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Questions?



Photo Credit: <http://cleaneasyenergy.com/>



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

## **Presentations on Ongoing Related Initiatives**


- 1. Tom Dietsch – U.S. Fish and Wildlife Service***
- 2. Mona Kahlil – U.S. Geological Survey***
- 3. Avian Solar Work Group Representatives: Julie Falkner, Defenders of Wildlife and Laura Abram, First Solar***
- 4. Tim Wendelin – National Renewable Energy Laboratory (NREL)***
- 5. Elise DeGeorge - NREL***

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



# Update on Solar-Avian Interactions in Southern California

Thomas Dietsch  
Migratory Bird Division  
US Fish and Wildlife Service  
CWG Public Meeting  
Sacramento, CA  
May 10, 2016



B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Objectives for Presentation

- Provide a review of solar-avian interactions in Southern California
- Discuss hypotheses for avian interactions
- Provide update on actions being taken

2



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Avian Impacts

## Direct Effects: Collisions



B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Collisions with panels are common



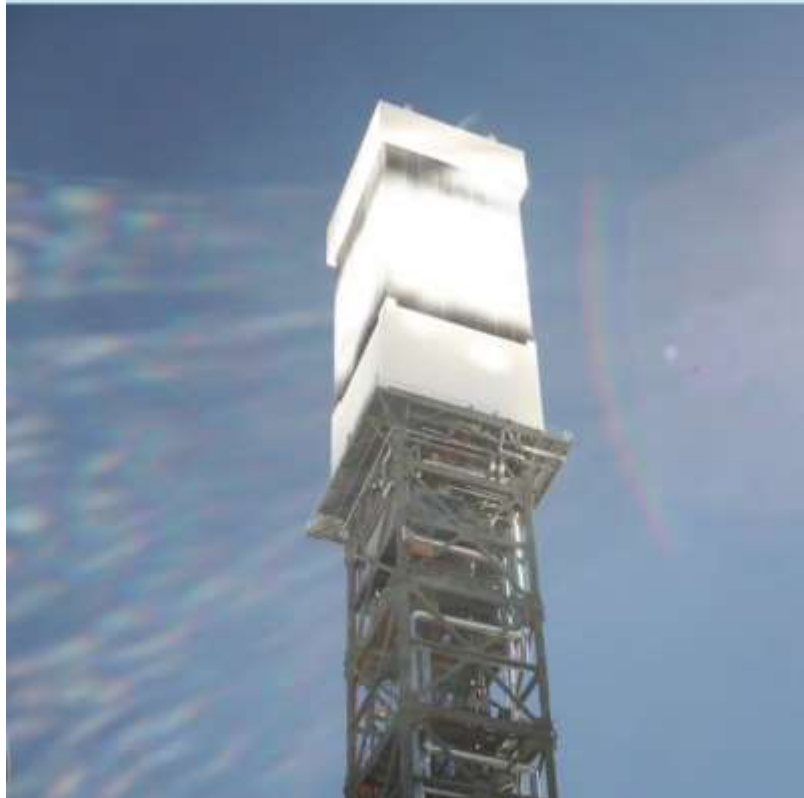
B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Concentrated Solar Technologies

## Direct Effects

Solar Flux (power tower)



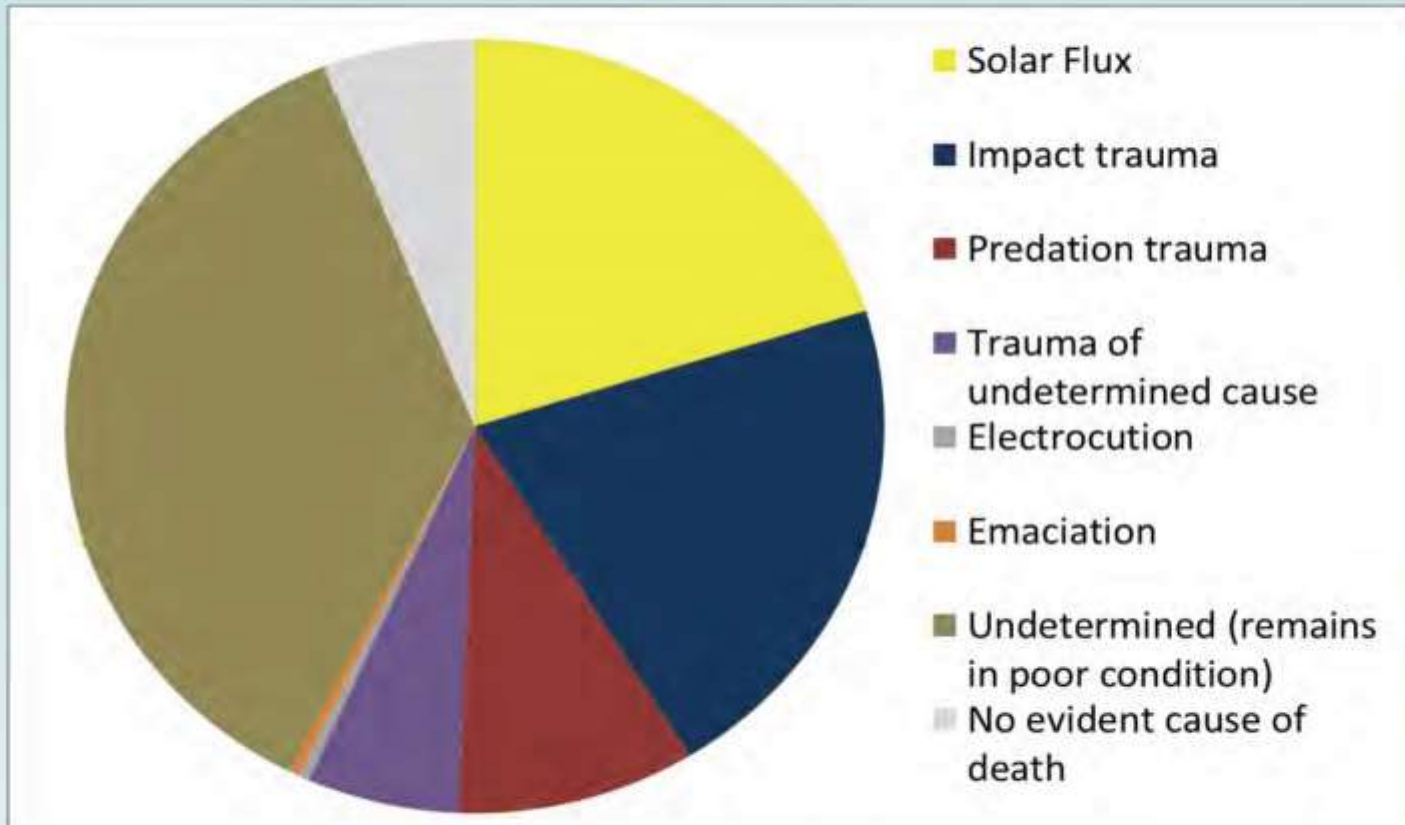
B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Cause of Death from National Fish and Wildlife Forensics Lab Report (Kagan et al. 2014)



**From 3 solar projects, 233 carcasses from 71 species.**

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Data for Today's Presentation

- Mortality monitoring and reporting is required by lead agencies on many projects.
- Data from 7 projects in Southern California  
(4 Photovoltaic, 2 Solar Trough, 1 Power Tower)
- Data reported from 2012-April 2016.
- Each species was categorized by habitat, migratory group, and foraging guild.

7



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Caveats on Solar Avian Mortality data

- Data are from a mix of incidental reports and systematic surveys on several projects.
- Magnitude of mortalities are not reported here.
- Only projects in Southern California are included in this presentation.
- Data can provide information on which species or taxonomic groups may be at risk.
- Project features and types of injuries also indicated.

8

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Initial Findings

- National Fish and Wildlife Forensics Lab Report (Kagan et al. 2014)
  - “Significant Bat and Insect Mortality, including Monarch Butterflies”.
- 3545 mortalities from 183 species (2012-April 2016)
  - Only mortalities found and reported included, no estimation.
  - Mix of reports from incidental finds and systematic surveys.
  - Many mortalities occur due to dehydration/heat stress after initial injury/stranding.
- Birds of Conservation Concern

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Species of Concern

- Federal Endangered/Threatened
  - Yuma Ridgeway's (Clapper) Rail
  - Willow Flycatcher
  - Yellow-billed Cuckoo
- State-listed/Fully Protected
  - Peregrine Falcon
  - Bank Swallow
- 19 Birds of Conservation Concern
  - Western Grebe
  - Horned and Eared Grebes
  - American White Pelican
  - Burrowing Owl
  - Calliope Hummingbird



10



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

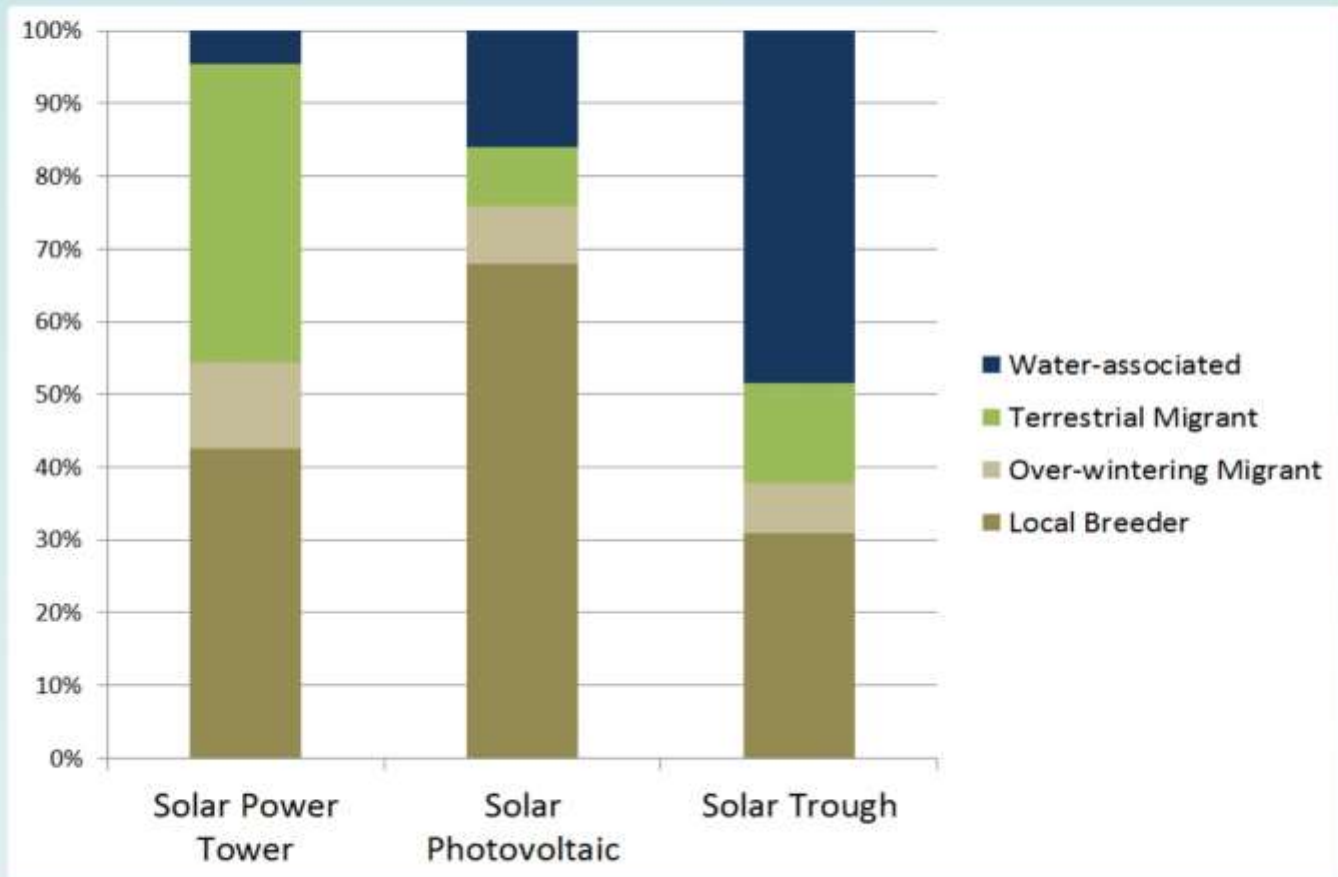
# Hypotheses

- Mortalities represent background mortality.
- Mortalities occur during normal bird movements (Anthropogenic, no landscape-scale attraction).
- Polarized light may attract birds and insects to solar projects in the Mojave Desert (Horvath et al. 2009).
- Other resources attract birds to solar projects (Insects and Ponds).

11

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Habitat/Migratory Status of Birds found injured on Solar Projects



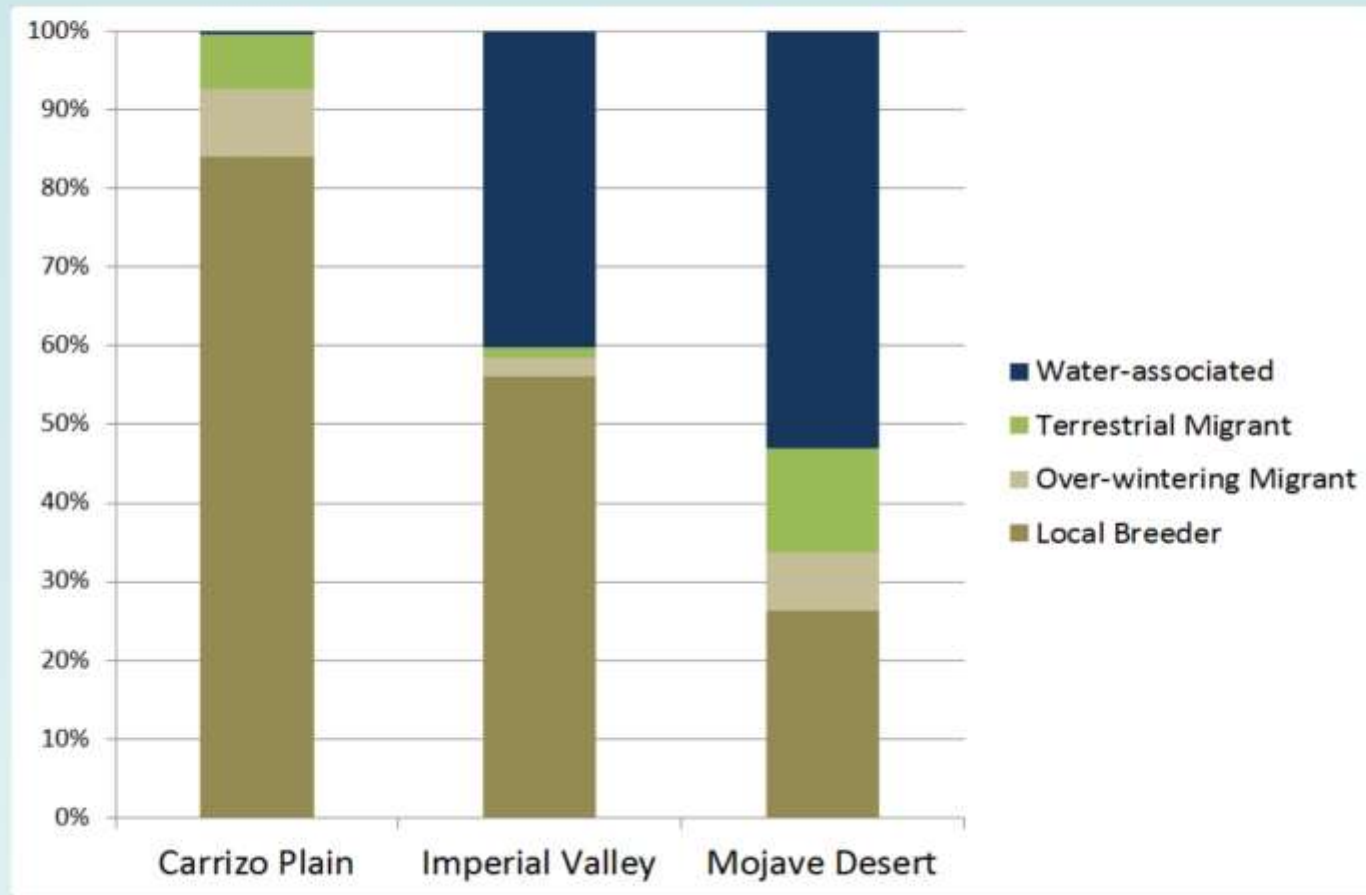
B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

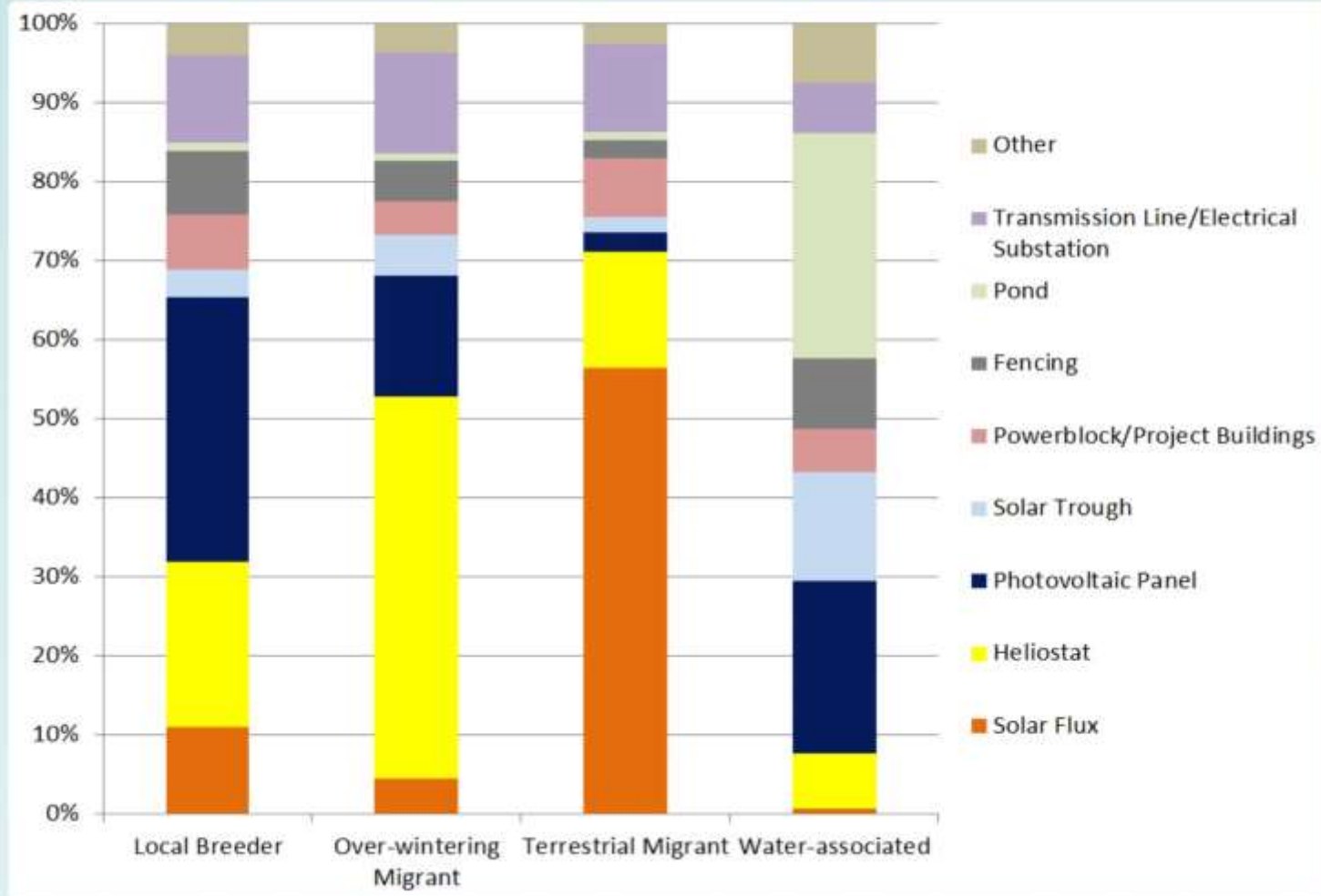
B5-122  
cont.

# Regional Differences for Photovoltaic



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

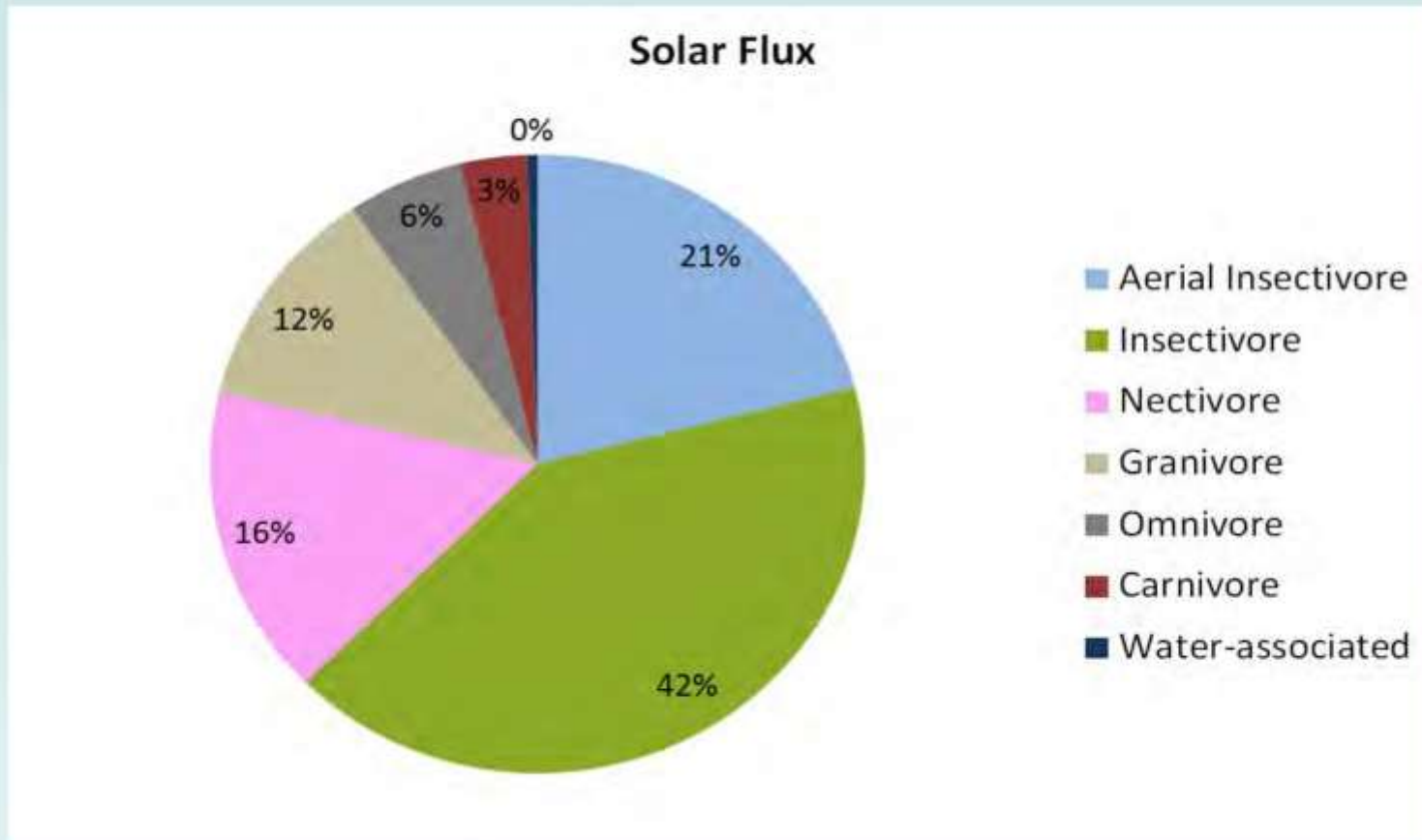
# Solar Project Features Associated with Mortalities



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Foraging Guilds of Birds with Solar Flux Injuries



15

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Findings

- There may be a “lake effect” associated with utility-scale solar projects similar to that described by Horvath et al. 2009.
- Many birds of conservation concern may be at risk.
- Regional (and site-specific) differences may affect which species are at risk.
- Insects may be attracting some birds to areas with elevated levels of solar flux.
- Many species affected are long-distance migrants, thus population level effects may be difficult to determine.
- Robust monitoring needed to better understand these phenomena and to support adaptive management.

16



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Mortality Monitoring Objectives

- Estimate the total number of birds and bats killed at a facility within a specified time period.
- Determine whether there are spatial or temporal/seasonal patterns of total bird fatality.
- Evaluate species composition and which taxonomic groups may be at risk.
- Provide results that allow comparisons with other solar sites and to evaluate changes in fatality due to adaptive management.

17

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Research Needs

- Project-scale information needs
- Mojave and Sonoran Desert Migratory Pathways
- Migratory Connectivity Research to identify populations affected
  - Populations affected may be distant from the source of mortalities
  - Stable Isotopes (USGS)
  - Genotypes (UCLA)
  - Telemetry of appropriate-sized birds
- Avian Behavior related to projects
  - Perception and Settling Response
  - Technological Fixes
- Identify Best Management Practices and Deterrent Methods

18

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.



# Update on actions being taken

- Working with solar industry to implement robust mortality monitoring.
  - Searcher Efficiency and Carcass Persistence Trials.
- Solar Bird and Bat Conservation Strategy Guidelines in development.
  - Public meeting on June 22<sup>nd</sup> in Sacramento.
- Collaborated with USGS to develop Mortality Monitoring Protocols for Solar
  - Protocols for monitoring at each technology type.
- Coordinating with other agencies to find ways to avoid and minimize avian mortalities.
- Coordinating with Avian Solar Working Group (industry and other stakeholders)
- Supporting ongoing research efforts by USGS and UCLA

19




Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



**U.S. Fish & Wildlife Service**

# Questions?



B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



# Research to Address Wildlife Interactions with Solar Energy Facilities

**Avian-Solar Collaborative Working Group**

May 10, 2016

USGS Ecosystems Mission Area



B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# U.S. Geological Survey

## Ecosystems

Natural Hazards

Energy and Minerals

Core Science Systems

Environmental Health

Water

Climate and Land Use Change

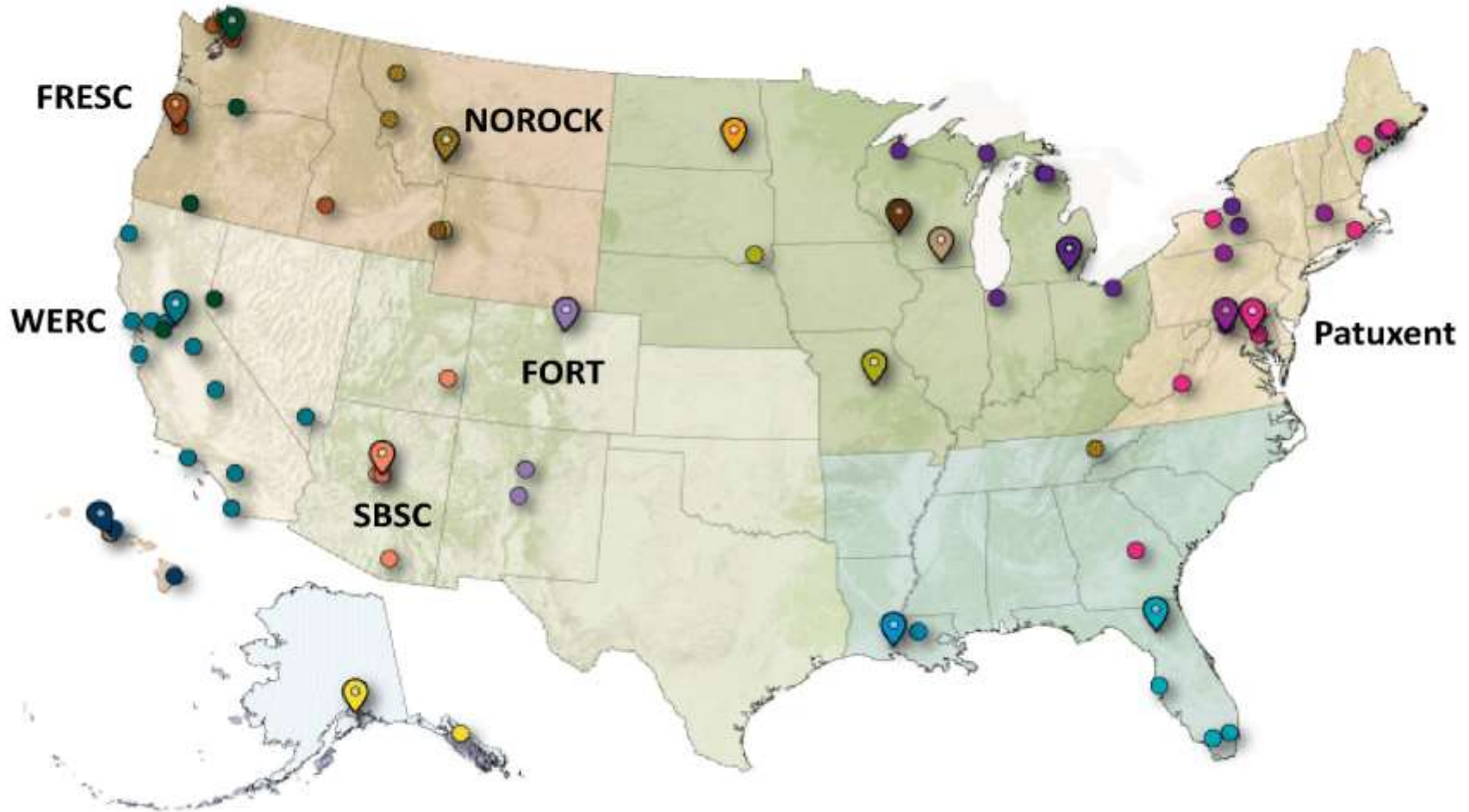
Provide the scientific information required for sound natural resource management and conservation decisions



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# USGS Ecosystems Mission Area 17 Science Centers

B5-122  
cont.



+ 40 Cooperative Research Units





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Energy and Wildlife Research

### Goals

- **Understand risks:** when and where wildlife occur and how they use space
- **Measure impacts** to wildlife, both direct and indirect
- **Develop solutions:** minimize impacts through technological fixes, management, mitigation

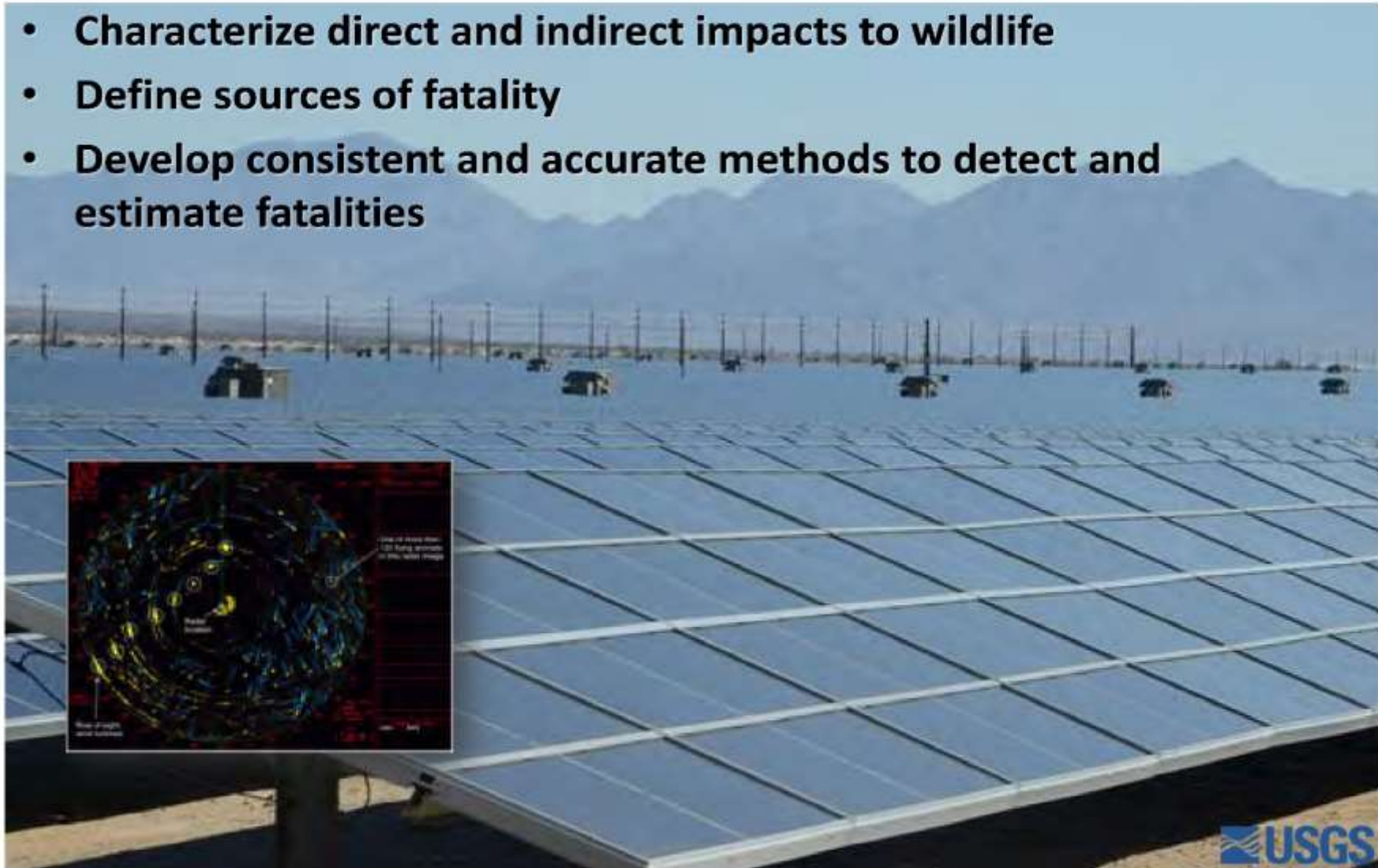




Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

## Measuring Impacts

- Characterize direct and indirect impacts to wildlife
- Define sources of fatality
- Develop consistent and accurate methods to detect and estimate fatalities



B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Efficacy of Wildlife Monitoring Technologies at the Ivanpah Solar Electric Generating System

### Objective:

- Evaluate efficacy of monitoring technologies to detect birds, bats, and insects flying in the vicinity of flux fields produced at the ISEGS
- Tested technologies concurrently (portable radar, surveillance video, thermal video). Also performed invertebrate sampling
- Monitoring period covered ~20 days in May and September 2014 during bird migration season
- Developing data handling and analysis software (presence/absence, speed, direction, abundance)

**PIs:** Robb Diehl (NRMSC), Paul Cryan & Ernie Valdez (FORT)

**Status:** In review. Full data release will accompany publication

B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Monitoring Methodology for Solar Facilities

- No guidance currently exists for addressing wildlife conservation concerns at solar energy facilities
- Published studies have not directly addressed the methodology needed to accurately estimate fatality of birds and bats at solar facilities

### Objective:

- Develop monitoring methodology for solar facilities to produce a consistent carcass search methodology

**PI:** Manuela Huso (FRESC)

**Project completion:** May 2016



US FWS Pacific Southwest Region





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Solar Fatality Estimator and “Evidence of Absence” Software

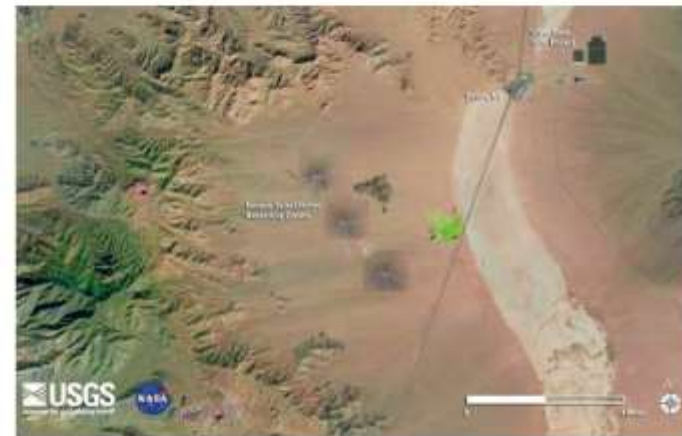
Need consistent and accurate methods to detect and estimate fatalities from carcass searches at solar facilities

### Objective:

- Modify existing software to produce unbiased estimates of fatalities at utility-scale solar facilities and “Evidence of Absence” software for rare species
- Define sources of fatality
- Estimate searcher efficiency and carcass persistence
- Determine when thresholds have likely been exceeded and mitigation might be considered

**PI:** Manuela Huso (FRESC)

**Anticipated completion:** April 2017



Ivanpah Solar Electric Generating System



Golden eagle at wind farm in CA.  
Credit: Jeff Lovich

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Assess Energy Development Impacts to Sensitive Bird and Bat Species and Populations

Need to more accurately estimate fatality rates and effectiveness of mitigation techniques

### Project Objective:

- Estimate geographic scope of species impacted
- Use demographic modeling to assess how fatalities affect population increases or declines
- Determine best practices for conducting risk assessments and predicting mitigation outcomes

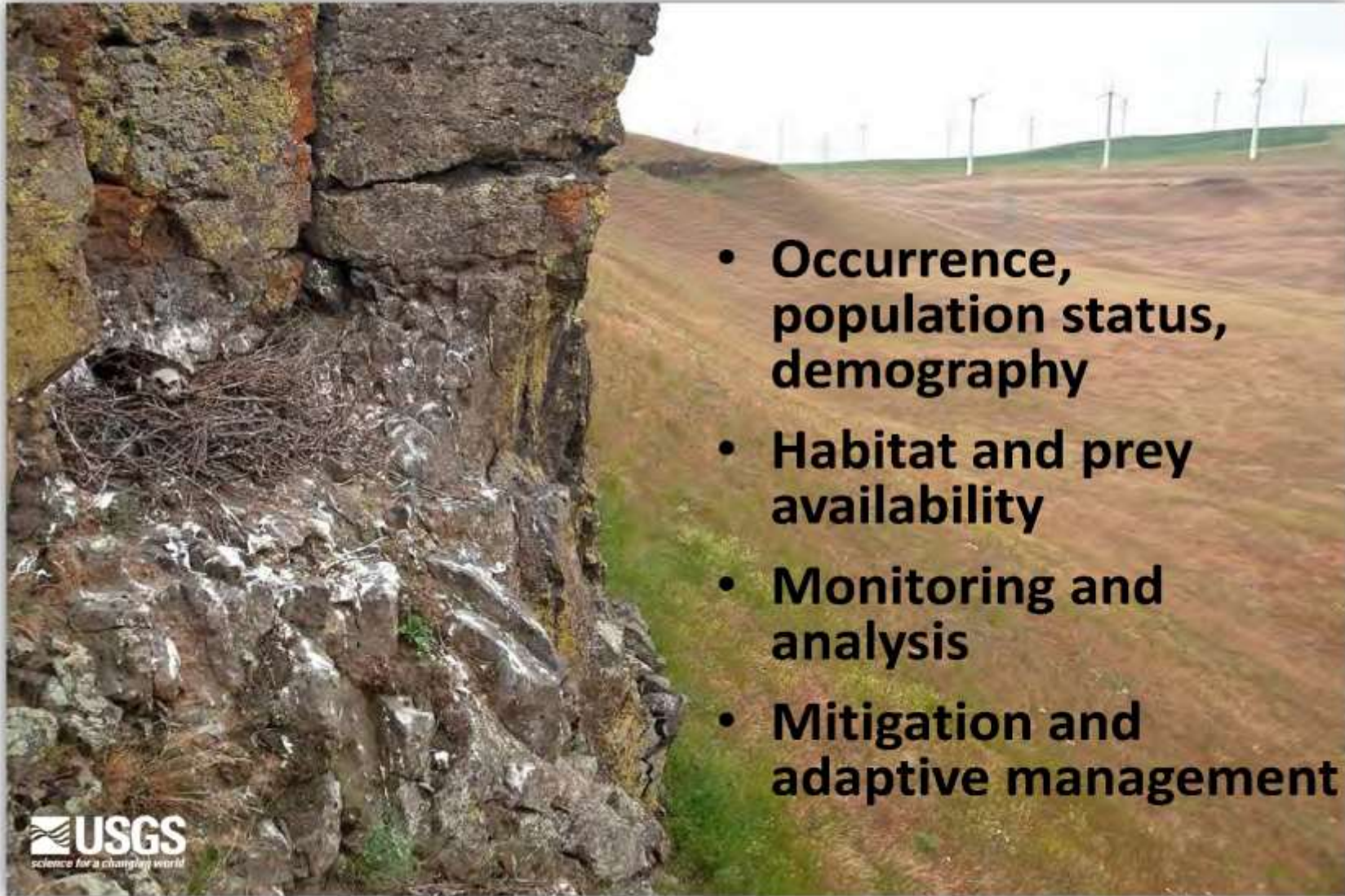
**PI:** Todd Katzner (FRESC)

**Project period:** 2015-2018



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

## Understanding Risks



B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Habitat Modeling to Inform Energy Development

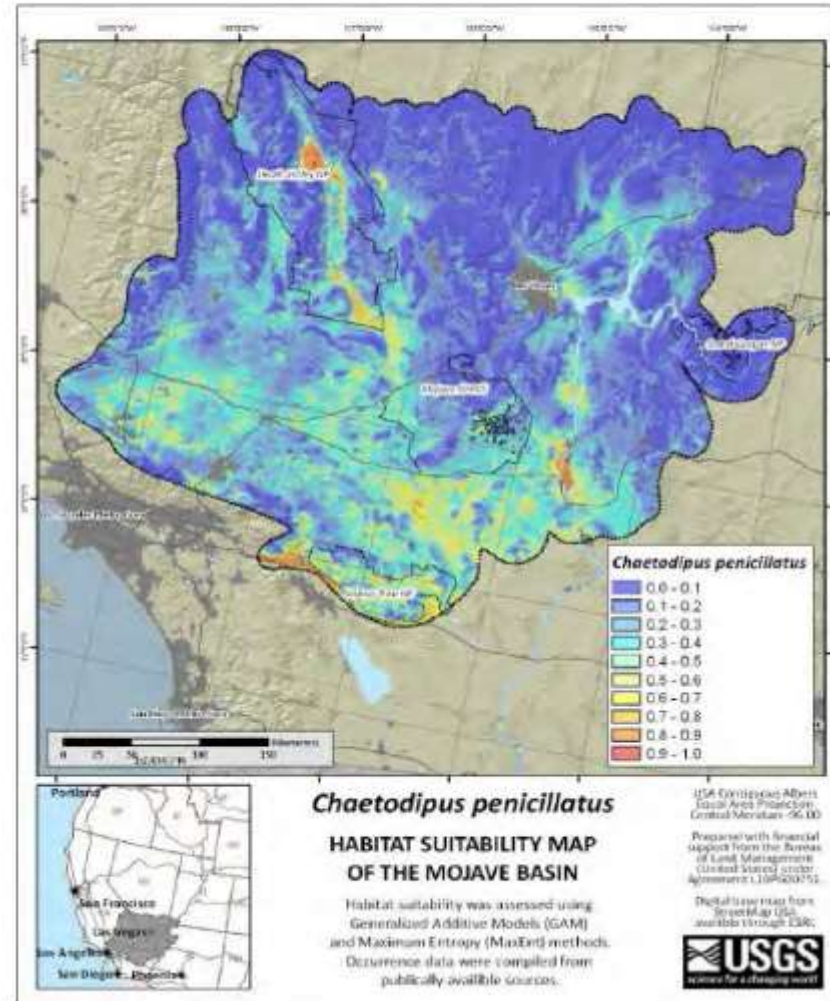
Renewable energy development in the Mojave Ecoregion is creating potential impacts to multiple species of wildlife

## USGS Published Research

- Habitat suitability models for over 50 desert plant and animal species can be used to rank potential habitat loss
- Golden eagle status assessments and monitoring protocols

**PIs:** Todd Esque, Amy Vandergast (WERC)

**Publication:** Inman, R. D. et al., 2014. Mapping Habitat for Multiple Species in the Desert Southwest. Open File Report 2014-1134.



B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Linking Habitat and Prey Availability to Golden Eagle Ecology and Solar Energy in the Mojave

Inform energy and land-use planning ; assist with delineating conservation and development zones

### Objectives:

- Assess food habits, reproductive success and prey availability of nesting golden eagles in the Mojave
- Synthesize and review rabbit distribution and abundance in the Western US
- Develop a regional prey database for rabbit populations across 17 western states

**PIs:** Kathleen Longshore & Todd Esque (WERC)

**Product completion:** Spring/Summer 2016

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Surveying and Monitoring Golden Eagles and Other Raptors in the DRECP Area

B5-122  
cont.

Effective surveys for eagles and status monitoring and mapping are needed to meet DRECP objectives

### Objective:

- Develop survey designs and field procedures to determine the distribution of golden eagles
- Assess their occurrence and nesting success in the DRECP area
- Compile and analyze eagle population data for CA & NV, and the larger context of their full migratory range into a geospatial database

**PI:** David Wiens (FRESC)

**Project Completion:** Summer 2016



## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Helping Inform Siting Decisions

What are regional golden eagle nesting and foraging behaviors that may lead to eagle – infrastructure interactions?

### Objectives:

- Population surveys, biotelemetry and genetics
- Focus on occupancy and movement
- Abundance and survival in relation to prey dynamics
- Regional understanding

**PIs:** Jeff Tracey & Robert Fisher  
(WERC)

**Products:** Biotelemetry data for 24 eagles released May 2016



B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Needs and Future Directions

- Expand research on wildlife interactions with large scale solar power facilities
- Understand direct and indirect effects on species and landscapes
- Expand knowledge of where species are on the landscape
- Continue efforts to develop deterrents to minimize interactions of wildlife with facilities and effective mitigation strategies

B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# USGS Energy and Wildlife Contacts

**Todd Esque**

Research Ecologist

Western Ecological Research Center

(702) 564-4506

[tesque@usgs.gov](mailto:tesque@usgs.gov)

**Manuela Huso**

Biological Statistician

Forest and Rangeland Ecosystem

Science Center

(541) 750-0948

[mhuso@usgs.gov](mailto:mhuso@usgs.gov)

**Mona Khalil**

Energy & Wildlife Specialist

Ecosystems Mission Area

U.S. Geological Survey (703)

648-6499 [mkhalil@usgs.gov](mailto:mkhalil@usgs.gov)





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Recent USGS Publications of Relevance to Solar Energy Development

- Braham, M.E., Miller, T.A., Duerr, A., Lanzone, M., Fesnock, A., Lapre, L., Driscoll, D., Katzner, T.E., 2015, Home in the heat- Dramatic seasonal variation in home range of desert golden eagles informs management for renewable energy development. DOI- 10.1016/j.biocon.2015.03.020: Biological Conservation, v. 186, p. 225-232.
- Duerr, A., Miller, T.A., Duerr, K.C., Lanzone, M., Fesnock, A., Katzner, T.E., 2015, Landscape-scale distribution and density of raptor populations wintering in anthropogenic-dominated desert landscapes. DOI- 10.1007/s10531-015-0916-6: Biodiversity and Conservation, v. 24, no. 10, p. 2365-2381.
- Simes, M.T., K.M. Longshore, K.E. Nussear, G.L. Beatty, D.E. Brown, and T.C. Esque, 2015, Black-tailed and white tailed jackrabbits in the American West: History, ecology, significance, and survey methods. Submitted to Western North American Naturalist 75(4):491-521.  
DOI: [10.3398/064.075.0406](https://doi.org/10.3398/064.075.0406)
- Simes, M.T., K.M. Longshore, K.E. Nussear, G.L. Beatty, D.E. Brown, and T.C. Esque. *In Review*. An annotated bibliography for the black-tailed jackrabbit (*Lepus californicus*) and white-tailed jackrabbit (*Lepus townsendii*). Prepared and submitted as a USGS Open-File Report
- Dilts, T. E., Weisberg, P. J., Leitner, P., Matocq, M. D., Inman, R. D., Nussear, K. E. and Esque, T. C. (2016), Multi-scale connectivity and graph theory highlight critical areas for conservation under climate change. Ecol Appl. Accepted Author Manuscript. doi:10.1890/15-0925
- Tracey, J.A., Madden, M.C., Sebes, J.B., Bloom, P.H., Katzner, T.E., and Fisher, R.N., 2016, Biotelemetry data for golden eagles (*Aquila chrysaetos*) captured in coastal southern California, November 2014–February 2016: U.S. Geological Survey Data Series 994, 32 p., <http://dx.doi.org/10.3133/ds994>.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## ASWG Mission

*The ASWG is a collaborative group of environmental organizations, academics, solar companies, and solar industry representatives that will advance coordinated scientific research to better understand how birds interact with solar facilities. Given the threat that climate change poses to avian species, participants will work with the shared interests of protecting avian species and developing solar projects in an environmentally responsible and a commercially viable manner.*

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

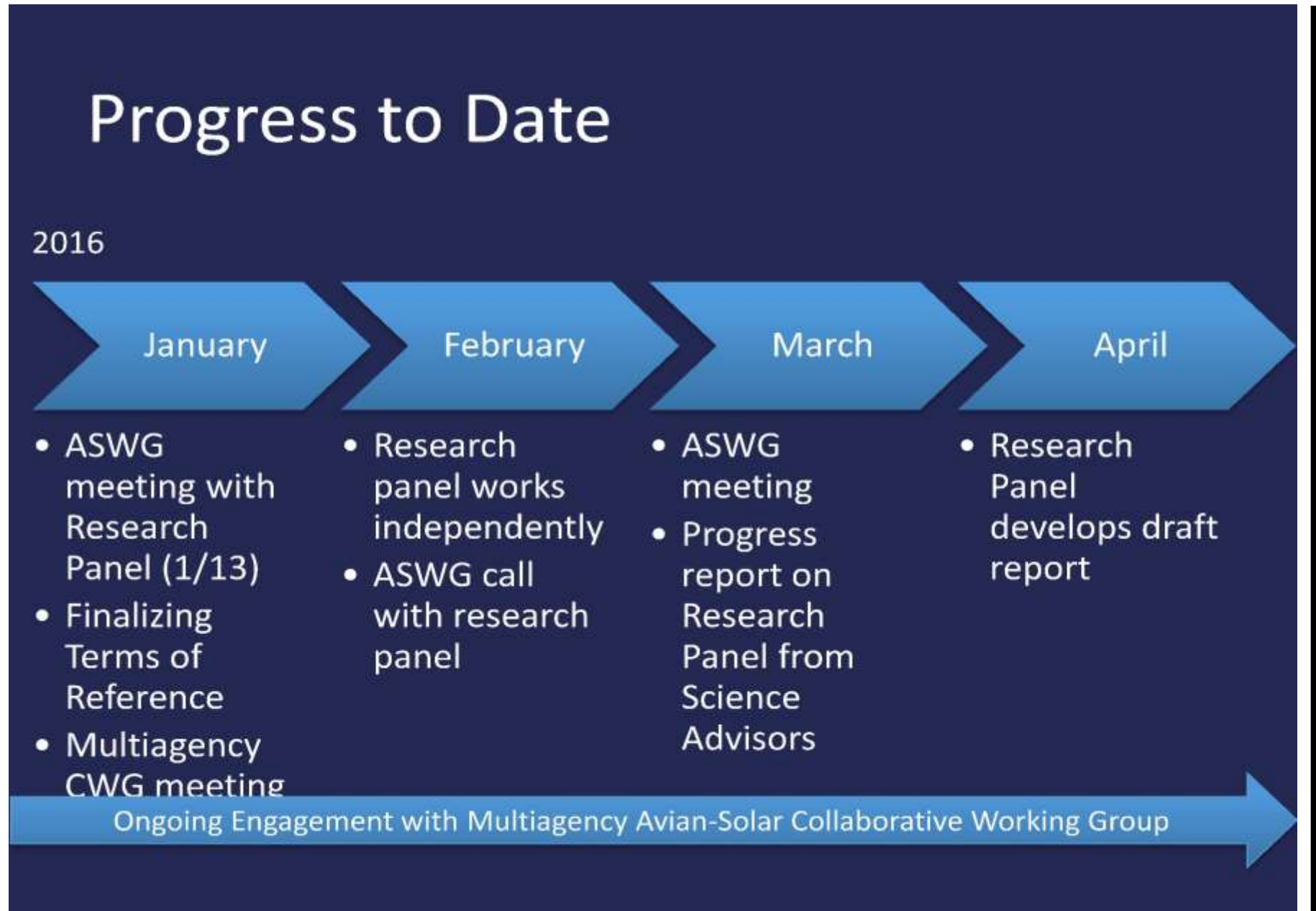
# Participants and Roles

- Convener: Large-scale Solar Association
- Facilitation team: Pivot Point
- Decision-making members:
  - Audubon California
  - Defenders of Wildlife
  - Duke Energy
  - First Solar
  - Large-scale Solar Association
  - Natural Resources Defense Counsel
  - NextEra Energy Resources
  - Recurrent Energy
  - SunEdison
  - SunPower



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.





Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Research Panelists

Science Advisors		
Thomas Smith	UCLA	Director, Center for Tropical Research
Kristen Ruegg	UCLA / UCSC	Institute for the Environment and Sustainability, Center for Tropical Research
Research Panelists		
Steve Beissinger	UC Berkeley	Professor of Conservation Biology
Wally Erickson	WEST Consulting	CEO / Senior Statistician
Vasilis Fthenakis	Brookhaven National Lab	Principal Investigator
Luke George	Colorado State University	Senior Research Associate
Rodney Siegel	Institute for Bird Populations	Executive Director

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# ASWG Research Questions

## I. Siting

- 1) Do avian mortality rates at PV solar power plants differ from background rates at control sites?
- 2) What is the relationship of mortality rates to site characteristics (e.g., panels, fence lines, overhead transmission lines, scale/configuration of installations, proximity to other solar facilities or other natural or human landscape features such as levels of fragmentation and loss of habitat, migratory flyways and stop over sites, etc.)?
- 3) How might siting be optimized to reduce potential impacts on vulnerable bird populations in a cost-effective manner?



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# ASWG Research Questions

## II. Population level effects

- 1) Are solar sites causing avian mortality that is significant at the scale of the population for individual species?
  - a) How should populations be defined in this context?
  - b) What research and data would be required to determine if mortality associated with solar sites is additive or compensatory?
  - c) How do population impacts differ by species, guild, migratory pathway, taxonomic unit and classification (threatened versus non-threatened), etc.?



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# ASWG Research Questions

## III. Lake Effect

- 1) Are water or other birds attracted to solar panels because they perceive them as water bodies (i.e., a “Lake Effect”)?
- 2) Is a possible Lake Effect related to geographic and environmental/infrastructure characteristics of sites?
- 3) Do birds show evidence of attraction to large solar arrays (e.g. show changes in flight direction or behavior as they approach arrays)?
- 4) What types of birds are affected?
- 5) Is possible mortality due to stranding, strikes or some other process?
- 6) If the Lake Effect is demonstrated, what cues are causing the birds to mistake the solar array as a water body (e.g., what wavelength of reflected light are they responding to)?
- 7) If a Lake Effect can be demonstrated, how might the threat be mitigated or eliminated?

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# ASWG Research Questions

## IV. Avian attraction/mitigation/deterrents

1) What are the avian risk-reduction options that might lower avian mortality?

## V. Feather spots

1) What do feather spots represent? Can feather spots be better defined and quantified?

a) What methods can be used to identify the species and number of individuals that comprise feather spots? Are feather spots a reliable indicator of avian strikes and/or fatalities.

b) Do feather spots from larger carcasses persist in the environment longer than spots from smaller ones?



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# ASWG Research Questions

## VI. Climate change and other broader impacts

- 1) What demographic effects may result from climate change in the absence of large-scale solar development, and how do these compare with the impacts of solar facilities for specific bird populations?
- 2) Using historical and contemporary data on the abundance and distribution of avian species with future climate projections, what are the predictions for the future avian distribution and population trends in California?
  - a) How can this be used to mitigate the impacts of PV facilities?



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Achieving Mutual Goals

- Understanding common research interests
- Identifying key priorities
- Identifying funding mechanisms
- Continued collaboration to drive short and long term results

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122



**Development of Tools, Training, and Outreach to Address Solar Glare and Flux-Related Avian Impacts**



**Multiagency Avian-Solar Collaborative Working Group Public Workshop**

**Timothy Wendelin**  
National Renewable Energy Laboratory

**Clifford K. Ho**  
Sandia National Laboratories

**Cianin Sims**  
Sims Industries

**May 10, 2016**

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Goals

- DOE is funding work to address avian flux hazards
  - Develop models and tools to quantify flux (power/unit area) from heliostat aiming strategies
  - Mitigate impacts of avian (and glare) hazards
  - Optimize operational performance

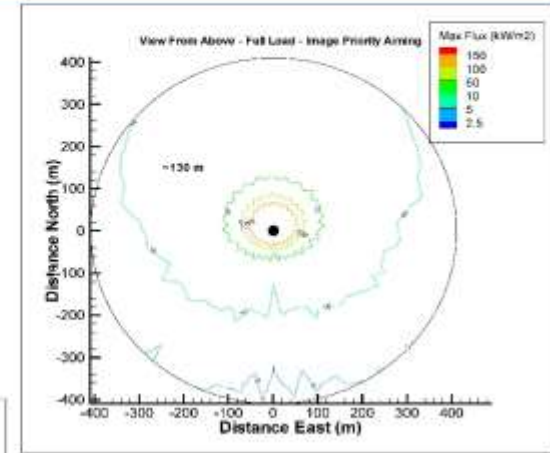
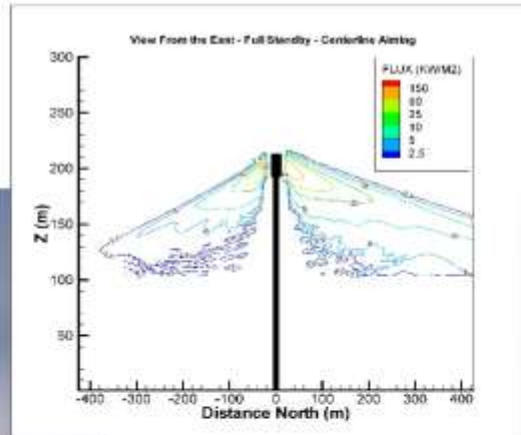


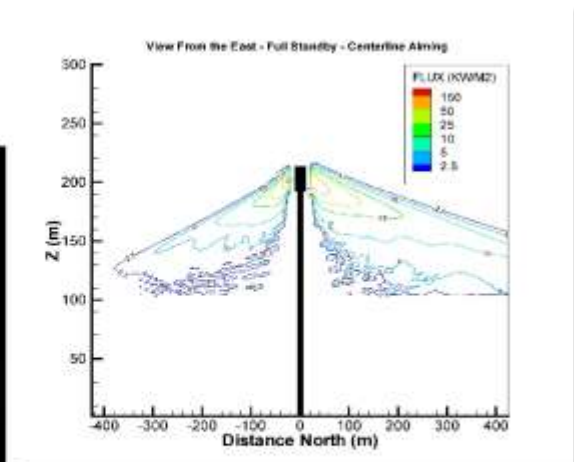
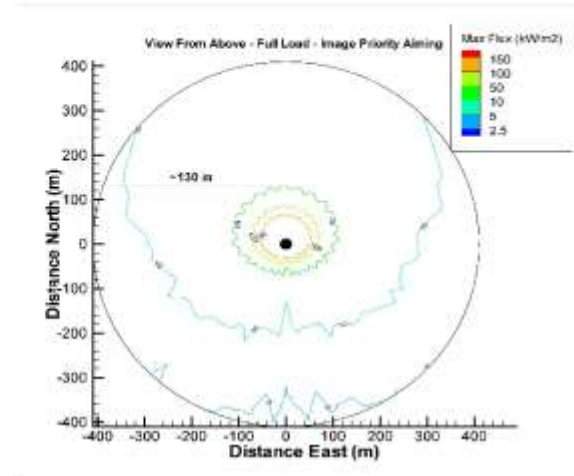
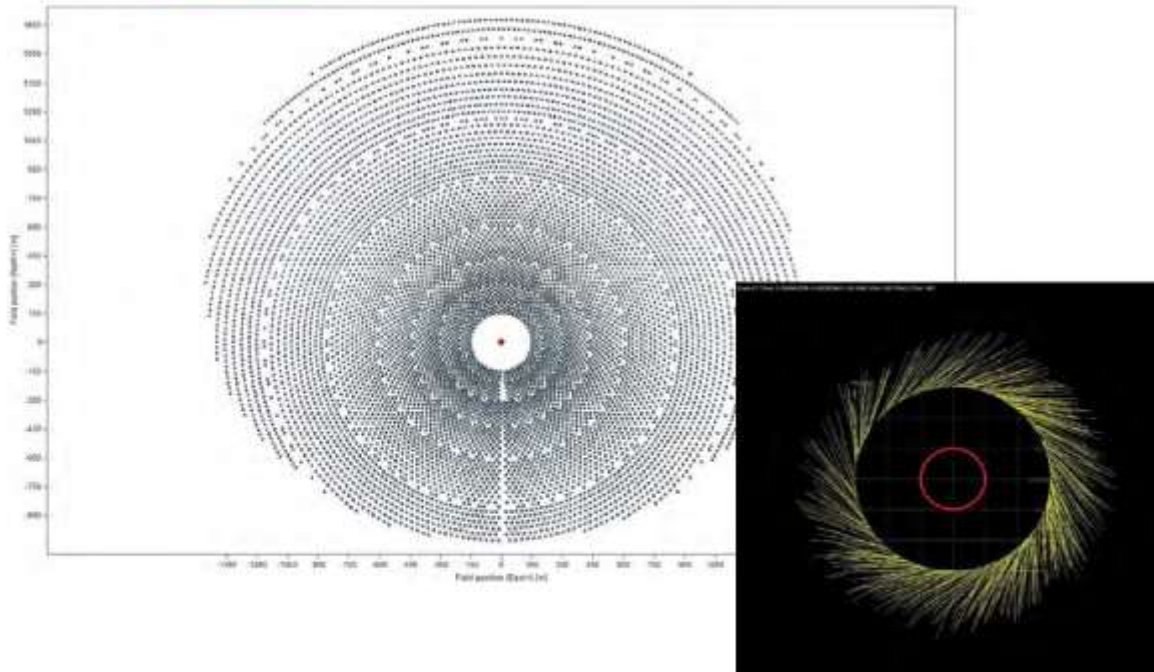
Photo and model of high-flux regions causing solar glare and avian hazards at Ivanpah Solar Electric Generating System



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Previous Work

- **Argonne/NREL Study “A Summary Review of Issues Related to Avian Mortality at Utility-Scale Solar Facilities”**
  - Preliminary results compare well with previous analyses
  - Various approaches to standby aiming can significantly reduce flux levels and their impact on avian mortality.
  - Future work recommended to determine the impact of alternative aiming strategies which simultaneously minimize impacts to plant operations and avian health.



B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Approach

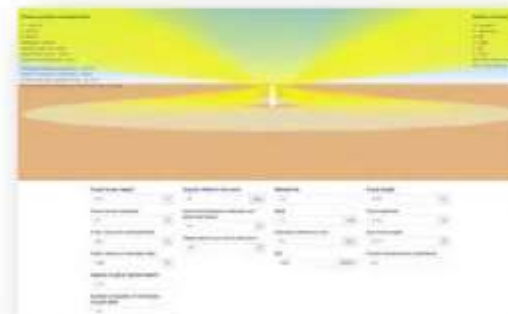
1. Identify metrics for safe solar flux levels
2. Develop tools to model solar flux in air space around power tower
  - Case studies: Ivanpah and NSTTF at Sandia (for validation)
3. Compare alternative heliostat standby-aiming strategies
  - Minimize solar flux according to metrics in (1) above
  - Minimize impact on plant operations
4. Develop user friendly assessment tool for agencies/stakeholders



Ivanpah Solar Electric Generating System



National Solar Thermal Test Facility (NSTTF)



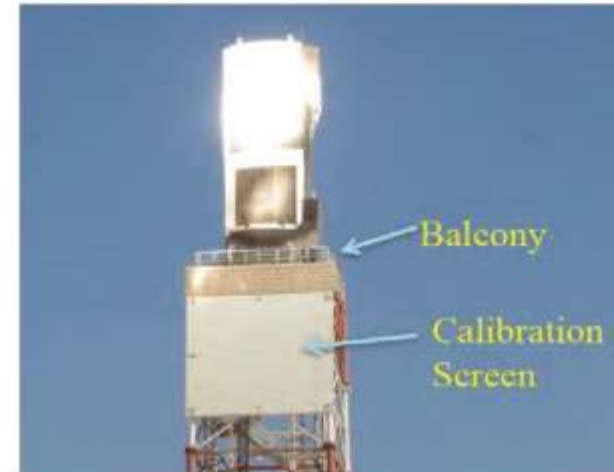
Tower Illuminance Model

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Solar Energy Development Center (Negev Desert, Southern Israel)

B5-122  
cont.

- Tests conducted with bird carcasses exposed to different flux levels (Santolo, 2012)
  - “no observable effects on feathers or tissue were found in test birds where solar flux was below 50 kW/m<sup>2</sup> with exposure times of up to 30 seconds.”
  - California Energy Commission analytical study found that “a threshold of safe exposure does not exist above a solar flux density of 4 kW/m<sup>2</sup> for a one-minute exposure”





## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Crescent Dunes (SolarReserve)

(Tonopah, Nevada)

- **110 MW<sub>e</sub> molten-salt power tower**
- **In January 2015, 3,000 heliostats were aimed at standby points above receiver**
  - 115 bird deaths in 4 hours
  - SolarReserve spread the aim points to reduce peak flux to < 4 kW/m<sup>2</sup>
    - Reported zero bird fatalities in months following change



Figure 1 – The halo created by the reflected light of 3,000 heliostats which caused the bird mortalities.

Images from <http://cleantechnica.com>

B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Ivanpah Solar Electric Generating System

(Ivanpah, California)

B5-122  
cont.

- **390 MW<sub>e</sub> direct steam power-tower plant (3 towers)**
- **Kagan et al. (2014) found 141 bird fatalities Oct 21 – 24, 2013**
  - 33% caused by solar flux
  - 67% caused by collisions or predation
- **H.T. Harvey and Associates found 703 bird fatalities in first year at ISEGS**
  - Study estimated 3500 bird fatalities accounting for search efficiency and scavengers removing carcasses
- **ISEGS has since implemented new heliostat aiming strategies and bird deterrents**



Cause	Number of Detections				Total
	Winter	Spring	Summer	Fall	
Singed	27	100	42	147	316
Collision	14	15	10	45	84
Other*	5	5	2	3	15
Unknown	51	82	61	94	288
<b>Total</b>	<b>97</b>	<b>202</b>	<b>115</b>	<b>289</b>	<b>703</b>

\* Includes detections in ACC buildings without evidence of singeing or collision effects.

H.T. Harvey and Associates, 2013 - 2014

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Gemasolar Thermosolar Plant

(Andalusia, Spain)

- 20 MW<sub>e</sub> molten-salt power tower plant
- 14-month study revealed no avian fatalities in vicinity of tower (Dept. of Zoology, U. Granada)



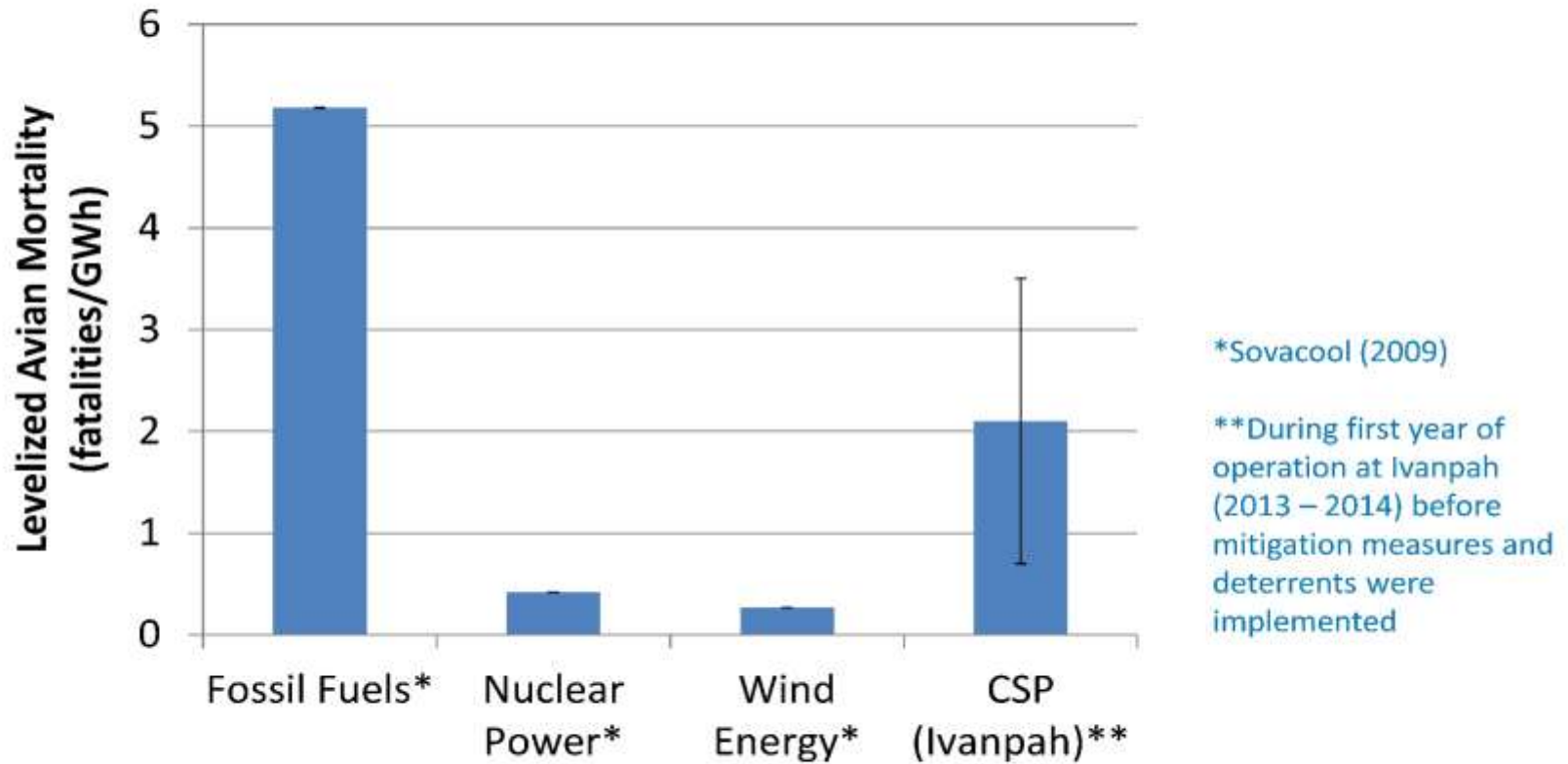
B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Levelized Avian Mortality for Energy (LAME)

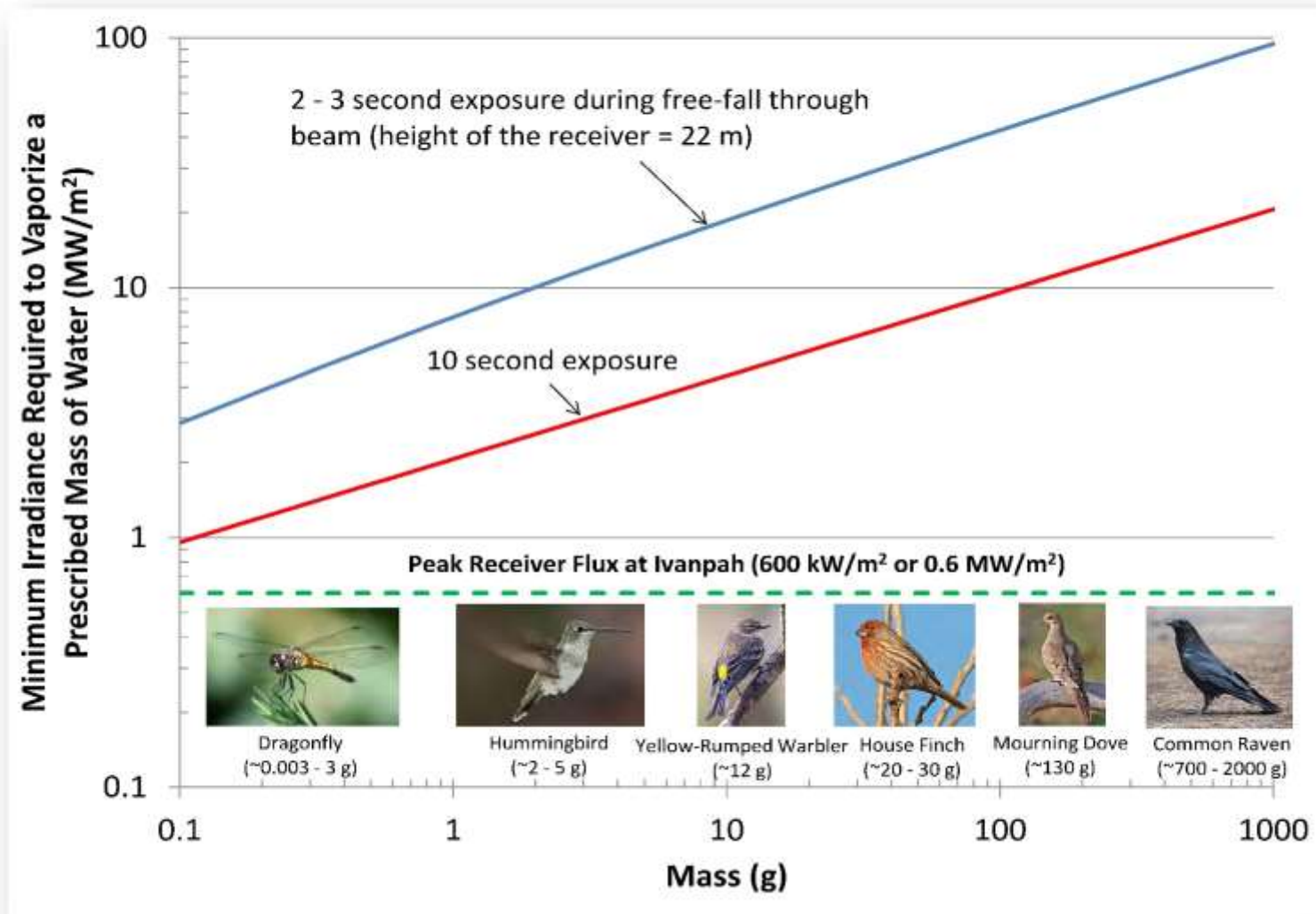
B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Feasibility of Bird Vaporization

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Deterrents

- **Acoustic**
  - Painful or predatory sounds
- **Visual**
  - Intense lights and decoys
- **Tactile**
  - Bird spikes, anti-perching devices
- **Chemosensory**
  - Grape-flavored powder drinks (methyl anthranilate)

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Conclusions from prior studies

- The large number of “streamers,” or smoke plumes, observed and attributed to vaporization of birds is likely caused by insects flying into the concentrated flux
- Complete vaporization of birds flying into concentrated solar flux is highly improbable
- Safe irradiance levels for birds have been reported to range from 4 kW/m<sup>2</sup> to 50 kW/m<sup>2</sup>
- Mitigation measures and bird deterrents can and are being used

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Flux Hazard Analysis

- Create computer model of baseline power tower design (Ivanpah Unit #2) in SolarPILOT / SolTrace.
  - Heliostat geometry, positions and tower height from NRG.
- Create computer model of National Solar Thermal Test Facility in SolarPILOT / SolTrace.
  - Validate model using flux measurement tools

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Flux Hazard Analysis

- Obtain/establish relevant information/parametric data from industry/stakeholder workshop
  - Baseline/novel aiming strategies.
  - Heliostat control capabilities (slew rates, aiming algorithms/capabilities)
  - Metrics for safe solar flux levels ( $I_{haz}$ ,  $V > I_{haz}$ )
  - Performance metrics

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Flux Hazard Analysis

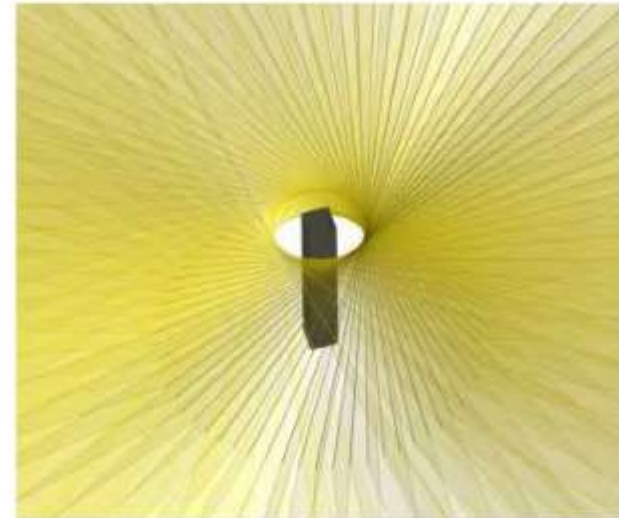
- Apply methodology to Ivanpah and NSTTF fields for analyzing baseline and alternative cases for standby conditions.
  - Generate volumetric flux maps for standby aim-point strategies for representative times and days of the year.
  - For representative flight paths through the volume, perform worse case thermal analysis to determine whether surface (feather) temperature exceeds 160° C along given flight path.
  - Consider number of flight paths exceeding 160°C or the total time of exceedance as metrics to determine the effectiveness of different stand-by aiming strategies.

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Flux Hazard Analysis

- Evaluate successful aiming strategies for impact on annual performance
  - Quantify time from standby to operational for representative days of the year and for both baseline and alternative standby aiming strategies.
  - Quantify annual performance impact of alternative vs baseline cases with the goal of achieving zero loss of annual energy delivered.
- Provide both input and output data from methodology for validation of the enhanced Tower Illuminance Model (TIM)

B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.



# Wind Energy/Wildlife Interactions: Overview of the Challenges and Current Efforts to Address Them



Elise DeGeorge, NREL

May 11, 2016



NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Outline

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- Collaboratives
- Conclusions



Red-tailed hawk eating a rabbit.  
*Photo by Dennis Schroeder, NREL 22325*

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Outline

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- Collaboratives
- Conclusions

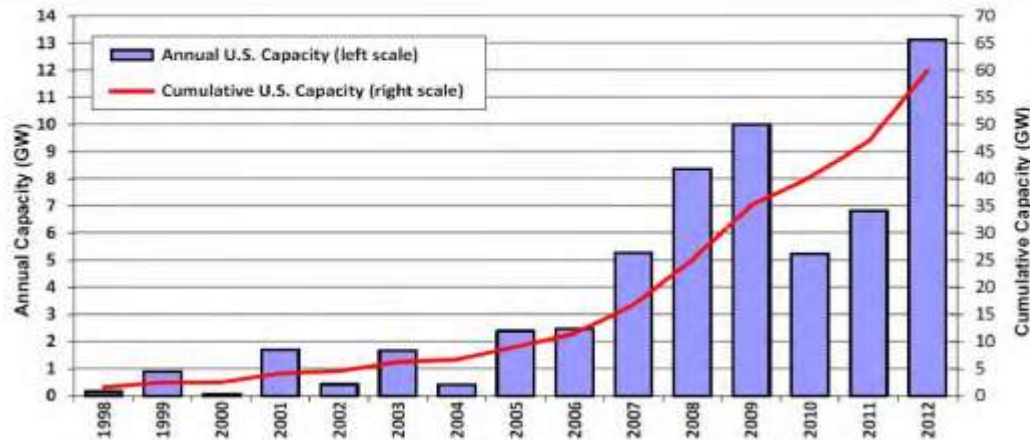


Photo by J. Lucas, Purdue University

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

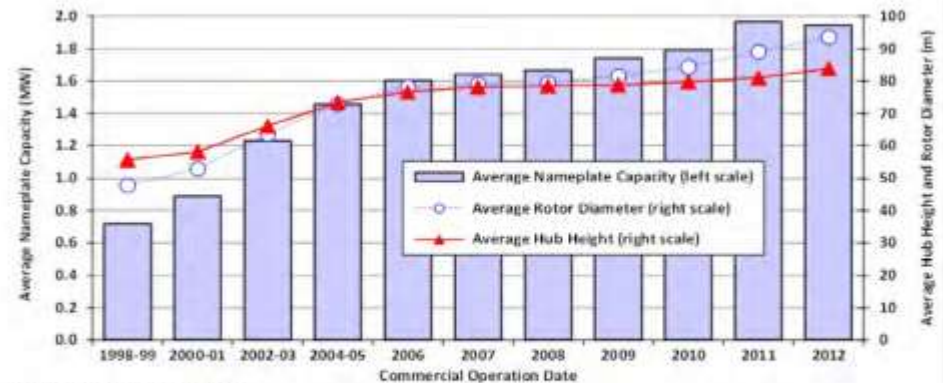
# Wind Installed Capacity over Time

B5-122  
cont.



Source: AWEA project database

Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity



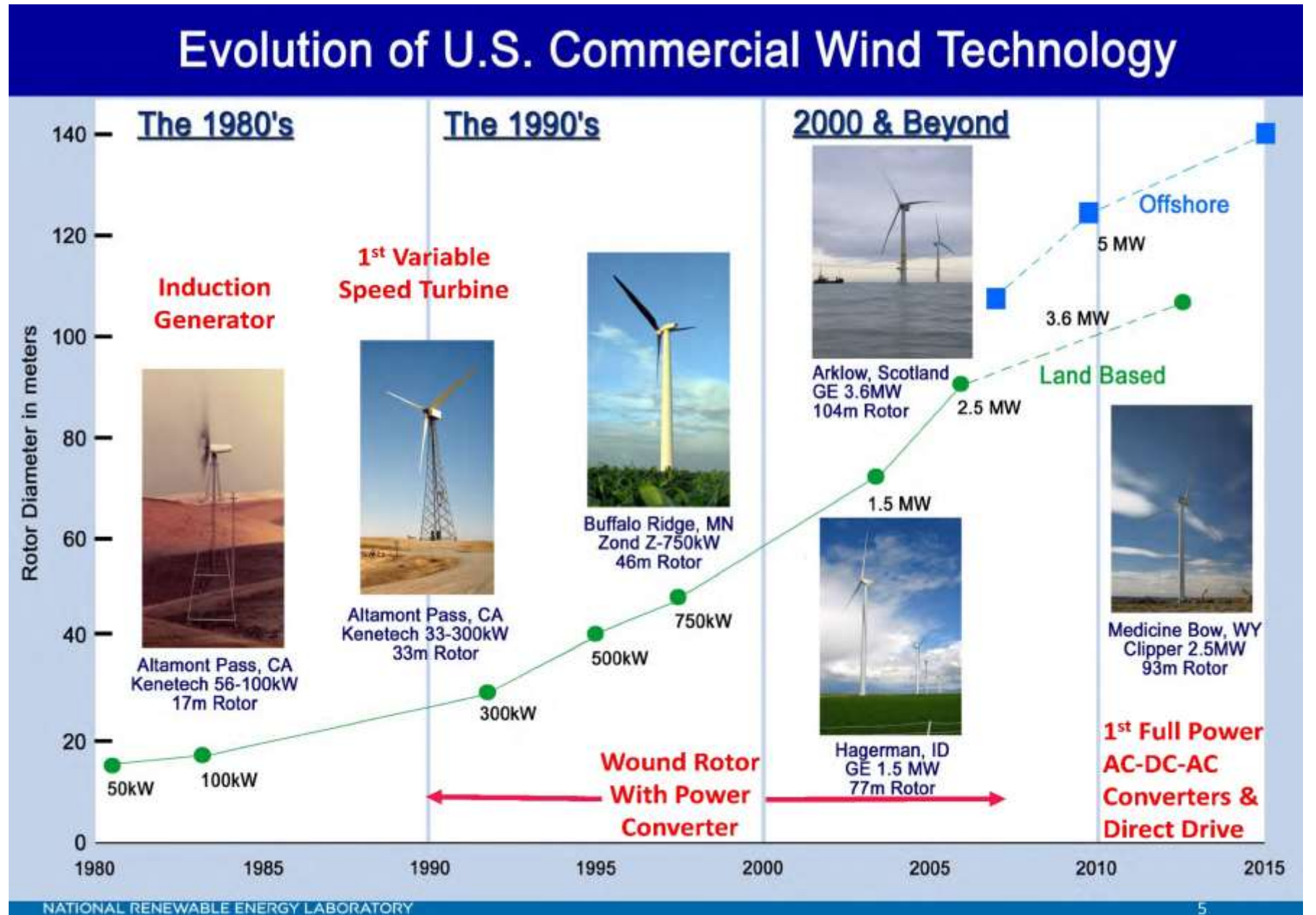
Source: AWEA project database

Figure 15. Average Turbine Nameplate Capacity, Rotor Diameter, and Hub Height Installed during Period (only turbines larger than 100 kW)

Source: 2012 Wind Technologies Market Report



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Wind Turbines May Impact Wildlife & Habitats

B5-122  
cont.

The discussion of wind turbine impact on wildlife began at the Altamont Wind Resource Area, California, in the late 1980s and early 1990s



Junction Hill Top Wind Farm, Iowa. Five GE 1.6-megawatt (MW) turbines. Photo by Tom Wind, NREL 26494

Altamont Pass Wind Resource Area, California. Kenetech 56-100 kilowatt (kW) turbines. Photo by Shawn Smallwood, NREL 17329



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Real or Perceived Wildlife Impacts can be a Challenge for Development

B5-122  
cont.

- Misinformation on potential of impacts is rampant
- Impacts are species- and habitat-specific
- Impacts are site-specific; micro-siting is critical to reducing these impacts.



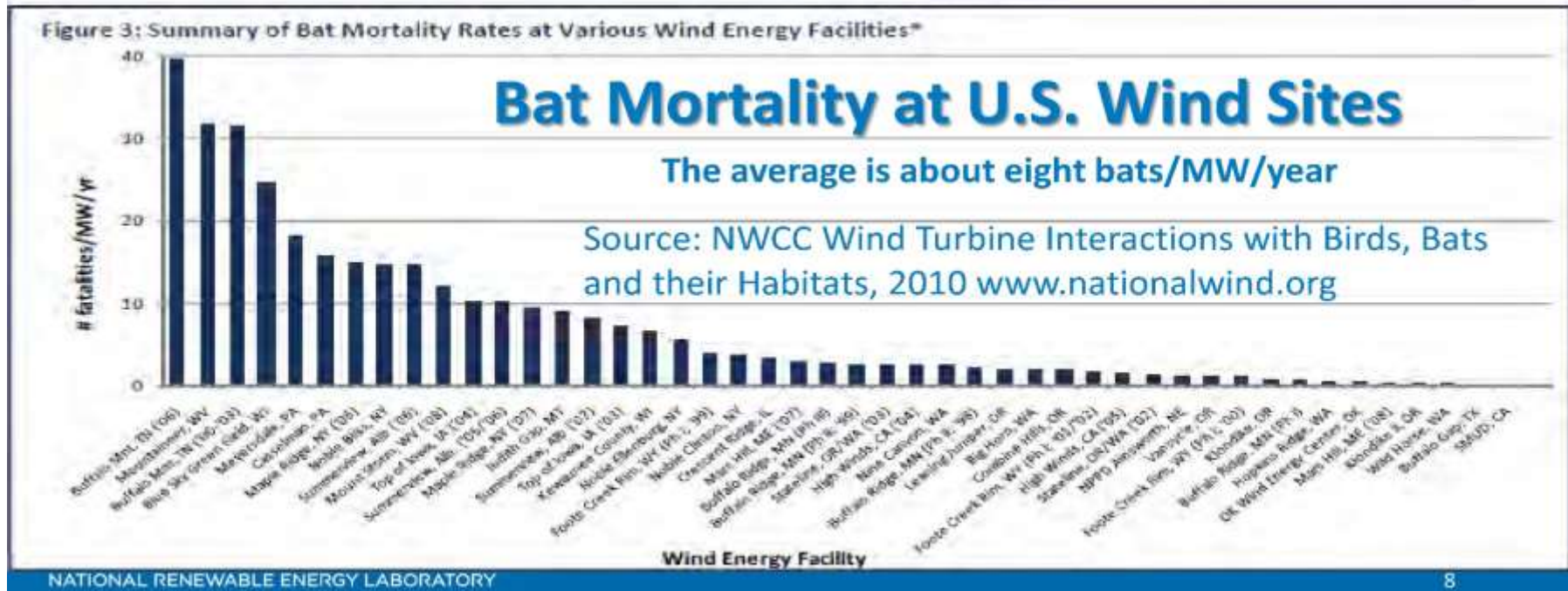
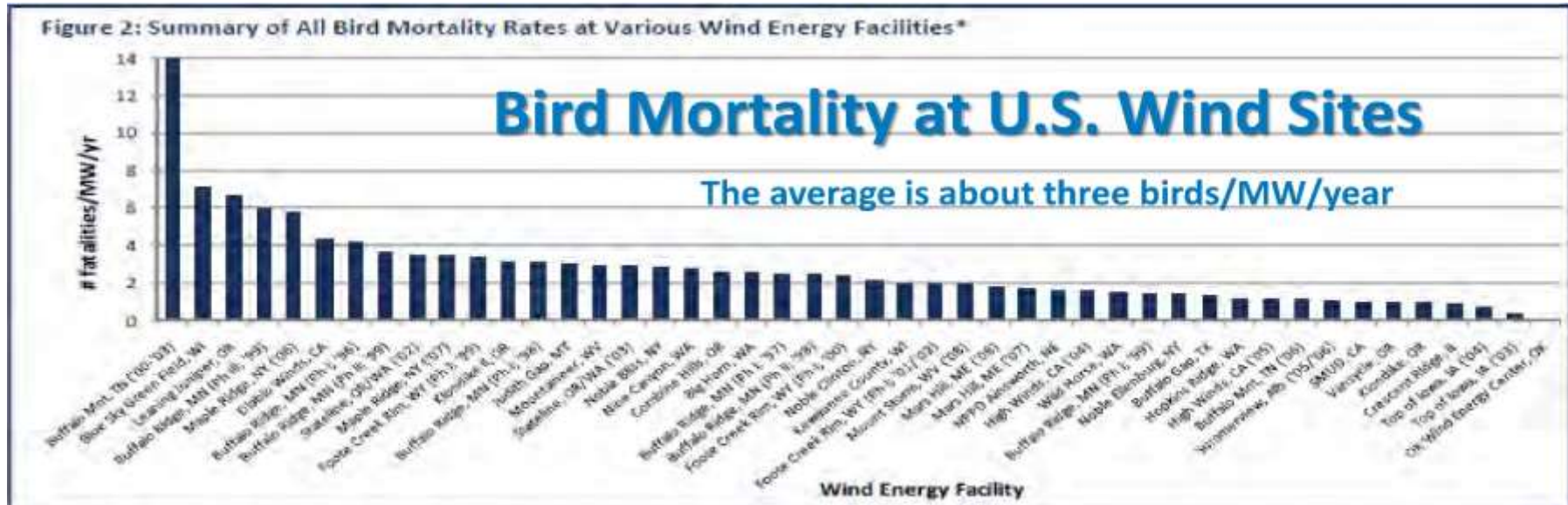
Combination of 221 Mitsubishi Heavy Industries 1-MW turbines and 53 GE 1.5-MW turbines at the Cedar Creek Wind Farm in Grover, Colorado.  
*Photo by Dennis Schroeder, NREL 30593*

Eight Nordex N60, 1,300-kW wind turbines in Garrett, Pennsylvania.  
*Photo by Green Mountain Energy Company, NREL 09699*



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## U.S. Fish and Wildlife Service Statutory Authority for Wind Permitting Guidelines

- **Endangered Species Act:**
  - Directs the Service to identify and protect threatened and endangered species and their critical habitat
  - Must provide a means to protect the species' ecosystems.
- **Migratory Bird Treaty Act:**
  - Based on a strict liability statute
  - Does not require proof of intent, knowledge, or negligence to be deemed a violation
  - Does include actions resulting in the 'taking' or possession of a protected species, in the absence of a USFWS permit or regulatory authorization, is deemed a violation.
- **Bald and Golden Eagle Protection Act:**
  - Provides additional legal protection for bald and golden eagles. First enacted in 1940/ golden eagle added in 1962



Whooping Crane. Photo by Karin Sinclair, NREL 27961



Bald Eagle. NREL 01101

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122

# Outline

---

- Historical overview and statutory authority
- **Challenges to wildlife**
- Key species habitat distribution
- Research
- Collaboratives
- Conclusions



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Challenges to Wildlife Related to Wind Energy

B5-122  
cont.

### Wildlife challenges include:

- Habitat and species that are likely to be impacted vary by
  - Climate
  - Topography
  - Location
- No single solution
- Impacts expected to increase as more turbines are installed across the country—but these can be managed.

### Ways of addressing the challenges:

- Identify-near-term research needs
- Use a multipronged approach
- Involve multiple stakeholders
- Garner support for collaborative field research, methods/metrics refinement, tools, mitigation strategies, and deterrent development/testing
- Disseminate information.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Challenges: Key Issues Being Addressed

### Impacts of wind turbines on wildlife include:

- Bats (mortality)
- Raptors (mortality)
- Nocturnal migration (mortality)
- Prairie birds (habitat – displacement; genetic diversity)
- Cumulative (population impacts).

### Tools to avoid problematic sites:

- Federal (e.g. Wind Energy Guidelines)
- State guidelines
- Pre versus post construction validation
- Mapping of migratory pathways
- Presiting assessments
- Risk assessments
- Literature archive
- Peer review (promote transparency)



Sage Grouse. NREL 20649

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Avian Strike Probability Versus Turbine Size

B5-122  
cont.

Altamont Scale



15-meter (m) diameter RSA and 100 kW

Next-Generation Scale



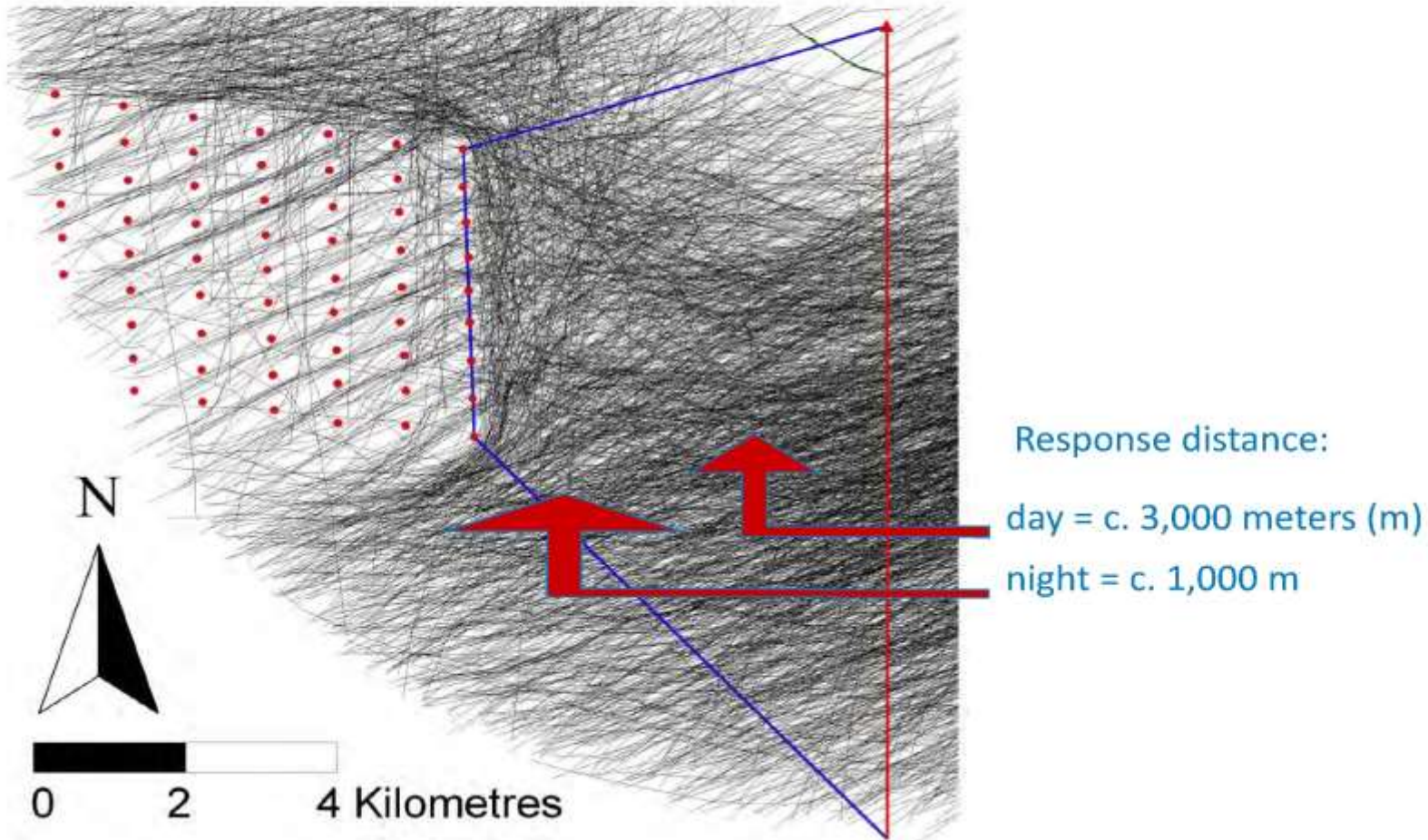
93-m diameter RSA and 2.5 MW



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Avoidance Behavior can be Significant

Radar tracks of migrating birds through the Nysted Offshore Windfarm for operation in 2033

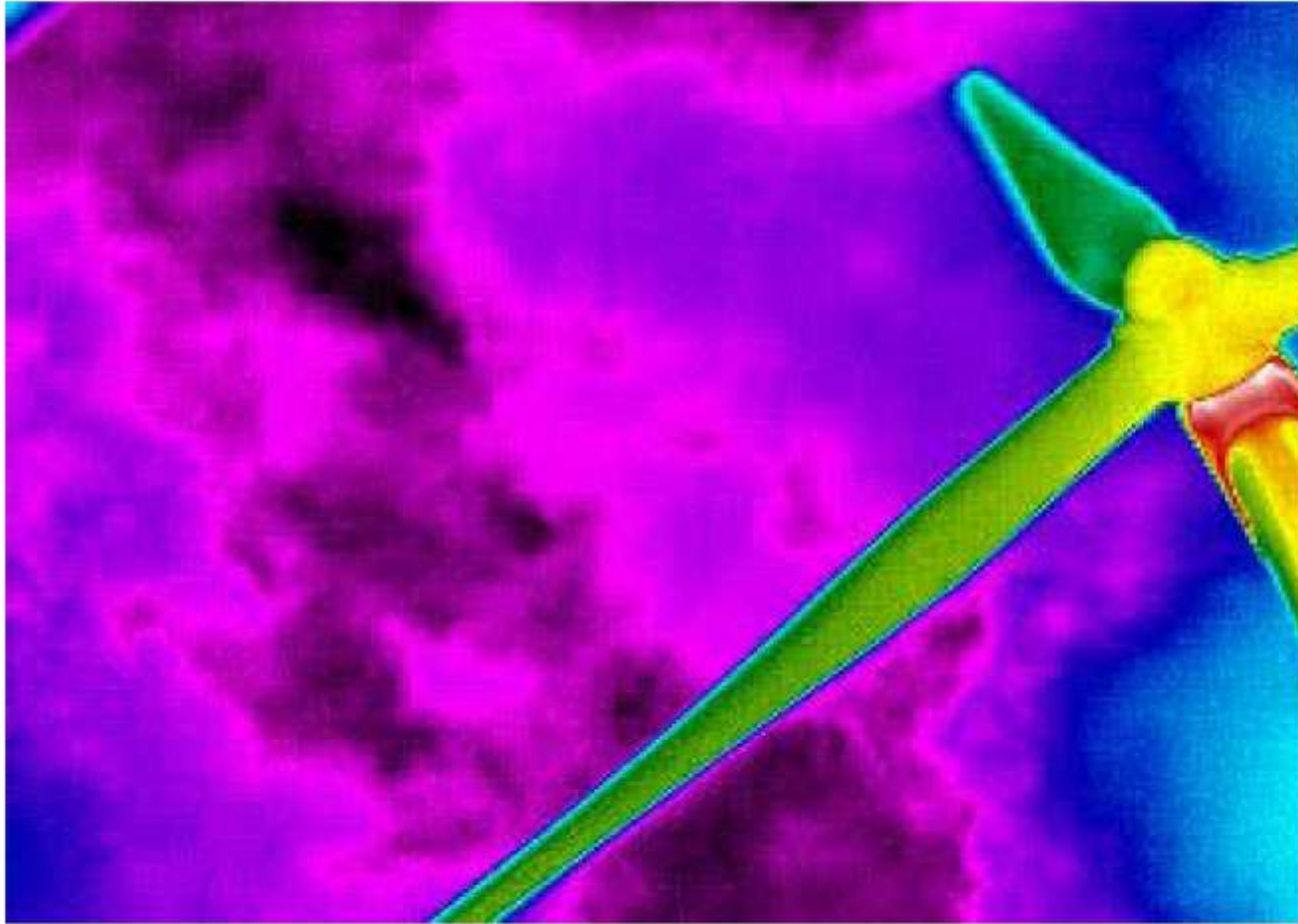


B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

## Bats Interactions: Curiosity?

B5-122  
cont.



Infrared Image of a Bat Flying Through a Wind Turbine Rotor

Video by Jason Horn, Boston University

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Outline

---

- Historical overview and statutory authority
- Challenges to wildlife
- **Key species habitat distribution**
- Research
- Collaboratives
- Conclusions

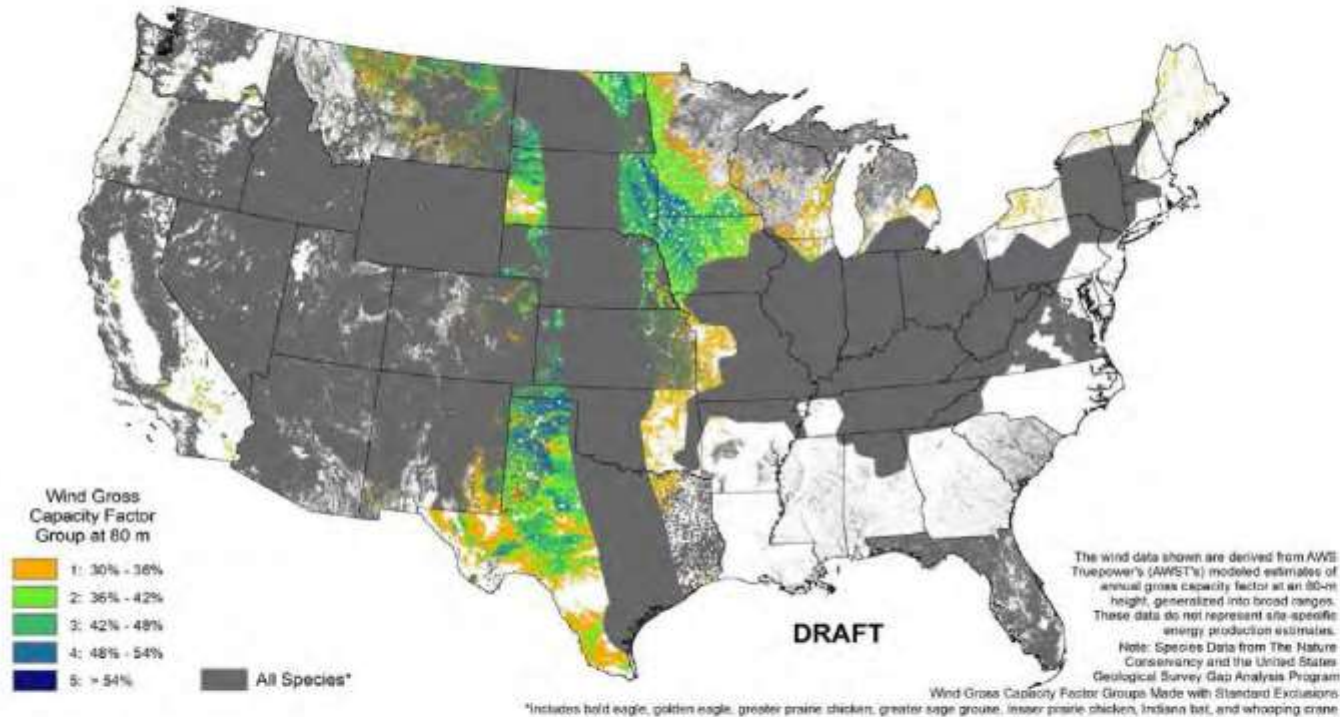
B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Key Species Habitat Distribution: Seven Species

B5-122  
cont.



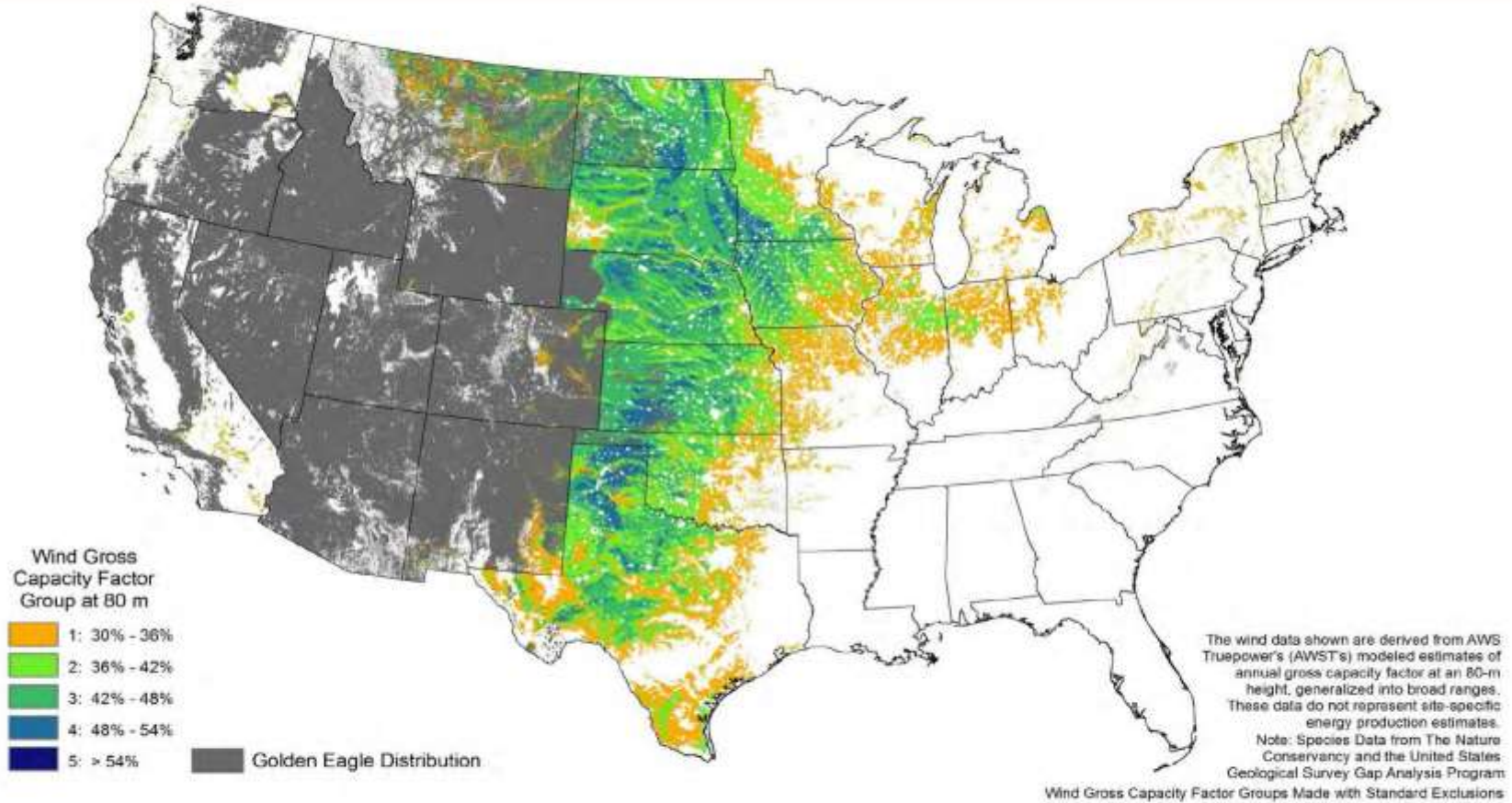
Areas in grey indicate where wildlife species live, breed, and migrate. These areas are *not* no-build zones, but are of special concern for developers that could increase costs and time, or lead to project delays or cancellation.

**Wildlife distribution can impact local areas very differently. On a national scale, 44%–53% of land could be affected.**

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Key Species Habitat Distribution: Golden Eagles

B5-122  
cont.



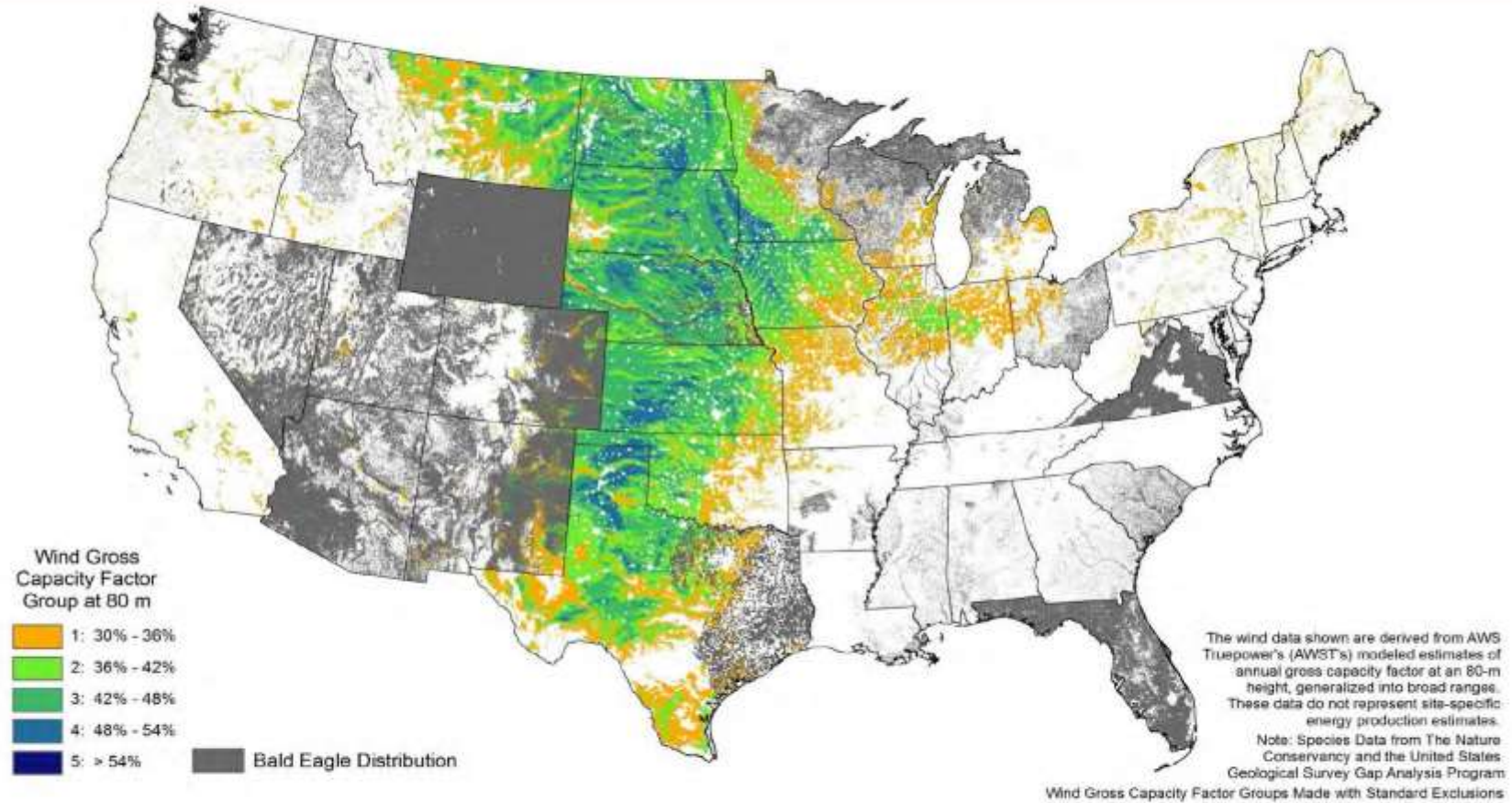
## Golden eagle habitat: areas requiring additional consideration



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Key Species Habitat Distribution: Bald Eagles

B5-122  
cont.



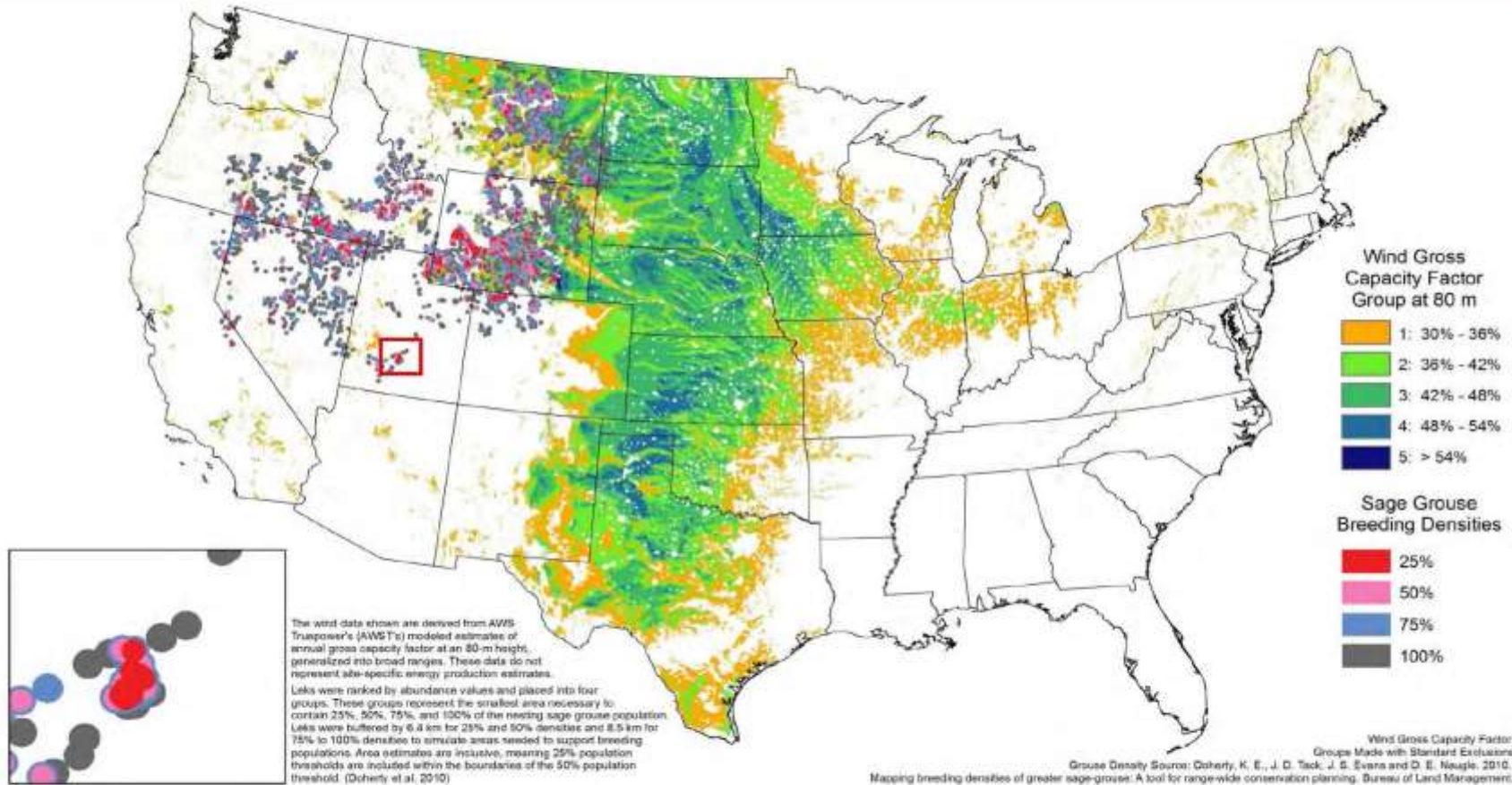
## Bald eagle habitat: areas requiring additional consideration



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Key Species Habitat Distribution: Sage Grouse

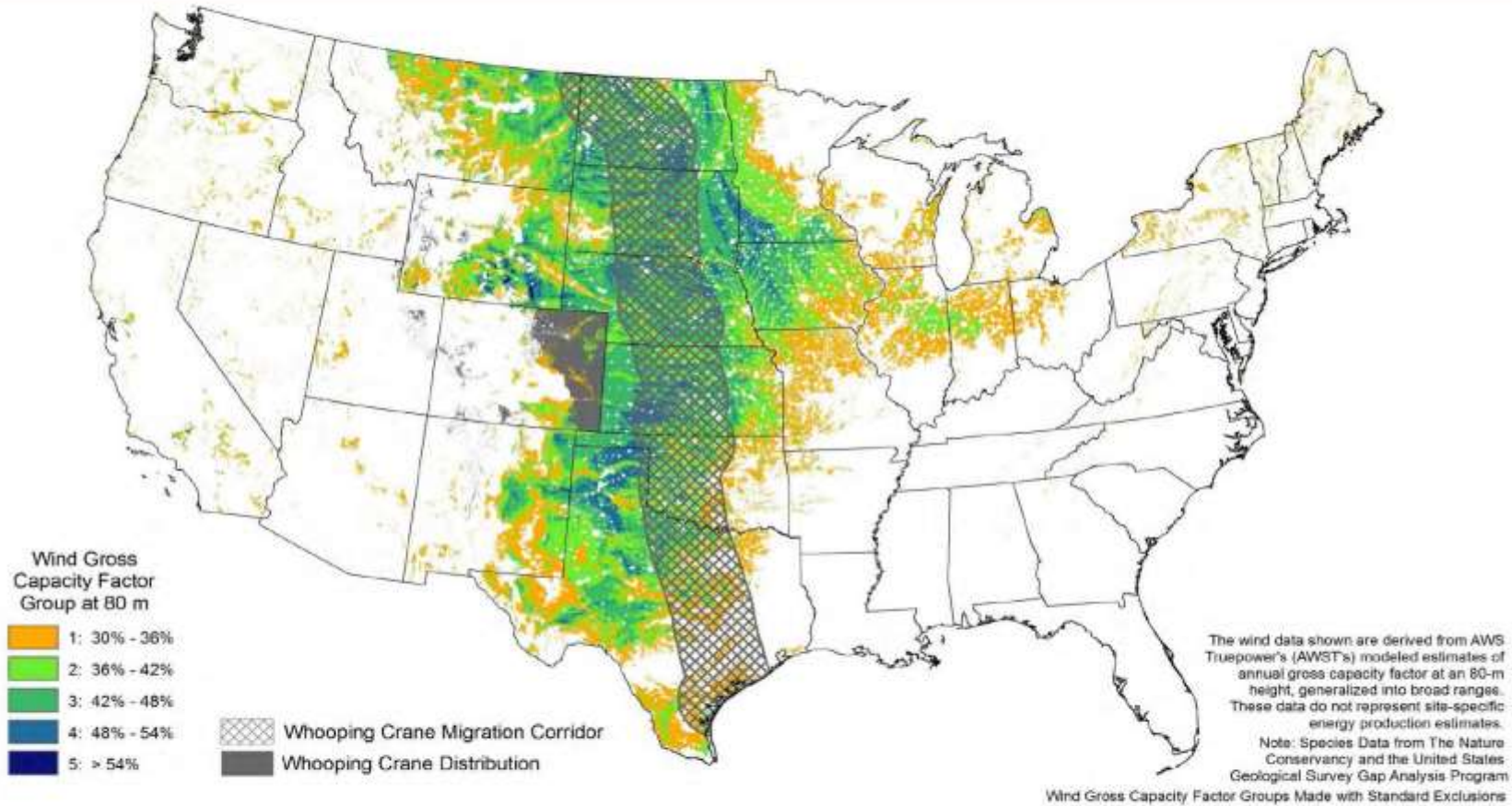


## Sage grouse habitat and breeding sites: areas requiring additional consideration

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Key Species Habitat Distribution: Whooping Crane

B5-122  
cont.



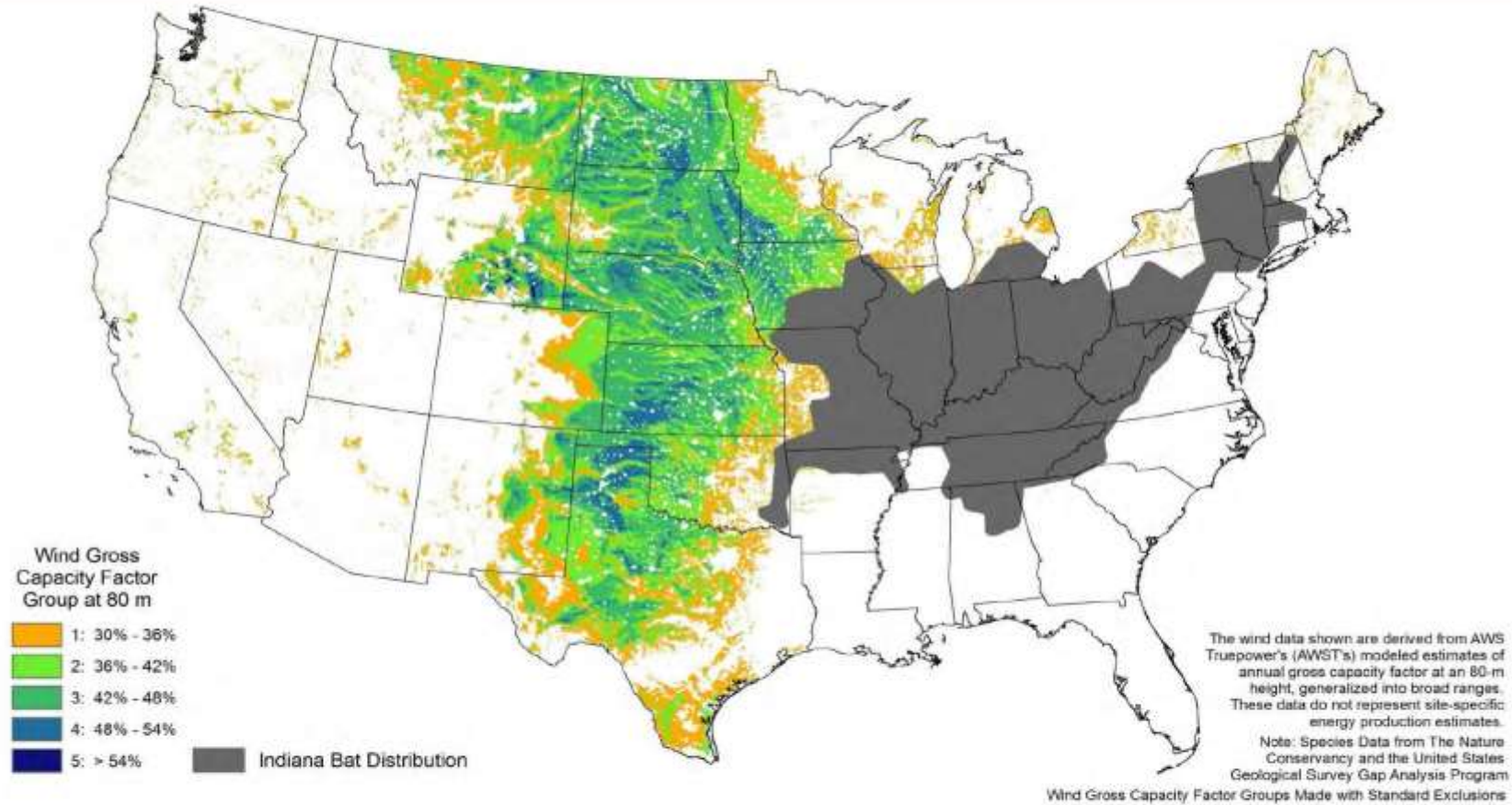
## Whooping crane habitat and migratory corridor: areas requiring additional consideration



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Key Species Habitat Distribution: Indiana Bat

B5-122  
cont.



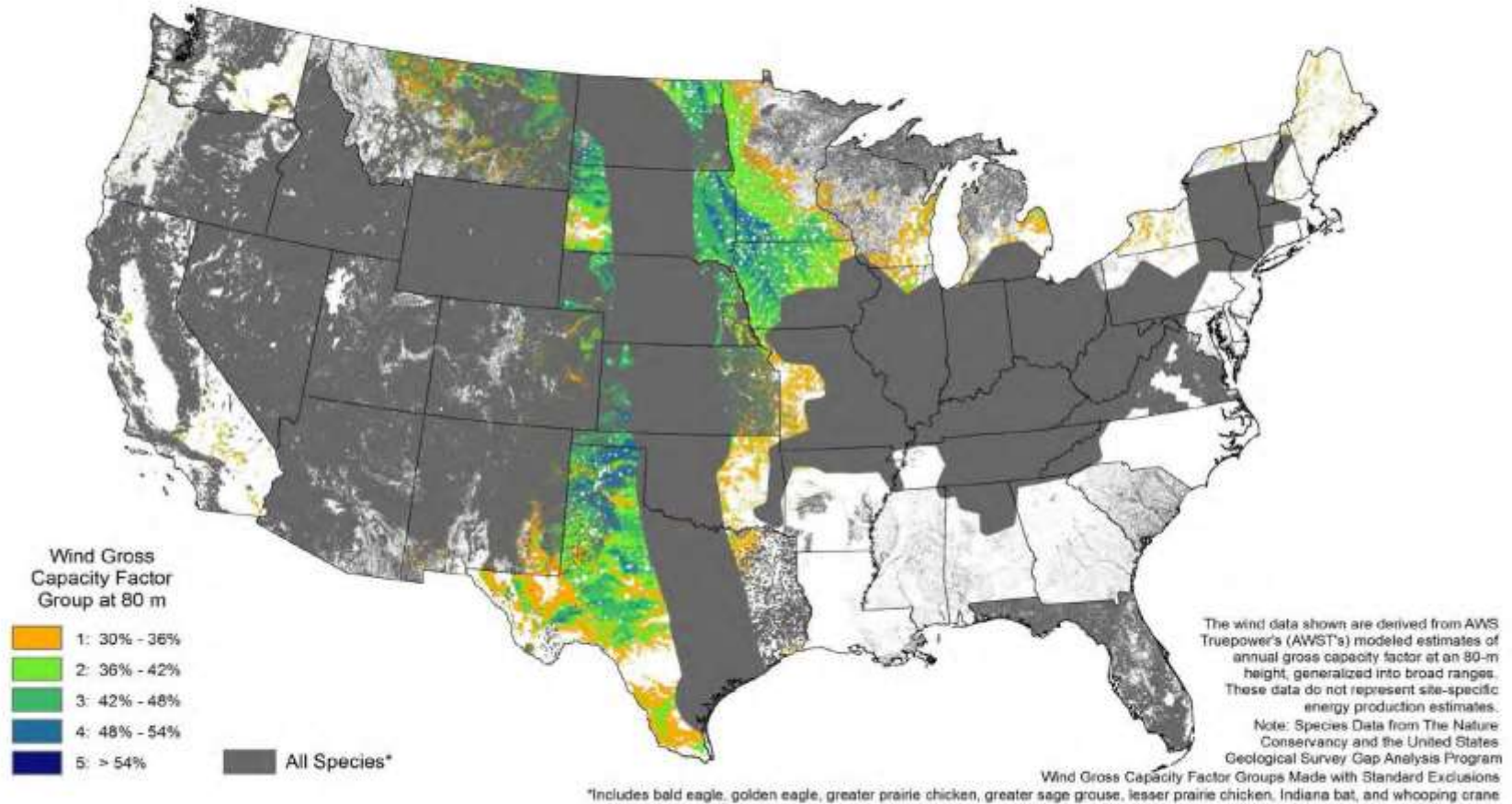
## Indiana bat habitat distribution: areas requiring additional consideration



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Key Species Habitat Distribution: Combined

B5-122  
cont.



## Combined wildlife impacts: areas requiring additional consideration

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Outline

---

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- **Research**
- Collaboratives
- Conclusions

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Mitigation Research

B5-122  
cont.

### Mitigation research focuses on:

- Deterrent development
- Correlating wind speed to utilization
- Correlating weather patterns to fatality patterns
- Offsite compensation
- Micrositing
- Turbine size
- Blade visibility
- Seasonal shutdowns
- Habitat manipulation
- Artificial roosts.



Greater Prairie Chicken. Photo by Mark Herse, Kansas State University, NREL 27970



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Technology/Model Research

B5-122  
cont.

### Technology/modeling research is focused on:

- Radar validation
- Thermal imaging cameras
- Near-infrared cameras
- Stable isotopes
- Predictive models.



Infrared camera. Photo by Dennis Schroeder, NREL 20338

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Testing Detection Systems at the NWTC

B5-122  
cont.



**Houdini in flight during FY15. GPS data logger can be seen on his right foot and UHF tracker can be seen on his left.**



**Testing of detection systems using Auburn University's golden and bald eagles**

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Importance of Convening Interdisciplinary Panel of Experts for Prioritizing Research

B5-122  
cont.

The National Renewable Energy Laboratory  
together with  
The Department of Energy's Wind and Water Power Technologies Office  
are pleased to invite you to the  
**Eagle Detection and Deterrent Technology Research Gaps and Solutions Workshop**

Land-based wind energy deployment is challenged by the lack of accepted solutions for reducing eagle fatalities at wind energy projects. Therefore, there is an expressed need for tools to reduce these fatalities and to facilitate permitting under the Bald and Golden Eagle Protection Act. For this workshop, we will be engaging experts from a wide range of fields to comprehensively assess the current state of technologies, key gaps, promising emerging technology solutions, novel ideas, and research and development needs.

Please join us ...  
**The National Renewable Energy Laboratory**  
 Research Support Facility  
 15013 Denver West Parkway  
 Golden, Colorado

Tuesday December 8 <sup>th</sup> , 2015	Full day
Wednesday December 9 <sup>th</sup> , 2015	Half day

**CONTACTS**

Bethany Straw <a href="mailto:bethany.straw@nrel.gov">bethany.straw@nrel.gov</a>	303.271.4500
Karm Sinclair <a href="mailto:karm.sinclair@nrel.gov">karm.sinclair@nrel.gov</a>	303.254.5945
Elise DeGeorge <a href="mailto:elise.degeorge@nrel.gov">elise.degeorge@nrel.gov</a>	303.274.2156

RSVP required.  
Please provide a response **no later than September 21, 2015** to [bethany.straw@nrel.gov](mailto:bethany.straw@nrel.gov).



- Bringing people of different focus areas/expertise to the table to understand and prioritize solutions
- Outcome as it relates to wind energy and eagle impacts: need to understand fundamental behavior and physiology of species of concern



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Recommendations from Physiology and Behavior Specialists

- Understand: population and habitat associations, threats, annual cycle, demography, flight behavior, diet, etc..
- Risk is when turbines intersect with a species basic needs (e.g. with eagles it is food, updraft and nesting sites)



Photo provided by T. Katzner



### For auditory deterrent research, one expert recommends the following:

- Measure the auditory system of these birds
  - Use this information to build a library of sounds that might be stressful (annoying)
  - Use heart monitors to give us an index of stress (estimated by an increase in heart rate)
  - Give a variety of different sounds to estimate stress induced by the sounds
- Test birds over different time intervals (hours to weeks) to estimate the rate of adaptation to these sounds

### Properties of the Vocal System Provide Clues about Properties of the Auditory System

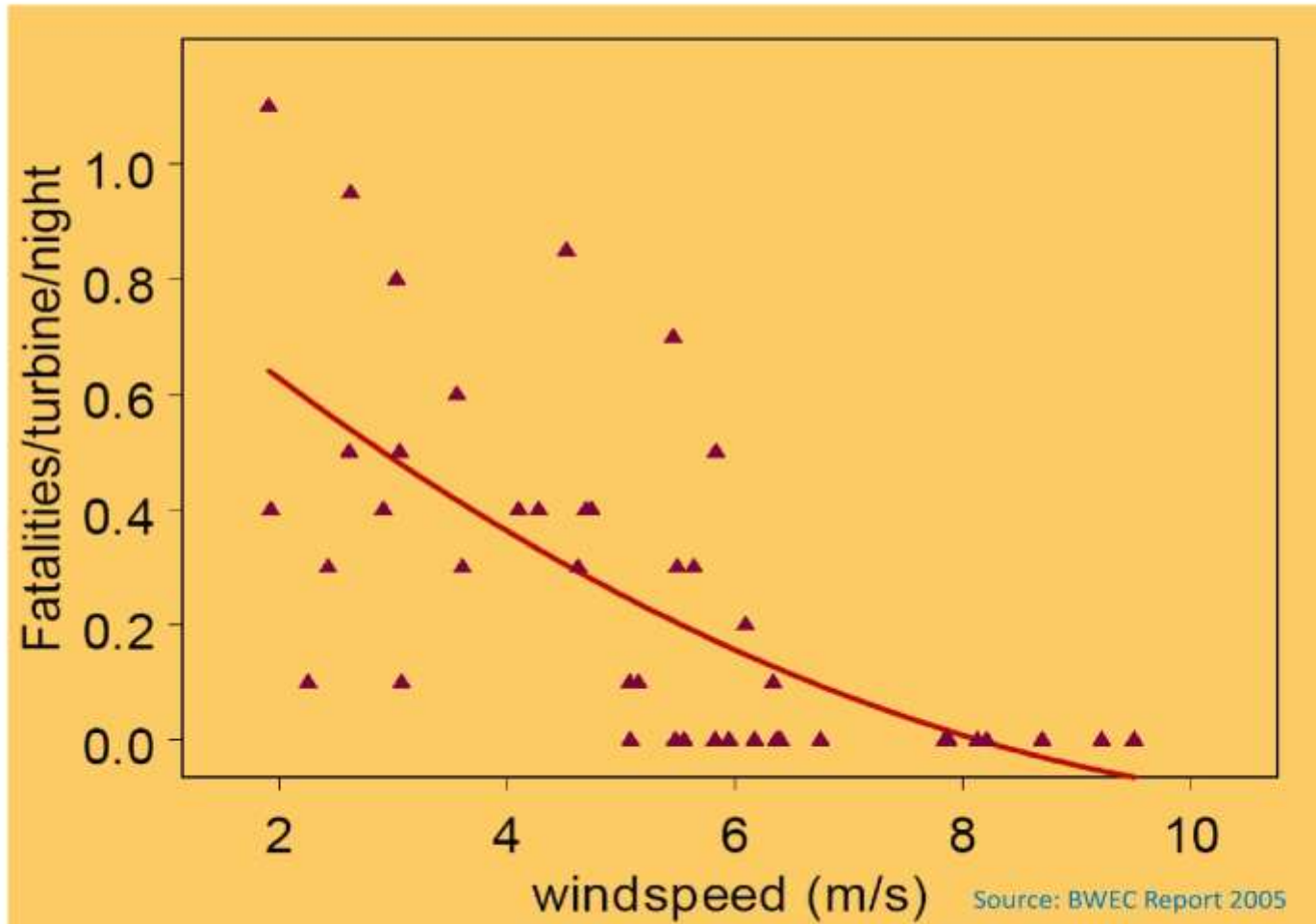


Source: As presented by Jeff Lucas, Purdue University at Eagle Detection and Deterrent Technology Research Gaps and Solutions Workshop, December 2015

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# BWEC Study Results

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Research Conducted from Settlement Agreements

### *Duke Energy at Top of the World Windfarm in Casper, Wyoming*

- Onsite wildlife specialists during daylight hours
- Working with FWS on an eagle trapping and tracking project
- GPS help to understand eagle migration movements
- Advancing IdentiFlight camera system
- Opportunities for R&D when faced with unsupported requirements



An aerial view of Duke's Top of the World wind farm, located in Casper, Wyo.  
Photo courtesy of Duke Energy Renewables

Source: [http://nawindpower.com/online/issues/NAW1604/FEAT\\_01\\_Duke-s-Avian-Mitigation-Techniques-Take-Flight-What-s-Working-And-Why.html](http://nawindpower.com/online/issues/NAW1604/FEAT_01_Duke-s-Avian-Mitigation-Techniques-Take-Flight-What-s-Working-And-Why.html)



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Outline

---

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- **Collaboratives**
- Conclusions

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Collaboratives are Often Beneficial for Advancing the Knowledge Base

B5-122  
cont.

Benefits of collaboratives include:

- Access to third party, unbiased research
- Accepted experts within collaborative
- Agreement on study design
- The ability to develop relationships (trust)
- A safe forum for discussion
- The ability to engage early and often
- Transparency/credibility
- Leveraging of funds
- Project access
- Access to interim results
- Accepted results
- A model for future interactions.



705-MW project in Tehachapi Pass Wind Resource Area, California.

*Photo by David Hicks, NREL 18455*

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

## Current collaboratives

B5-122  
cont.

### Current collaboratives include:

- The National Wind Coordinating Collaborative (NWCC). Includes federal, state, utilities, nongovernmental organizations (NGOs), and wind industry
  - Grassland Shrub Steppe Species Collaborative. Includes federal, state, NGOs, and wind industry
  - Sage Grouse Collaborative. Includes federal, state, NGOs, and wind industry
- Bats and Wind Energy Cooperative (BWECC). Includes federal, state, NGOs, and wind industry
- American Wind Wildlife Institute (AWWI). Includes industry and NGOs
- International Energy Agency Wind Task 34. Includes nine member countries.

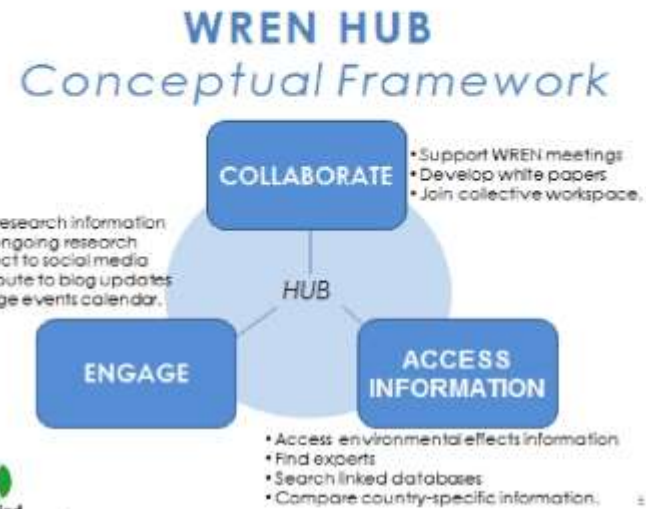


Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# More on International Energy Agency Wind Task 34

B5-122  
cont.

- Working Together to Resolve Environmental Effects of Wind Energy, known as **WREN**
- October 2012–2016; extension under discussion
- Current member countries: Ireland, Netherlands, Norway, Spain, Switzerland, United Kingdom, United States, France, and Sweden.



**Primary products:**

- WREN Hub/Tethys (<http://tethys.pnnl.gov/>)
- White papers: Adaptive management, individual impacts to population effects, green versus green, cumulative impacts, transboundary issues
- Webinars: on land/offshore, birds/bats/marine mammals, tools  
<http://tethys.pnnl.gov/environmental-webinars?content=wind>

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

# Outline

---

- Historical overview and statutory authority
- Challenges to wildlife
- Key species habitat distribution
- Research
- Collaboratives
- **Conclusions**

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Conclusions

- Wind-wildlife impact concerns are complicated
- Micrositing is key to avoiding, minimizing, and mitigating impacts; some locations may just not be appropriate for wind development
- Research and development of tools is ongoing and benefits from interdisciplinary approaches
- Collaboratives provide opportunities to leverage resources to find solutions for common challenges.



Grand Ridge Wind Energy Center. GE 1.5-MW turbines in Lasalle County, Illinois. *Photo by Invenergy, LLC, NREL 16040.*

B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



B5-122  
cont.

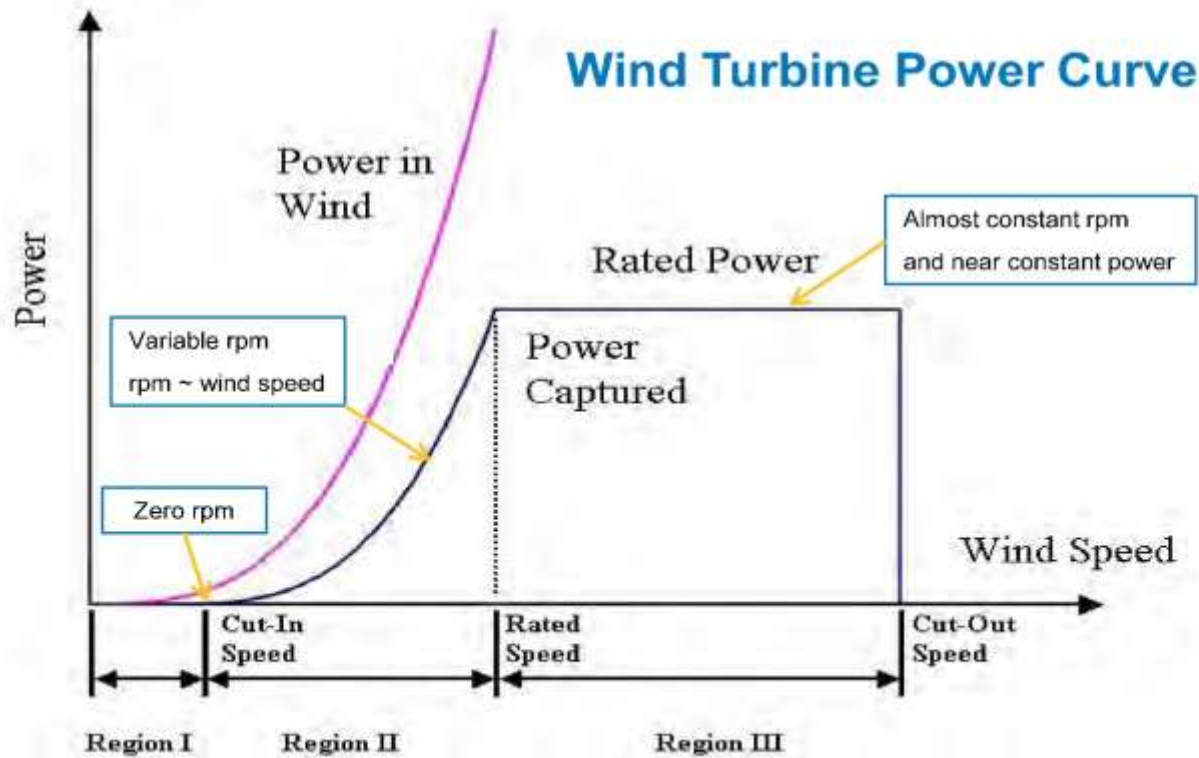
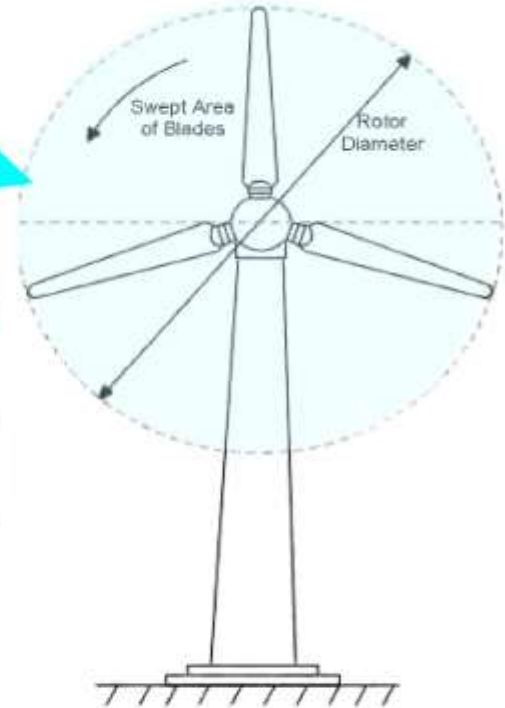
Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Turbine Power Basics

B5-122  
cont.

**Power in the Wind =  $\frac{1}{2}\rho AV^3$**

A - Area of the circle swept by the rotor  
 ρ = Air density  
 V = Wind Velocity



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

## NWCC

B5-122  
cont.

Formed in 1994, founding members included NREL and DOE, the American Wind Energy Association, National Audubon Society, Electric Power Research Institute, and Union of Concerned Scientists. Membership currently exceeds 1,500 people.

Major features of the NWCC include:

- Multistakeholder
- Facilitated; ground rules for engagement
- Coordinated field research
- Information dissemination (e.g., website; coordination of report preparation and publication; presentations at meetings)
- Biennial Research Meeting (X in December 2014)

Recent research activities were initiated under the Grassland Shrub Steppe Species Collaborative, and include:

- Grassland Community Collaborative (Prairie-Chicken research)
- Sage Grouse Collaborative (Sage Grouse research)

<http://www.nationalwind.org/>



## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

### BWEC

Formed in 2004, founding members included the American Wind Energy Association, Bat Conservation International, USFWS, and NREL, with DOE and the U.S. Geological Survey later. Major features of the BWEC include:

- Objective, science-based
- International expertise tapped
- Organizational structure includes an oversight committee, technical committee, and science committee
- Coordination of field research (e.g., operational curtailment, acoustic deterrent, other)
- Information dissemination (e.g., website; coordination of report preparation and publication; presentations at meetings)
- Frequent science meeting.

<http://www.batsandwind.org/>



Source: Arnett, et al. 2008. Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities

B5-122  
cont.

## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

### AWWI

Formed in 2008, board members consist of 50 industry and 50% NGOs.

Primary activities include:

- Research
- Data repository

Wind-Wildlife Research Information System

- Landscape tools

Landscape Assessment Tool

- Mitigation strategies for eagle take

Through the use of expert elicitation, AWWI has facilitated the development of two models to predict numerical effects of compensatory mitigation on golden eagle survival and reproduction through: lead abatement and vehicle collision reduction strategies.

- Education

<http://www.awwi.org/>



Golden Eagle with a transmitter on its back.  
Photo by Randy Flament, NREL 23585

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Candidate Avian Risk Metrics

B5-122  
cont.

**Hypothesis: “Mortality risk increases with flight time in the rotor zone (yellow zone), if the turbine is operating”**

### **A Candidate Preconstruction Relative Risk Metric:**

Species Relative Risk = (Flight Hours in Rotor Zone with Wind in Operating Range)/(Plant Swept Area x Hours with Wind in Operating Range)

### **A Candidate Postconstruction Fatality Metric:**

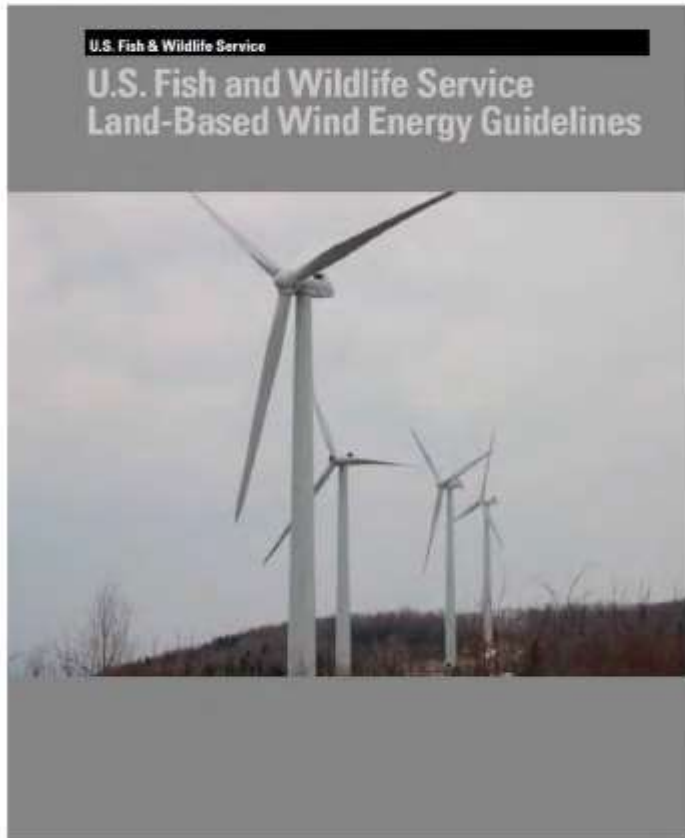
Species Risk = Fatalities/(Swept Area x Turbine Operation Hours)



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## The USFWS Land-based Wind Energy Guidelines



Released March 2012

### Provide a Tiered Approach, including:

- Tier 1 – Preliminary site evaluation (landscape-scale screening of possible project sites)
- Tier 2 – Site characterization (broad characterization of one or more potential project sites)
- Tier 3 – Field studies to document site wildlife and habitat and predict project impacts
- Tier 4 – Postconstruction studies to estimate impacts
- Tier 5 – Other postconstruction studies and research.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# USFWS Guidelines: Developer and Service Roles

B5-122  
cont.

<i>TIER</i>	<i>Project Developer/Operator Role</i>	<i>Service Role</i>
Tier 1: Preliminary site evaluation	<ul style="list-style-type: none"> <li>• Landscape level assessment of habitat for species of concern</li> <li>• Request data sources for existing information and literature</li> </ul>	<ul style="list-style-type: none"> <li>• Provide lists of data sources and references, if requested</li> </ul>
Tier 2: Site characterization	<ul style="list-style-type: none"> <li>• Assess potential presence of species of concern, including species of habitat fragmentation concern, likely to be on site</li> <li>• Assess potential presence of plant communities present on site that may provide habitat for species of concern</li> <li>• Assess potential presence of critical congregation areas for species of concern</li> <li>• One or more reconnaissance level site visit by biologist</li> <li>• Communicate results of site visits and other assessments with the Service</li> <li>• Provide general information about the size and location of the project to the Service</li> </ul>	<ul style="list-style-type: none"> <li>• Provide species lists, for species of concern, including species of habitat fragmentation concern, for general area, if available</li> <li>• Provide information regarding plant communities of concern, if available</li> <li>• Respond to information provided about findings of biologist from site visit</li> <li>• Identify initial concerns about site(s) based on available information</li> <li>• Inform lead federal agencies of communications with wind project developers</li> </ul>
Tier 3: Field studies and impact prediction	<ul style="list-style-type: none"> <li>• Discuss extent and design of field studies to conduct with the Service</li> <li>• Conduct biological studies</li> <li>• Communicate results of all studies to Service field office in a timely manner</li> <li>• Evaluate risk to species of concern from project construction and operation</li> <li>• Identify ways to mitigate potential direct and indirect impacts of building and operating the project</li> </ul>	<ul style="list-style-type: none"> <li>• Respond to requests to discuss field studies</li> <li>• Advise project proponent about studies to conduct and methods for conducting them</li> <li>• Communicate with project proponent(s) about results of field studies and risk assessments</li> <li>• Communicate with project proponents(s) ways to mitigate potential impacts of building and operating the project</li> <li>• Inform lead federal agencies of communications with wind project developers</li> </ul>
Tier 4: Post construction studies to estimate impacts	<ul style="list-style-type: none"> <li>• Discuss extent and design of post-construction studies to conduct with the Service</li> <li>• Conduct post-construction studies to assess fatalities and habitat-related impacts</li> <li>• Communicate results of all studies to Service field office in a timely manner</li> <li>• If necessary, discuss potential mitigation strategies with Service</li> <li>• Maintain appropriate records of data collected from studies</li> </ul>	<ul style="list-style-type: none"> <li>• Advise project operator on study design, including duration of studies to collect adequate information</li> <li>• Communicate with project operator about results of studies</li> <li>• Advise project operator of potential mitigation strategies, when appropriate</li> </ul>

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## USFWS Eagle Conservation Plan Guidance (April 2013)

- To facilitate issuance of programmatic eagle take permits for wind energy facilities the USFWS finalized the Eagle Conservation Plan Guidance- Module 1- Land-based Wind Energy Version 2
- This Guidance provides a framework for developing and evaluating Advanced Conservation Practices, which is the framework for detect and deter technologies



Photo by T. Katzner

B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Power and Size of Turbines Over Time

B5-122  
cont.

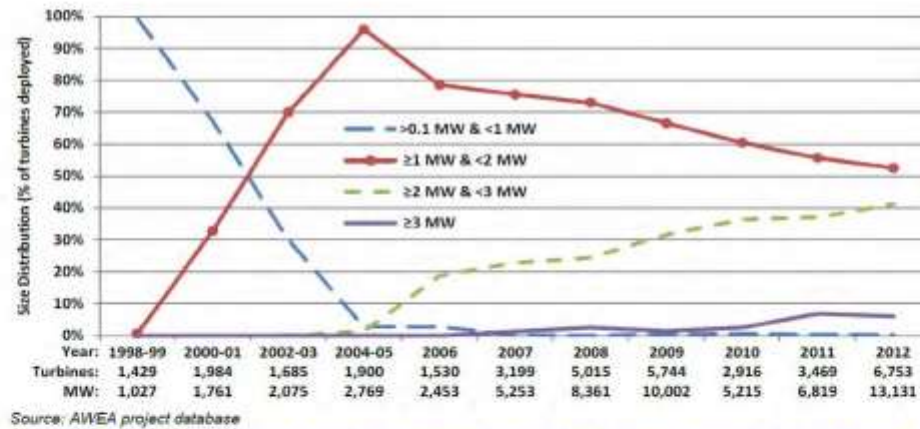


Figure 16. Size Distribution of Number of Turbines (>100 kW) Deployed in Each Period

Source: 2012 Wind Technologies Market Report

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Representative Wind Turbine Specifications

B5-122  
cont.



National Wind Technology Center – NREL Pic 25898



Danish National Wind Test Center – Photo by R. Thresher

Turbine	Power - MW	Rotor Size - m	Rotor Area – m <sup>2</sup>	Rotor Speed - rpm	Tower Height - m	Cut-in Wind Speed m/s
GE 1.5 se	1.5	70.5	3904	12-22.4	54.7 – 64.7	4
GE 1.5 sl	1.5	77	4657	11-20.4	61.4 - 100	3.5
GE 1.5 sle	1.5	77	4657	11-20.4	61.4 - 100	3.5
GE 1.5 xle	1.5	82.5	5346	10.1-18.7	58.7 - 100	3.5
GE 1.6 or 1.7	1.6 – 1.7	100	7854	?	80 -96	?
GE 2.5 -100	2.5	103	8333	?	75-100	3
GE 3.2 -103	3.2	103	8333	?	70-98	?
Siemens SWT 2.3	2.3	100	7854	6-16	80 or Site specific	3-4
Siemens Offshore SWT – 6.0 – 154	6	154	18,600	5-11	Site Specific	3-5

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## U.S. Department of Energy Wind Program's Mission

- Reduce challenges to project development to accelerate deployment of appropriate wind energy
- Support achievement of 20% wind energy by 2030
- Accelerate wind energy capacity growth/ development of domestic energy options (Energy Policy Act of 2005).



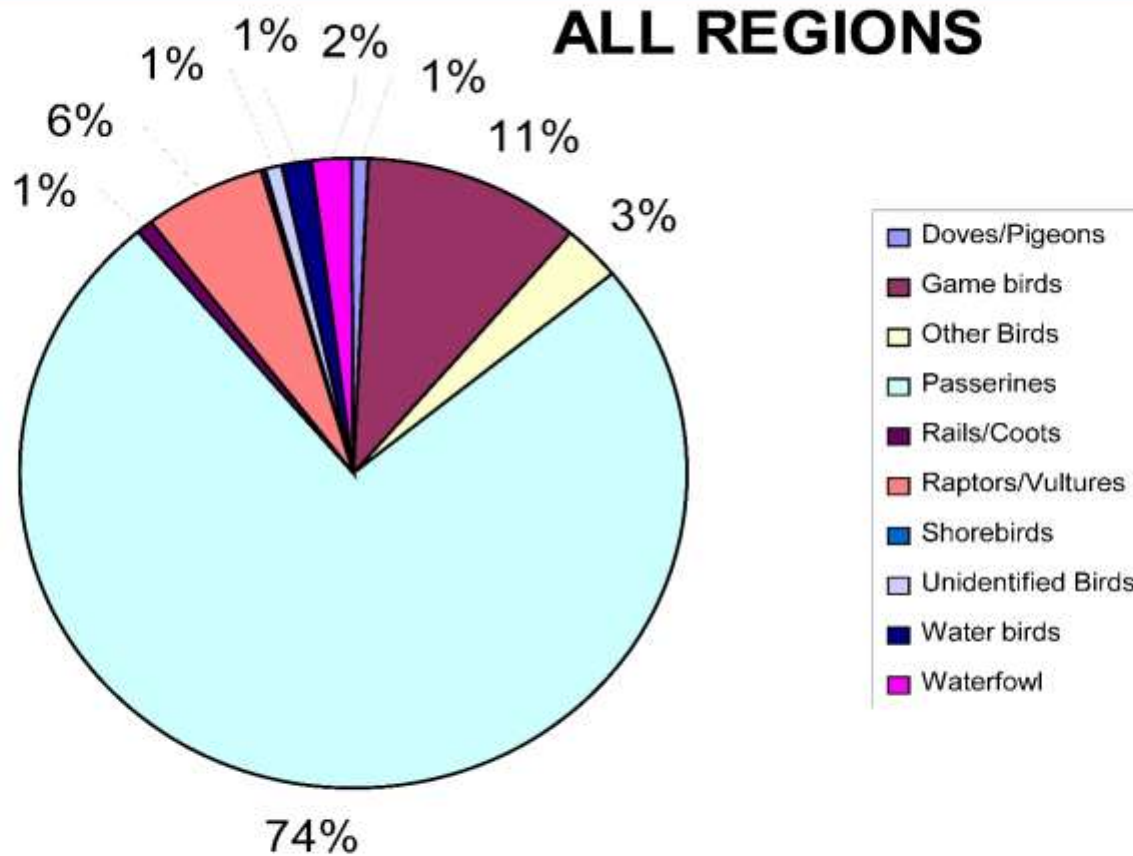
Northwind 100, 100-kW wind turbine;  
Hempstead, New York.  
*Photo by Town of Hempstead, NREL 28963*



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Research: Species Composition of Bird Fatalities

B5-122  
cont.



Proportion of fatalities at sites reporting fatalities by species, for all regions where studies have been conducted (the Pacific Northwest, Midwest, Rocky Mountains, and East).

Source: Strickland and Morrison, February 26, 2008.

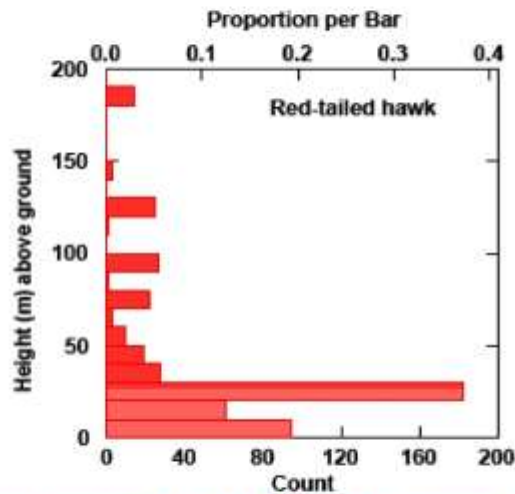
[http://www.fws.gov/habitatconservation/windpower/Past\\_Meeting\\_Presentations/Morrison\\_Strickland.pdf](http://www.fws.gov/habitatconservation/windpower/Past_Meeting_Presentations/Morrison_Strickland.pdf)

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Red-Tailed Hawk Flight Observations in Altamont Pass

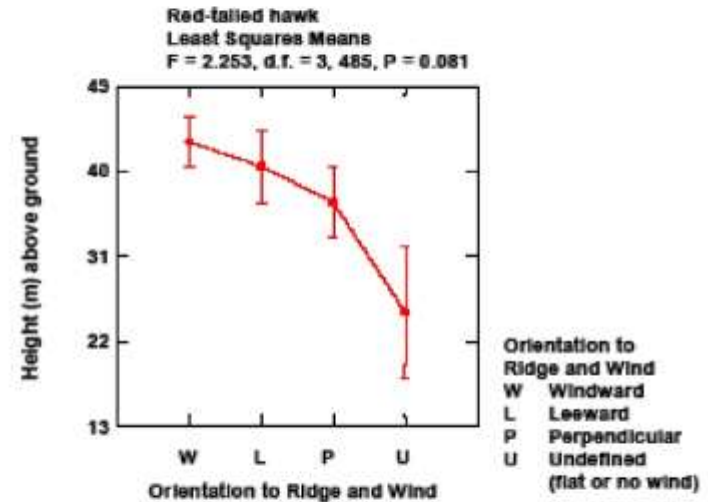
B5-122  
cont.

Height Histogram



Distribution of flight heights above ground level amount red-tailed hawks observed during behavioral observation sessions during 2003 and 2004 in the Altamont Pass Wind Resource Area.

Height versus Orientation



Mean flight heights of red-tailed hawk over aspect of ridge relative to oncoming winds.

Source: K. Smallwood and L. Neher, CEC-500-2005-005, December 2004

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Highlights of One Interaction Study in Altamont Pass

### Raptor Fatalities and Sightings

	<u>Fatalities</u>	<u>Sightings</u>	<u>Rel. Risk F/S</u>
Burrowing Owl	38	56	0.68
American Kestrel	22	429	0.05
Red-Tailed Hawk	100	1,780	0.06
Golden Eagle	10	401	0.02
Northern Harrier	2	114	0.02
Prairie Falcon	1	63	0.02
Turkey Vulture	0	756	0
Common Raven	0	792	0

*From: Bird Risk Behaviors and Fatalities at the Altamont Pass  
WRA, Carl G. Thelander, et al*

B5-122  
cont.



## Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Sage Grouse Research

B5-122  
cont.

These are preliminary results and are not for distribution or citation.

### Annual Report

#### A STUDY OF THE IMPACTS OF A WIND ENERGY DEVELOPMENT ON FEMALE GREATER SAGE-GROUSE IN SOUTHEASTERN WYOMING

January 27, 2014

**Presented to:**

National Wind Coordinating Collaborative Sage-Grouse Research Collaborative Oversight  
Committee

### *Internal Document – Not for Distribution*

### Ecology of Male Greater Sage-Grouse in Relation to Wind Energy in Wyoming

Research Team: Power Company of Wyoming  
and University of Missouri










Sage Grouse. NREL 20649

53

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Properties of the Vocal System Provide Clues about Properties of the Auditory System

B5-122  
cont.

White-breasted nuthatch		
Golden eagle copulation call		
Golden eagle skunk call		
Bald eagle chatter call		

Examples of amplitude modulation and frequency spectrums

Source: As presented by Jeff Lucas, Purdue University at Eagle Detection and Deterrent Technology Research Gaps and Solutions Workshop, December 2015

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

# Breakout Session 1 (Day 1)

Stakeholder Concerns, Additional Relevant Data  
Sources, and Additional Research underway



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

# Breakout Group 1

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Other things CWG should undertake?

- Greater stakeholder involvement
  - CWG & ASWG
  - FACA?
  - Use industry as a resource
  - Review of the Science Plan
- Outline next steps beyond the Science Plan
  - Implementation

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## New Information

- New solar project in Pahrump, NV
  - Panel spacing may diffuse the lake effect
- Widen the scope beyond AZ, CA, and NV
- USGS-FWS OFR on standardized monitoring



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

# Group 2 (Day 2)

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**What other tasks should the CWG Undertake (1 of 2)**

- Focusing on the science is the correct approach. Monitoring should be informed by research. Don't monitor for sake of monitoring. Interrelationship between monitoring and research.
- Consider costs when determining monitoring requirements (Danielle, Jeremiah)
- Monitoring should be designed to answer specific questions.
- Monitoring Guidelines due out in June. Will be publically available. Different from the CWG Science Plan.
- Monitoring procedures are a research question.
- Determine level of overall mortality
- Look at causation.
- Get data to focus the research
- Science plan should have priorities as a product
- What is the low hanging fruit?
- Leverage information and existing data

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**What other tasks should the CWG Undertake (1 of 2)**

- Site specific monitoring vs understanding where projects should go
- What are we siting for? Any specific species? (Songbirds, migratory birds, etc.) E.g. wind now focuses on bats and raptors.
- Good model is San Joaquin Valley Least Conflict Plan (goes beyond science)
- What features in the landscape influence avian presence and behavior
- Keep in mind Technology specific effects
- Keep visibility on ongoing research efforts, common database? AWWI web site has extensive list of studies. When should studies be released?
- General research studies vs project data. CEC posts project data after review.
- Lots of folks want data/information, but many studies are still underway
- CWG and ASWG access to raw data? What questions can be answered?



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**Any ongoing or planned research or data collection efforts that are relevant to developing the science plan**

- ASWG Research Panel looking at rough methodologies to answer ASWG questions
- ASWG Research Panel asked to sequence the research

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

# Breakout Group 3

Stakeholder Concerns, Additional Relevant Data  
Sources, and Additional Research underway

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Group 3

- Dan Boff, DOE
- Kirk LaGory
- Amy Fesnock,
- Bill Werner
- Katie Umekubo
- Chuck Griffin
- Juliette Falkner
- Karyn Coppinger
- Brian Boroski, H.T. Harvey
- Matt Hutchinson



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Other things CWG should undertake?

- Need to specify focus on causation of mortality
- Look at sublethal effects (e.g., decreased reproduction, carrying capacity, etc.)
- Scope should go beyond regulatory requirements

B5-122  
cont.

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Data and models

- Use of existing monitoring data: What does it tell us? What would we do differently?
- Making data available to the public. Data quality issues.
- Need to develop a toolkit

---

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.

## Relevant studies

- Genetic studies to examine population of origin
- Golden eagle research related to populations
- Look at rare and common species to provide bookends
- Condor Issue (vol 118): several papers population concerns related to renewable energy issues
- Draft article submitted to JWM, modeling estimates related to searcher efficiencies for rare species
- Draft paper looking at direct and indirect effects for solar, wind, and transmission



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122



# Conceptual Understanding of Avian-Solar Interactions

*Lee Walston*  
*Argonne National Laboratory*

*May 10-11, 2016*  
*Sacramento, California*



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Why Develop a Conceptual Model?

- Illustrate important processes
  - Direct & indirect effects
  - Interactions and cumulative effects
- Synthesize current understanding of avian-solar interactions
  - Foster a common understanding
- Identify information gaps and research priorities
- Starting point for the avian-solar science plan



*Multiagency CWG Stakeholder Workshop, May 2016*

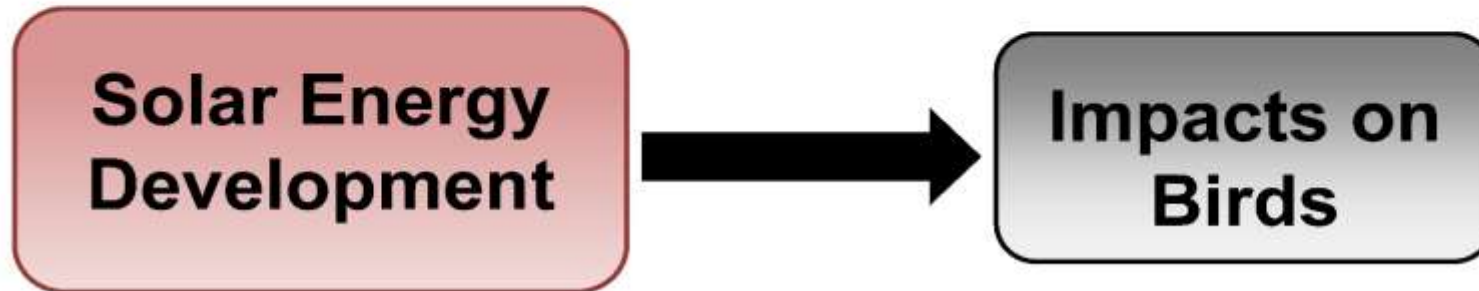
2

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Avian-Solar Conceptual Model

- Simple vs. Complex



- Two main focal points

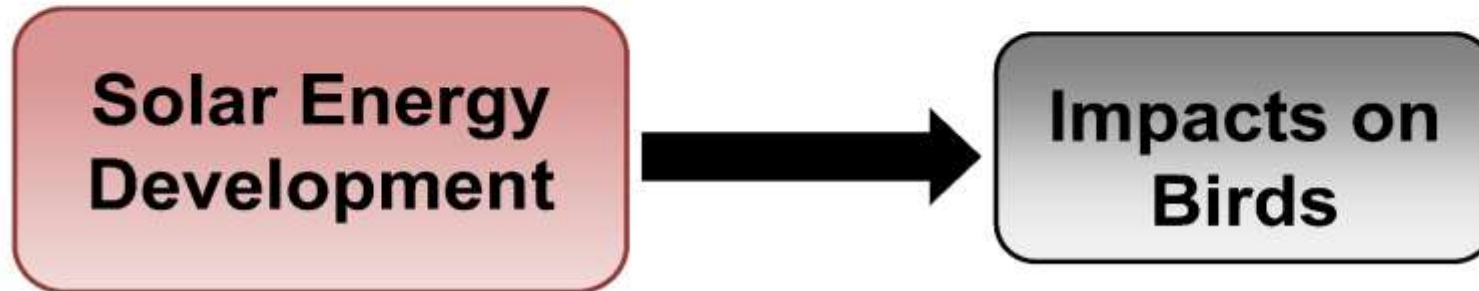


Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

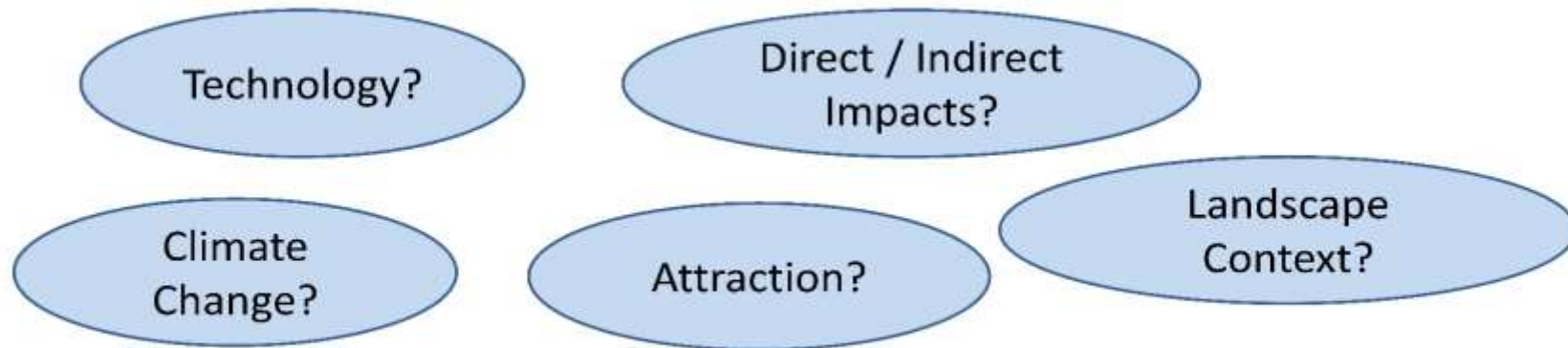
B5-122  
cont.

# Avian-Solar Conceptual Model

- Simple vs. Complex



- Impacting factors, pathways, and interactions



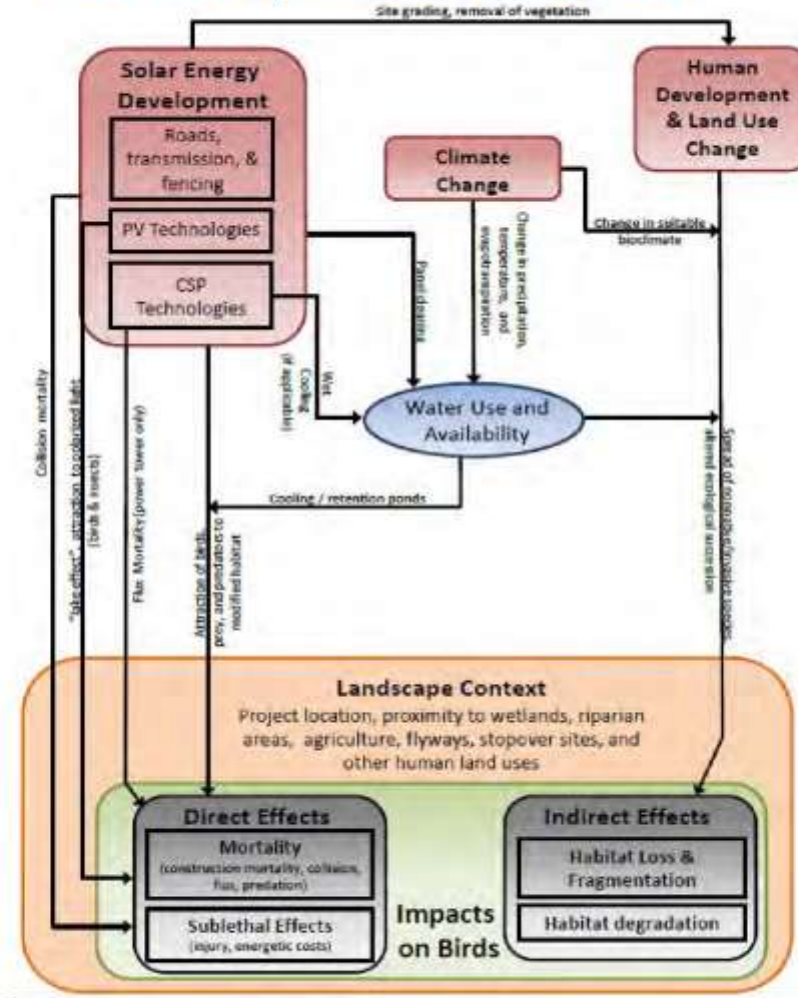
Multiagency CWG Stakeholder Workshop, May 2016

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Avian-Solar Conceptual Model

DRAFT



Multiagency CWG Stakeholder Workshop, May 2016

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Avian-Solar Conceptual Model

Climate Change

Human Development & Land Use Change

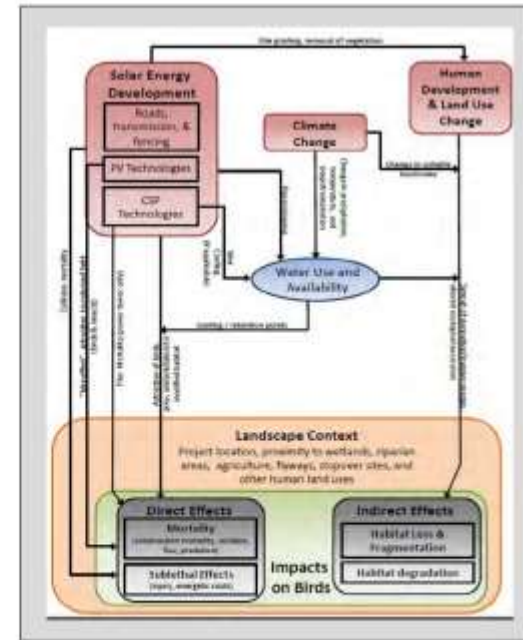
**Solar Energy Development**

- Roads, transmission, & fencing
- PV Technologies
- CSP Technologies

## Indirect Effects

- Habitat loss & fragmentation
- Habitat degradation

Change in suitable climate  
 Habitat loss  
 Spread of nonnative / invasive species  
 Altered ecological succession



Multiagency CWG Stakeholder Workshop, May 2016



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Avian-Solar Conceptual Model

Climate Change

Human Development & Land Use Change

Solar Energy Development

Roads, transmission, & fencing

PV Technologies

CSP Technologies

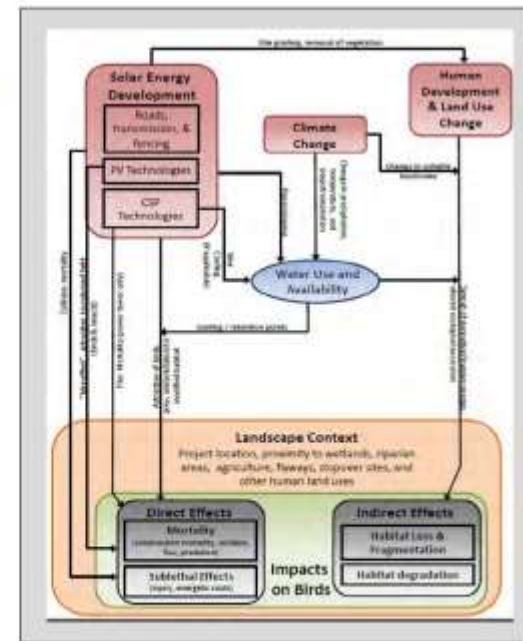
## Direct Effects

- Mortality
- Sublethal Effects

Construction mortality, collision, flux, predation

Attraction of birds, prey, and predators

Technological considerations & project design (e.g., water)



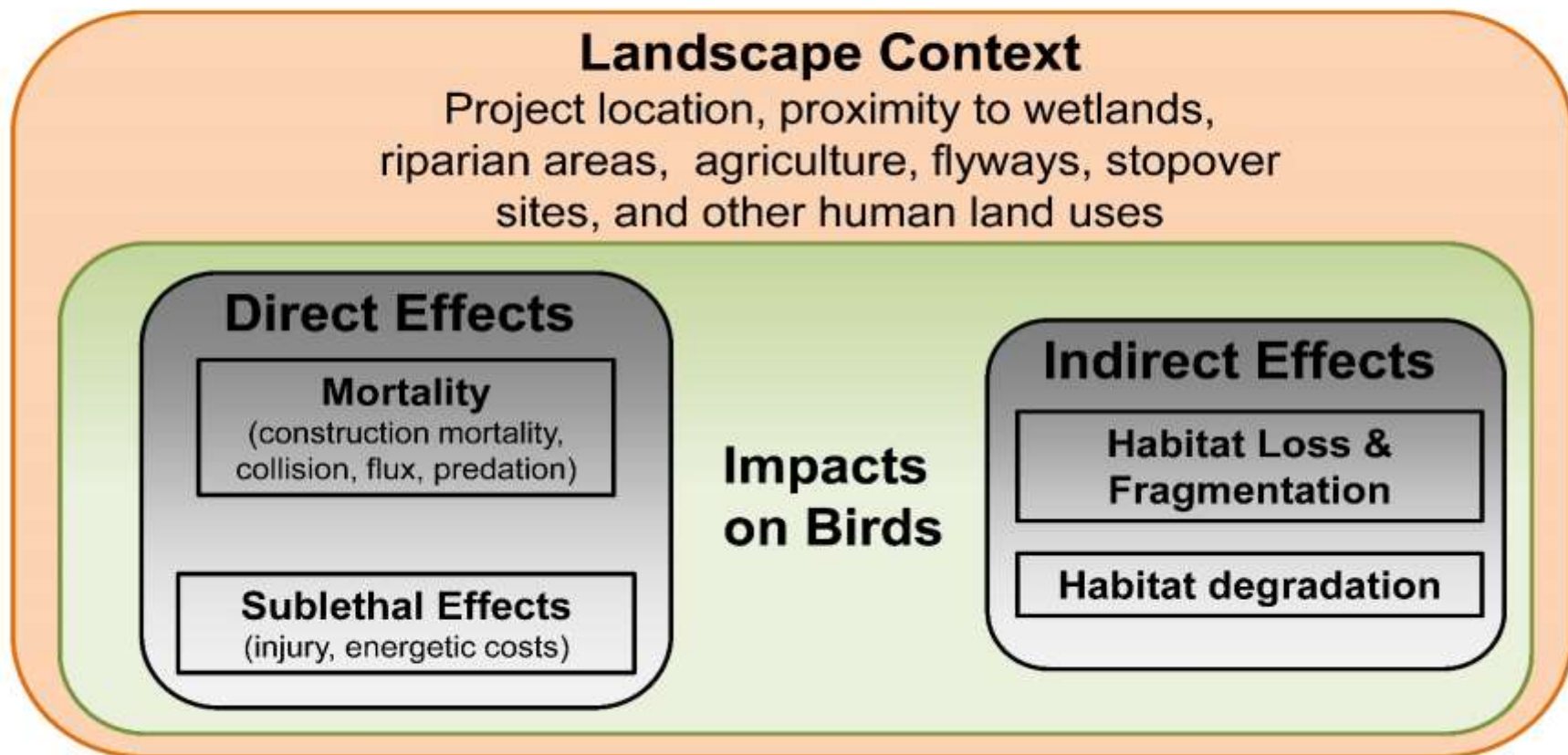
Multiagency CWG Stakeholder Workshop, May 2016

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Avian-Solar Conceptual Model

- Location matters



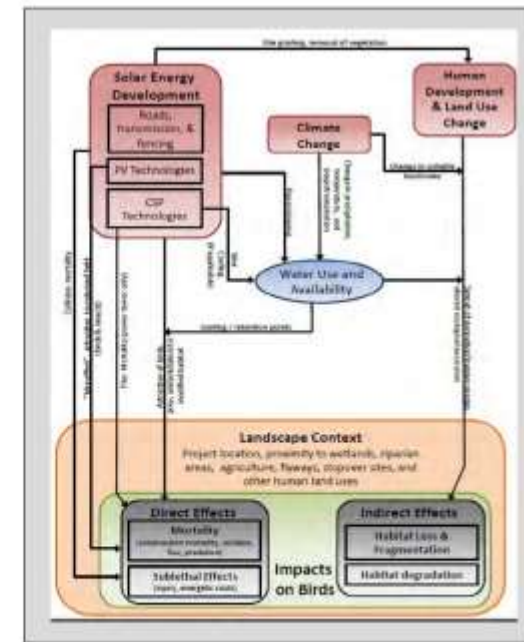
Multiagency CWG Stakeholder Workshop, May 2016

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Avian-Solar Conceptual Model

- Focus on processes and interactions the CWG may be most concerned about
- Supporting text to be provided in the science plan
- The diagram illustrates *potential* impacts that could occur
  - Projects sited on previously disturbed lands may have less impact
  - Projects with minimal water requirements (and no ponds) may have less impact



9

Multiagency CWG Stakeholder Workshop, May 2016



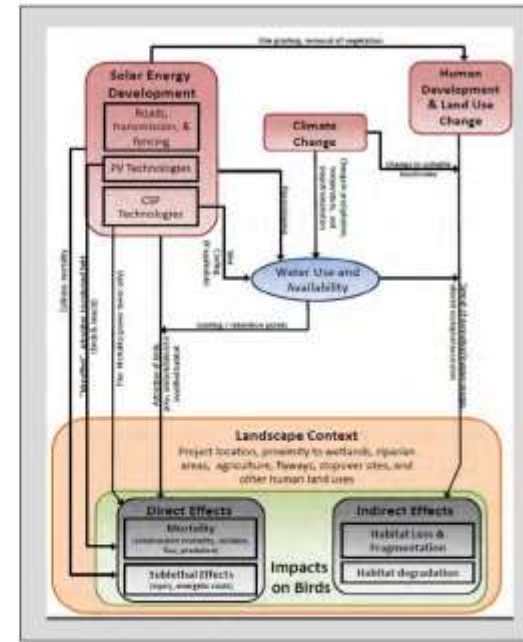


Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Avian-Solar Conceptual Model

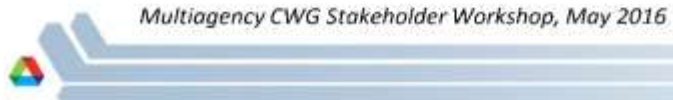
- To inform selection and prioritization of the CWG management questions
  - Are any processes more important for agency decision making?
  - What are the information gaps?
  - Which information gaps should be addressed first?
  
- Future versions of the model may illustrate important information gaps and CWG priorities
  - Color / thickness of the arrows
  - Additional annotation



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

Questions?



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

**NREL**  
NATIONAL RENEWABLE ENERGY LABORATORY

**Argonne**  
NATIONAL LABORATORY

Powered by  
**SunShot**  
U.S. Department of Energy

U.S. DEPARTMENT OF  
**ENERGY**  
Energy Efficiency &  
Renewable Energy

# Agency Management Questions and Related Research Needs

**Tony Jimenez**  
**May 11, 2016**

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

B5-122  
cont.



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Outline

- Avian-Solar Interaction Model
- “Management Question” Defined
- Sample Questions
- Management Question Categories
- Generalized Management Questions
- Research Prioritization
- Discussion

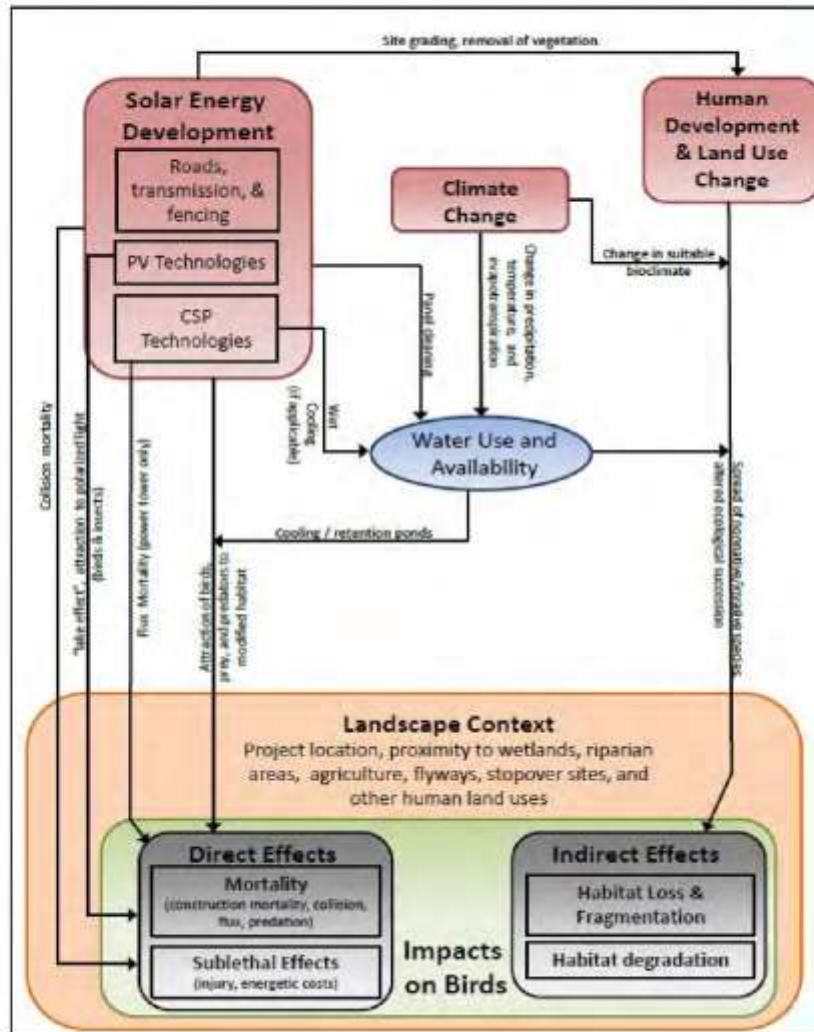


Red-tailed hawk eating a rabbit.  
*Photo by Dennis Schroeder, NREL 22325*

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

# Avian Solar Conceptual Framework

B5-122  
cont.



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Management Questions Background

- Define what information the agencies need
- Define research needs
- Tied to the conceptual model
- Due to differing missions, different agencies may have different questions
- Received 108 questions
- Questions grouped into seven (7) categories
- Questions consolidated into 14 “generalized questions”



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Sampling of Management Questions

B5-122  
cont.

- What are the most scientifically rigorous and cost-effective population monitoring tools available for: 1) quickly identifying potential impacts to populations, and 2) determining effectiveness of mitigation strategies at local and regional scales?
- Is higher mortality realized during any particular time of year?
- Are birds being attracted to the site to forage on insects killed by the concentrated solar flux?

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Management Questions Categories

1. Landscape Considerations
2. Methods to Evaluate Avian Risk and Impacts
3. Sources of Mortality and Injury
4. Avian Behavior (Attraction/Avoidance)
5. Impacts to Habitat and Other Wildlife That Might Affect Birds
6. Taxonomic and Guild-Specific Impacts
7. Minimization, Mitigation, and Adaptive Management

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Generalized Management Questions

<p>1. Landscape Considerations</p>	<p>What are the larger-scale avian movement patterns in the region (including seasonal movements and factors that influence avian movements such as the presence of stopover sites in the landscape)?</p> <p>What are the landscape-level cumulative impacts on regional bird populations or on bird populations migrating through landscapes targeted for solar development?</p> <p>What is the anticipated solar energy build-out for the foreseeable future? (e.g., project size, location, technology type)</p>
<p>2. Methods to Evaluate Avian Risk and Impacts</p>	<p>What are the best methods for monitoring and evaluating avian mortality, specific to each type of solar energy technology?</p> <p>What are the best methods for identifying the bird species that would be most vulnerable during all phases of solar development (pre-construction, construction, and post-construction)?</p>
<p>3. Sources of Mortality and Injury</p>	<p>What are the sources of avian mortality and injury at solar facilities (i.e., project features), and what factors (e.g., location, habitat characteristics, time of year, species) affect frequency of those mortalities and injuries?</p>



## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Generalized Management Questions

4. Avian Behavior (Attraction / Avoidance)	<p>How do solar facilities affect landscape level movements of birds (i.e., migration and dispersal movements), and what factors (e.g., location, habitat characteristics, time of year, species) affect these movements?</p> <p>How do solar facilities affect local-scale movements/behaviors of birds (i.e., foraging and breeding behaviors), and what factors affect these behaviors?</p>
5. Impacts to Habitat and Other Wildlife That Might Affect Birds	<p>What are the impacts of solar development to other wildlife (such as predators or prey) and habitat that might affect birds?</p>

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Generalized Management Questions

6. Taxonomic and Guild-Specific Impacts	<p>How do solar developments affect different bird taxa or guilds?</p> <p>What are the population effects from solar developments to individual bird species, particularly those of conservation concern?</p> <p>Which population or species-specific impacts are of greatest conservation concern?</p>
7. Minimization, Mitigation, and Adaptive Management	<p>What are the most effective minimization and mitigation methods to reduce or eliminate avian mortality? (e.g., project siting, technology engineering and project design to reduce attractiveness of facilities to birds, construction timing, operational parameters, deterrents, or offset)</p> <p>What off-site mitigation is most effective for off-setting mortalities for affected populations/species?</p>

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Research Prioritization

Based upon initial input from CWG members

- **Management:** Questions that are important for informing management decisions (management questions vs. research questions)
- **Timeliness:** Questions that can be answered in 3-5 years
- **Overlap:** Questions shared by multiple agencies



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)



B5-122  
cont.

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

# Day 2 Breakout Group Discussions

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**Group #1**



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**Conceptual Framework**

- Add stranding as another form of mortality
- Add dust suppression as water use

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**Management Questions (General)**

- Research questions cannot be fully addressed through monitoring; require research/study design
- Not all questions can be answered with existing data
- Focus on natural history of taxa most likely to interact with solar facilities (e.g., insectivores).

**#1 Landscape Considerations**

- Scope concerns with the amount of foreseeable development question.
- Meta-analysis of existing data could address landscape considerations
  - ebird
  - Breeding bird survey

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**#2 Monitoring Methods**

- Consider changes to pre-construction baseline surveys for taxa most likely to be affected (“better” baseline monitoring data)
  - Different seasons
  - Species-specific protocols
  - What taxa are most likely to interact with solar facilities?

**#3 Source of Mortality and Injury**

- It is possible (“maybe”) for existing data and monitoring protocols to help inform sources of mortality and causation.

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**#4 Behavior**

- Existing data/studies that could be used to understand avian behavior:
  - Pre-construction radar study for at least one solar project
  - Raptor telemetry data

**#5 Impacts to habitat and other wildlife**

- Could use predictive information on ravens, raptors, and desert tortoise.



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**#6 Population-level effects**

- Monitoring data could help address how solar impacts different taxa differently.

**#7 Mitigation**

- Look at deterrents used in other industries (wind, aviation)
- Connect new approaches to systematic monitoring designs

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**Climate Change**

- Could also be used to determine species of concern.

**Criteria**

- Budget & duration
- Would the answer to the question affect decisions?

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**Group 2 (Day 2)**

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**Any Important elements missing or misrepresented in the conceptual framework?**

- These were mostly captured in the discussion after Lee’s presentation
- All birds lumped as one. Consider differential impacts to different guilds/species
- Take into account potential benefits and risks? Or relabel “Potential Negative Impacts” which acknowledges that there may be potential benefits.



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.

**Can any of the management questions be addressed with **existing information/data**? What questions would require additional field work?**

- Do we have a good understanding of current monitoring protocols? Protocols evolve based on past experience.
- Look at monitoring approaches for uniformity.
- What are the sources of mortality? (Partial).
- How do impacts of development affect different guilds/taxonomies (Partial)
- Most of the questions will need research.
- Some/many effects appear to be location specific. Depend upon landscape and terrain features.
- Use existing data to develop hypothesis and inform the next iteration of research

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.**Additional critical research needs that weren't identified**

- Preconstruction monitoring (as research) to establish baseline mortality for areas that will see lots of development.
- How do we gather baseline mortality data? How funded?
- What before/after data already exists?
- Effect of emerging/future/sunseting technologies? E.g. types of panels, antireflective coatings. tracking/fixed tilt.

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**B5-122  
cont.

**What criteria should be considered by the agencies in establishing priorities for future research? Can you rank in terms of importance for guiding future research (e.g. allocation of funds)?**

- Prioritize questions that can be answered sooner?
- Cost/difficulty
- Avoid duplication
- Foundationality
- Fills an important gap
- Should different agencies focus on different questions?
- What are the priorities of the individual agencies?
- Scope and applicability
- Unique to solar
- Solicit public comment on criteria & research needs

**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

**Other**

- No definitive focus yet (as to priorities)
- Need to do background comparisons
- How do we ensure these agreed-upon priorities are carried out by the member agencies (implementation)



**Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)**

B5-122  
cont.

# Breakout Session 3

Conceptual Framework,  
Management Questions, Research  
Needs and Priorities

Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Group 3

- Dan Boff, DOE
- Kirk LaGory
- Amy Fesnock,
- Bill Werner
- Katie Umekubo
- Chuck Griffin
- Juliette Falkner
- Karyn Coppinger
- Brian Borowski, H.T. Harvey
- Matt Hutchinson

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

# Conceptual Framework

- Suggestions included
  - Place solar impact box within human development to show proper context
  - Solar should show as positive effect on climate change
  - Add season and weather as influencing factors
  - Present as hypothesis driven
  - Include avian behavior as factor
  - Define indirect
  - Factors are not comprehensive list. Add “e.g.,”
  - Water availability and use should be placed within solar box
  - Need to include potential benefits (e.g., use more neutral language regarding change rather than just degradation)

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Management Questions

- Many questions have landscape context but not included in landscape bin
- Data are available on solar development projections, but may not have specific information on where these would go
- Monitoring data available on limited questions regarding mortality



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Research Needs and Priorities

- What are the fundamental data needs to answer questions?
- Focus on basic processes:
  - Why are birds at site?
  - What are they exposed to?
  - What results in fatality?
- What is net effect on birds

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

**Breakout 4 –**

- *Landscape Framework comments*
  - *Broader context would be good beyond just solar.*
  - *Also, put INTO context to ensure it isn't misinterpreted when seen as a standalone document.*
  - *Should be entitled "pathway for potential impacts";*
  - *Suggest that at the core, it begins with the concepts lifecycle/life history perspective*

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Breakout 4

- *Management questions comments*
  - *‘landscape considerations’ is not a management question but rather required background for solving other management questions.*
    - *Importance of background mortality*
  - *Level of pre-construction needed*
    - *BACI versus geospatial*
    - *Understand first what agency’s want to see*
  - *Different ways to determine which guilds/species to study, e.g.*
    - *disproportional impacts, water birds, subset example of all guilds, other?*

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

B5-122  
cont.

## Breakout 4

- ASWG compared to CWG questions
  - Feather spots...include clearly in CWG
  - *climate change futures with landscape considerations management question*
  - *Standardization - what attributes are needed to determine best methods?*
- *Criteria Ranking*
  - *#1 Fundamental need – recommend adding this*
  - *#2 Management*
  - *#3 Overlap*
  - *#4 Timeliness*



Comment Set B5 – Basin & Range Watch and Western Watersheds Project (cont.)

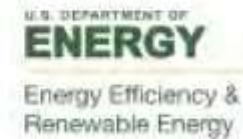


# Multiagency Avian-Solar Collaborative Working Group: Stakeholder Workshop

## *Next Steps*

*May 10-11, 2016*

*Sacramento, California*



B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Stakeholder Input Wanted

- All handouts and presentations will be available on the CWG webpage: <http://blmsolar.anl.gov/program/avian-solar/>
- Stakeholders can comment during this meeting and/or in writing following the workshop by **June 1, 2016**
- Agencies are seeking input from stakeholders on all matters relevant to the CWG objectives:
  - Concerns about avian-solar issues
  - Relevant existing data and studies
  - Understanding of avian-solar interactions
  - Focus of future research
  - Priorities for research needs
  - Future activities of the CWG
  - Level and mode of future stakeholder engagement

*Multiagency CWG Stakeholder Workshop, May 2016*

2

B5-122  
cont.

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Draft Avian-Solar Science Plan

- Revise draft elements incorporating stakeholder comments
  - Summary of available data
  - Conceptual framework
  - Management questions
- Develop additional elements
  - Prioritization of management questions
  - Implementation plan
  - Comparative cost data
- Draft plan released for stakeholder review mid summer

B5-122  
cont.

Multiagency CWG Stakeholder Workshop, May 2016

3

## Comment Set B5 – Basin &amp; Range Watch and Western Watersheds Project (cont.)

## Future Stakeholder Engagement

- A stakeholder webinar will be hosted to present and take comments on the draft avian-solar science plan (late summer 2016)
- For more information:
  - Subscribe for email updates: send request to [rollins@anl.gov](mailto:rollins@anl.gov)
  - CWG webpage: <http://blmsolar.anl.gov/program/avian-solar/>

B5-122  
cont.

Multiagency CWG Stakeholder Workshop, May 2016