DOCKETED

Docket Number:	09-AFC-07C
Project Title:	Palen Solar Power Project - Compliance
TN #:	200968
Document Title:	PSH's Rebuttal Testimony to Intervenor CBD's Opening Testimony
Description:	N/A
Filer:	Marie Fleming
Organization:	Galati | Blek LLP
Submitter Role:	Applicant Representative
Submission Date:	10/21/2013 3:20:58 PM
Docketed Date:	10/21/2013

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October 21, 2013

California Energy Commission
Dockets Unit
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: **PALEN SOLAR HOLDINGS, LLC'S REBUTTAL TESTIMONY TO INTERVENOR CENTER FOR BIOLOGICAL DIVERSITY'S OPENING TESTIMONY**
PALEN SOLAR ELECTRIC GENERATING SYSTEM
DOCKET NO. (09-AFC-7C)

Enclosed for filing with the California Energy Commission is the electronic version of **PALEN SOLAR HOLDINGS, LLC'S REBUTTAL TESTIMONY TO INTERVENOR CENTER FOR BIOLOGICAL DIVERSITY'S OPENING TESTIMONY**, for Palen Solar Electric Generating System (09-AFC-7C).

Sincerely,

Marie Fleming

STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of: Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DOCKET NO. 09-AFC-07C** **DECLARATION OF FRED NIALS**

I, Fred Nials, declare as follows:

1. I am an independent consultant currently under contract with Centerline.

2. A copy of my professional qualifications and experience was included with my Opening Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached testimony relating to Biological Resources for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on Oct. 19 2013.

Fred Nials

STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of: Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DOCKET NO. 09-AFC-07C** **DECLARATION OF ALICE KARL**

I, Alice Karl, declare as follows:

1. I am an independent consultant currently under contract with Centerline.

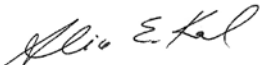
2. A copy of my professional qualifications and experience was included with my Opening Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached testimony relating to Biological Resources for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on 17 October 2013.



Alice Karl

STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of: Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DOCKET NO. 09-AFC-07C** **DECLARATION OF MICHAEL J. KUEHN**

I, Michael J. Kuehn, declare as follows:

1. I am a Senior Biologist/Statistical Analyst with Bloom Biological, Inc.

2. A copy of my professional qualifications and experience was included with my Opening Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached testimony relating to Biological Resources for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on 19 oct. 2013.

Michael J. Kuehn

STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of: Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DOCKET NO. 09-AFC-07C** **DECLARATION OF CLAY JENSEN**

I, Clay Jensen, declare as follows:

1. I am presently employed by BrightSource Energy, Inc. as Senior Director of Project Development.

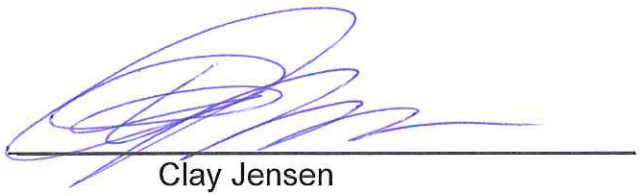
2. A copy of my professional qualifications and experience was included with my Rebuttal Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached testimony relating to Biological Resources for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on October 17 2013.



Clay Jensen

STATE OF CALIFORNIA

Energy Resources
Conservation and Development Commission

In the Matter of: Petition For Amendment for the **PALEN SOLAR ELECTRIC GENERATING SYSTEM**	**DOCKET NO. 09-AFC-07C** **DECLARATION OF WALLY ERICKSON**

I, Wally Erickson, declare as follows:

1. I am presently employed by West Inc.

2. A copy of my professional qualifications and experience was included with my Rebuttal Testimony and is incorporated by reference in this Declaration.

3. I prepared the attached testimony relating to Biological Resources for the Petition for Amendment for the Palen Solar Electric Generating System (California Energy Commission Docket Number 09-AFC-07C).

4. It is my professional opinion that the attached prepared testimony is valid and accurate with respect to issues that it addresses.

5. I am personally familiar with the facts and conclusions related in the attached prepared testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury, under the laws of the State of California, that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on ____10/21_____ 2013.

Wallace P. Erickson

Wally Erickson

PALEN SOLAR ELECTRIC GENERATING SYSTEM
BIOLOGICAL RESOURCES
REBUTTAL TESTIMONY

I. Names:

Fred Nials
Dr. Alice E. Karl
Dr. Michael Kuehn
Clay Jensen
Wally P. Erickson

II. Purpose:

We provide this Rebuttal Testimony to address the biology-related issues raised by Intervenor Center for Biological Diversity (CBD) in its Opening Testimony for the construction and operation of the Palen Solar Electric Generating System (PSEGS) (09-AFC-7C).

III. Qualifications:

Fred Nials: I am presently a consulting geomorphologist and geoarchaeologist and have 45 years of experience performing consulting and teaching at the University level. I have degrees in Geology and a graduate degree in (AbD) Geology, graduate minors in Soils and Ecology, University of Idaho, 1967. My experience includes 28 years teaching at graduate and undergraduate levels (Univ. Nevada, Reno; Washington State Univ., and Eastern NM Univ.). I am an independent consultant to centerline in support of the Petition For Amendment for the PSEGS. I reviewed the Opening Testimony of Dr. Allan Muth relating to sand transport and offer this Rebuttal Testimony on sand transport and impacts to Mojave Fringe Toed Lizard (MFTL). My resume was included as Attachment A to my Opening Testimony.

Dr. Alice E. Karl: I am presently the owner of Alice E. Karl and Associates. I have a M.S Degree in Biology and a Ph.D. in Ecology. I have been an environmental consultant since 1978 and have over 35 years of experience working continually in the deserts of the Southwest U.S. and Mexico. I reviewed the Opening Testimony of Ileene Anderson and Pat Flanagan and offer this Rebuttal Testimony in the areas of Desert Tortoise Connectivity and Translocation, Desert Kit Fox and Badgers, Burrowing Owl and Cryptobiotic Soils. My resume was included as Attachment A to my Opening Testimony.

Dr. Michael Kuehn: I have over 15 years of experience in conducting ecological research and assessing biological resources, with 13 years of experience with the flora and fauna native to southern California, including

both the Sonoran and Mojave desert ecoregions. I have a Doctoral Degree in Behavioral Ecology from the University of California, Santa Barbara, and a Bachelor's of Science in Fisheries and Wildlife Management from Lake Superior State University, Michigan. I have published research papers in the primary, peer-reviewed literature related to avian ecology and conservation and presented papers and posters on these topics in scientific meetings. I have directed or participated in field surveys for federal- and state-listed threatened and endangered species, as well as other rare and common species. I have served on a Technical Advisory Committee for a Walton Family Foundation funded initiative to restore habitat for Southwestern Willow Flycatchers in the Colorado Basin. I am currently a Senior Biologist/Statistical Analyst with Bloom Biological, Inc. (BBI) where I am primarily responsible for designing, implementing, analyzing results for, and reporting on environmental assessment studies, primarily in Southern California, including multiple projects in Riverside County. I have been primarily responsible for designing, implementing, analyzing results for, and reporting on avian surveys conducted by BBI on the PSEGS project site during the spring and summer seasons of 2013. My resume is attached to this Rebuttal Testimony.

Clay Jensen:

I am the Senior Director of Project Development for BrightSource Energy. I have a Bachelor of Science Degree in Civil Engineering and a Master's Degree in Business Administration (MBA).I have over 18 years' experience working on complex projects in the southwestern United States. My professional focus has been on project management of large scale developments in the desert environment. I understand the potential for significant impacts caused by development and I have worked proactively to minimize impacts and to support appropriate adaptive management/mitigation solutions. I have worked with BrightSource for over 4 years and I have spent most of this time exploring solutions that will allow a project to meet its purpose and need while minimizing impacts of BrightSource's power tower technology. My resume is attached to this Rebuttal Testimony.

Wally P. Erickson:

I am the Chief Operating Officer/Senior Biometrician at Western EcoSystems Technology, Inc (WEST) and have been employed in that capacity since 1991. I have a MS in Statistics and have over 23 years' consulting experience related to the design and analysis of environmental and wildlife studies. I have been the lead statistician/project manager for WEST for baseline studies, environmental permitting, and/or operational monitoring/research at wind energy projects in over 30 states. I have participated in numerous assessment and monitoring projects related to understanding and assessing the effects of wind turbines on birds and

bats, and in avian and bat risk reduction studies. I have been involved in studies involving use of radar, and other remote sensing methods for detecting birds and bats at wind facilities, and with methods used to reduce or minimize impacts such as prey reduction, acoustic and visual deterrents and other methods. I have also developed Avian and Bat Protection Plans (ABPP), Bird and Bat Conservation Strategies (BBCS) and Eagle Conservation Plans (ECP) for several wind projects. I reviewed the Opening Testimony of CBD and offer this rebuttal testimony in the areas of Adaptive Management as part of the BBCS for the PSEGS.

To the best of our knowledge all referenced documents and all of the facts contained in this testimony are true and correct. To the extent this testimony contains opinions, such opinions are our own. We make these statements and provide these opinions freely and under oath for the purpose of constituting sworn testimony in this proceeding.

IV. Rebuttal:

FRED NIALS

Sand Transport

The Opening Testimony of Dr. Muth does not address the primary issue associated with Staff's calculation of indirect impacts. In the original proceeding, the flaws of the PWA model were not known. As pointed out in my Opening Testimony, I and Staff's expert, Dr. Lancaster, agree on the problems with the model. Further during the original proceeding, it was assumed that the amount of sand transport blockage (0-25, 25-50, 50-75, 75-100 percent) was believed to equal erosion and deflation. Dr. Lancaster stated in the last workshop that blockage did not equal deflation. Even with this statement from their own consultant, both Staff and Dr. Muth assume that if sand transport is interrupted such that 50 percent of the sand is blocked, then all areas downwind of the area where the blocked sand would have been deposited will eventually deflate.

I disagree with this assumption for two reasons. First the wind patterns do not return to "pre-project" patterns immediately adjacent to the downwind fence, but rather gradually return to "pre-project" patterns with distance away from the downwind fence. So there are areas closer to the fence where the sand will receive less transport but will not be eroded because the wind as well as the sand, is blocked and is not traveling with enough force to cause any deflation. Second, in order for Dr. Muth's theory to be accurate, it would require erosion to take place at a greater rate than sand input. While we know this not to be the case, I have nevertheless assumed the same type of gradual erosion for every area where the sand input is reduced by 50 percent or more. This conservative assumption ignores the facts that sand is input from the wind blowing in different directions and that onsite and nearby washes also transport sand to these same areas. Finally, in areas where sand blockage is <50%, then 50% of

the sand *is still entering* the site, and because erosion does not occur at a greater rate than input, as explained above, areas with at least 50% sand input remain. Therefore, I recommend the conservative estimate of indirect of impacts to MFTL of 178 acres be adopted by the Commission.

The mitigation ratio for direct and indirect impacts to MFTL was adjudicated in the original proceedings and there is no new scientific evidence provided by Dr. Muth that should warrant reopening that issue.

DR. ALICE KARL

Desert Tortoise

All of the issues raised by Ms. Anderson and Ms. Flanagan relating to desert tortoise populations, translocation, mitigation ratios and connectivity were thoroughly adjudicated in the original licensing proceeding for the Approved Project and therefore my testimony will only address the new scientific information provided in support of their testimony.

It is indisputable that tortoise populations have declined since and before the tortoise was listed by the USFWS. But, to evaluate project-related impacts on desert tortoises, site-specific conditions must be examined, including, but not limited to, population abundance and distribution on the PSEGS project and in the project vicinity, connectivity and mitigation.

Ms. Anderson (Page 5) states:

> "Despite these declines, the project is being sited in the only WHMA established by BLM to provide connectivity from the Chuckwalla DWMA in the southern part of the Colorado River Recovery Unit to the northern part of the Unit, including to the Chemehuevi DWMA. … Even with mitigation, this key connectivity area will be lost forever…"

These statements are not accurate as presented. First, this *proposed* WHMA does not connect two DWMAs (Chuckwalla and Chemehuevi). It connects the Chuckwalla DWMA to a *multi-species* WHMA on the north side of the freeway. The major connection to the north for tortoises is the DWMA itself, which BLM modified to include the habitat on the north side of the freeway, well west of the project. Second, the BLM's connectivity WHMA is roughly five times the width of the solar site, and extends both east and west of the solar site. The solar site itself lies in a portion of the WHMA that has few to no tortoises and little to no tortoise habitat, so it is not an effective connectivity corridor.

Ms. Flanagan also discusses the importance of connectivity at the project site, citing the work completed by Penrod *et al*. (2012) and relying heavily upon the land facet analysis. However, the authors of that analysis actually state (P 62):

> "Although the landscape permeability and land facet analyses delineate swatches of habitat based on model assumptions and available GIS data…, they do not address whether suitable habitat in the Preliminary Linkage Network occurs in large enough patches to support viable populations or whether patches are close enough together to allow for inter-patch dispersal…"

The authors then modify their preliminary habitat and land facet analysis for tortoises by including Nussear et al's (2009)[1] model (Penrod *et al.* 2012: 134), which ranked the project location as having a mid-range potential for tortoise presence. (Note: Nussear et al.'s analysis was considered as part of the initial Approved Project license.) Penrod *et al.*'s final analysis shows that the PSEGS project site is in part of a broad "move-through" area, and is not an occupied patch or core area (Figure 1). However, even this is incorrect because the model's assumptions are not entirely valid. One only needs to look at the CNDDB reported occurrences in this figure, from the several large-scale surveys for solar projects on the PSEGS project site and in the region, to see that the PSEGS site is not occupied, even though the model suggests that tortoises "move through" this area. Certainly, an occasional tortoise might move through the site of the solar field, but the solar site does not provide adequate habitat for occupation – it is mostly too poorly vegetated or the soils too loose. Further, it is connected to even worse habitat to the north, Palen Dry Lake and Palen Dunes, neither of which are tortoise habitat. The most recent USFWS connectivity model supports the lack of connectivity at the project site (Figure 2).

In summary, while connectivity is a critical feature for species persistence, lengthy connectivity corridors for a low-mobility species such as a tortoise actually must be occupied by the animal. The PSEGS solar site does not offer habitat that is or would be occupied, and there is no tortoise habitat immediately north of the site. So, despite a theoretical model showing a "corridor" through the PSEGS solar site, it does not actually meet the standard for a desert tortoise connectivity corridor. By contrast, the gen-tie *does* intersect occupied habitat west of the solar site. However, the gen-tie will not block connectivity. Nonetheless, a fencing/culvert program is part of BIO-9 to maintain connectivity between any occupied habitat, or habitat that is likely to be occupied, north and south of the freeway. This measure is, however, mainly to mitigate the effects of the freeway, thereby providing safe connectivity that is now interrupted by the freeway. The measure also ensures that tortoises disrupted by the presence of and

[1] Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H. Webb. 2009. Modeling habitat of the desert tortoise (Gopherus agassizii) in the Mojave and parts of the Sonoran deserts of California, Nevada, Utah and Arizona. U.S. Geological Survey Open-file Report 2009-1102. 18 pp.

activities associated with PSEGS do not experience increased risk of mortality on the freeway.

Ms. Anderson (Page 5) requests that all mitigation lands “provide desert tortoise connectivity” and that such “mitigation lands will be acquired, designated and protected in perpetuity for desert tortoise connectivity.” There is no argument that connectivity, when present or when could be present if tortoise populations recover, is vital to population persistence. But, the connectivity needs to be well placed, based not on coarse-grained models, but on actual data. Because survey data clearly demonstrate that the solar site is not in a connectivity corridor, then BIO-12’s original language that the mitigation lands have the “potential to contribute to desert tortoise habitat connectivity and build linkages” is adequate.

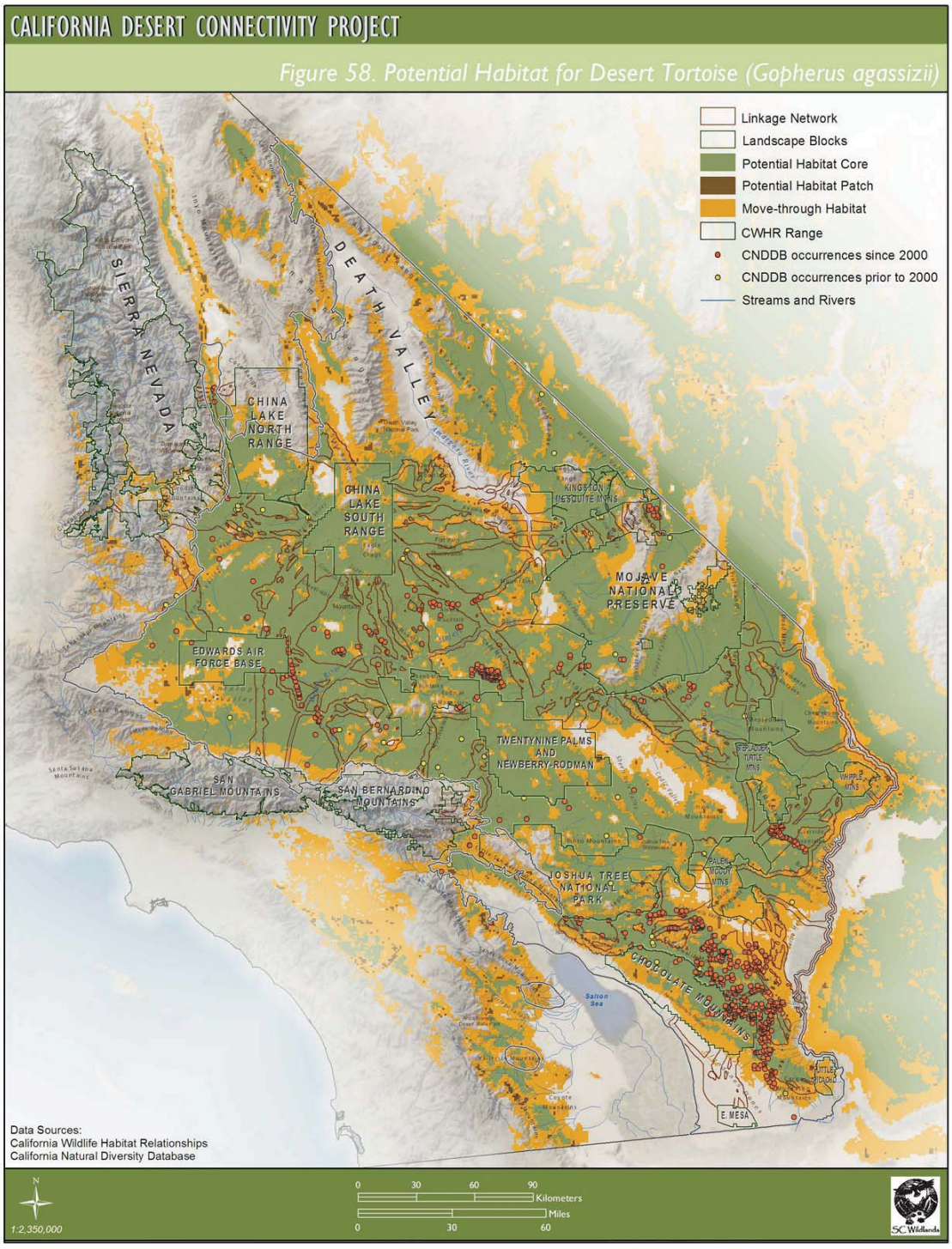


Figure 1. Final analysis of connectivity corridors from Penrod *et al.* (2012).

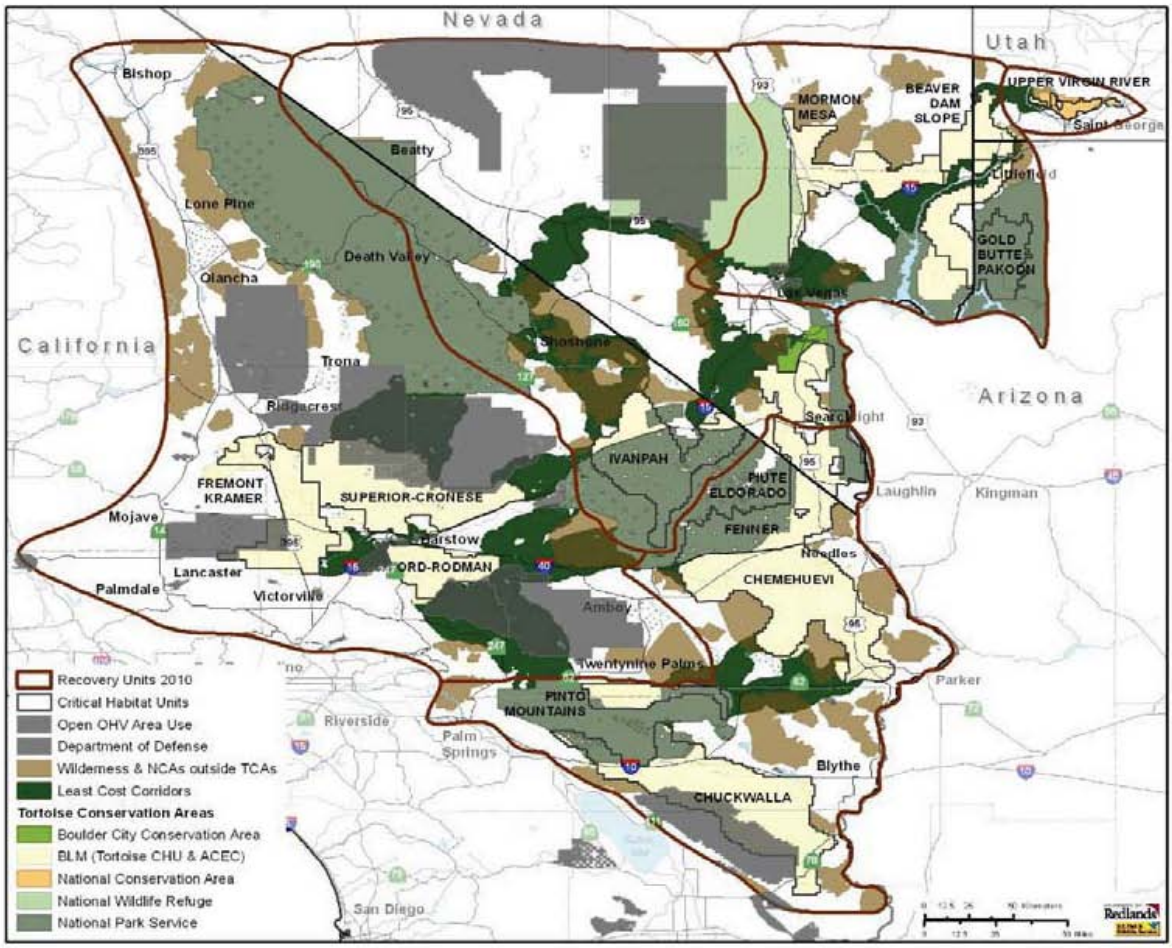


Figure 2. FWS connectivity model for the desert tortoise. Source: FWS (2012): Figure 3[2].

[2] U.S. Fish and Wildlife Service Desert Tortoise Recovery Office. 2012. Connectivity of Mojave Desert Tortoise Populations. Reno Nevada. 18 pp.

Desert Tortoise Translocation

There is nothing new in Ms. Anderson's argument about translocated tortoises that was not previously discussed for the original Approved Project license.

Desert Kit Fox and Badgers

Ms. Anderson (Page 7) states:

> "The FSA relies on outdated data from 2009 and 2010 on desert kit fox occurrence on the proposed project site with 2013 surveys only on habitat within the newly proposed linears."

Actually, the FSA relies on *baseline* data for Staff's analysis and includes an updated consideration of distemper in light of more recent information. This is a reasonable approach to determine potential effects on kit fox. BIO-17 then requires pre-construction surveys to provide information on current distribution and age structure on the project site, which will be used to revise the approved American Badger and Kit Fox Mitigation and Monitoring Plan, if necessary.

Ms. Anderson further states (Page 8) that:

> "The most recent Bureau of Land Management Final Environmental Impact Statement for a large scale solar project includes …a testing component in which researchers trap and test a representative subsample of the population for canine distemper…"

Ms. Anderson then describes a variety of measures that are included in the BLM's FEIS for this solar project, the McCoy Solar Energy Project.

The McCoy Solar Energy Project FEIS was published in 2012, before the PSEGS FSA or workshops for PSEGS. Many of the measures in the McCoy FEIS are also in BIO-17. CDFW has been involved in the PSEGS proceedings and has proposed a more updated approach for kit foxes, including optional participation in a CDFW-led study that would include health analyses. The kit fox issue is complex because of the CDFG code, as well as what is known and not known about desert kit foxes. CDFW is the current comprehensive resource for desert kit fox information and has funded investigations of desert kit fox in the Chuckwalla Valley. Armed with the most comprehensive and recent data base, CDFW has determined that the best approach is the one addressed in the FSA BIO-17.

Burrowing Owl

Ms. Anderson expresses the opinion that "the CEC should follow the requirement of the CDFW" (Page 15), in CDFG(W)'s (2012) *Staff Report on Burrowing Owl Mitigation*. The CDFG (W) (2012) guidance is not a set of requirements, but is instead, a set of recommendations. Staff

collaborated with CDFW for the FSA, so CDFW provided current input on burrowing owl analysis and measures.

Burrowing owls were already adjudicated in initial licensing. No new information has been presented by CBD that would alter that analysis.

Cryptobiotic Crusts

In her Opening Testimony, Ms. Anderson states (Page 17):

> "I believe that increased dust emissions from the proposed project site will occur in areas where cryptobiotic soils are disturbed, and request that surveys for cryptobiotic soils be implemented so that impacts from the proposed project can be at least analyzed."

Where present, cryptobiotic crusts are, as Ms. Anderson notes earlier in her discussion, important and fragile features of desert soil surfaces. However, they are not present on surfaces that are dynamic (i.e., subject to frequent change). Once again, local conditions at PSEGS should be an important consideration in any biological analysis of site impacts. The soils on the solar site, outside of the sheet flow areas, are loamy sands and soft to loose sands that are highly subject to surface movement and erosion. The sheet flow areas are subject to periodic overland flow and shifting water courses. By the very nature of these dynamic soil types and hydrologic features, biological crusts are unlikely to be supported on most, if not all, of the solar site.

Nothing in any of the supporting documentation to Anderson's and Ms. Flanagan's Opening Testimony would support modifying the early findings by the Commission.

Yuma Clapper Rail and Bald Eagle Observations

In written testimony, Ms. Anderson cites the FSA (4.2-41) and indicates the Yuma clapper rail and the Bald Eagle were observed on the Project site. However, it should be noted that although the FSA does, in fact, indicate the Yuma clapper rail and Bald Eagle were observed on site, none of the biological reports and surveys for the Approved Project or for the PSEGS Amendment indicate that either of these two species were observed on or near the project site.

DR. MICHAEL KUEHN

In written testimony, Ms. Anderson of the Center for Biological Diversity has stated that it is her opinion that "the project poses a serious threat to the Yuma clapper rail". She supports this opinion, by citing that the FSA (4.2-41) indicates the Yuma clapper rail was observed on the Project site. However, it should be noted that although the FSA does in fact indicate the Yuma clapper rail was observed on the Project site none of the survey work I or my firm BBI conducted in support of the PSEGS Amendment

indicates that a Yuma clapper rail was every observed on or near the PSEGS site.

CLAY JENSEN

Adaptive Management

As a representative of PSH, the company is committed to implementing robust methods to investigate any sources of mortality, mitigation measures in advance of the investigation of mortality and adaptive management methods. Condition of Certification **BIO-16a** provides mitigation in advance of impacts and Condition of Certification **BIO-16b** requires development of a BBCS which will include a monitoring program to inform decisions on which adaptive management technique(s) would be most useful to achieve the objective of minimizing and reducing impacts to avian species while allowing the project objectives to be realized. Attachment A to this testimony includes some of the adaptive management techniques that we have been exploring to date, many of which have been successfully employed for wind projects and at airports. Attachment A is not intended to be an exhaustive list of all methods available. However, we believe the approach set forth under Condition of Certification **BIO-16b** (which requires the cooperative development of the BBCS with state and federal wildlife agencies) can result in the development and successful implementation of a comprehensive adaptive management program for the PSEGS.

WALLY P. ERICKSON

Adaptive Management

Adaptive management can be an effective process to use in addressing avian risk when there is some uncertainty related to effects and types of strategies to the reduce the risk, particularly when dealing with a new technology such as the concentrating solar power (CSP) facility being proposed for Riverside County California. For adaptive management to be effective it is first necessary to understand the avian behavior and associated risk at the site during operations. . Based on an initial assessment and an evaluation of the available risk reduction management measures, an adaptive management process can be established to evaluate the most effective risk reduction measures. This adaptive process includes implementation of one or more management actions in an experimental framework, a determination of the effectiveness of those measures, and a decision to implement the successful measures as routine management and/or the evaluation of other management methods. It is important first to understand the avian behavior and associated risk with the project in order to evaluate potential management methods before they are considered for routine management. This type of adaptive

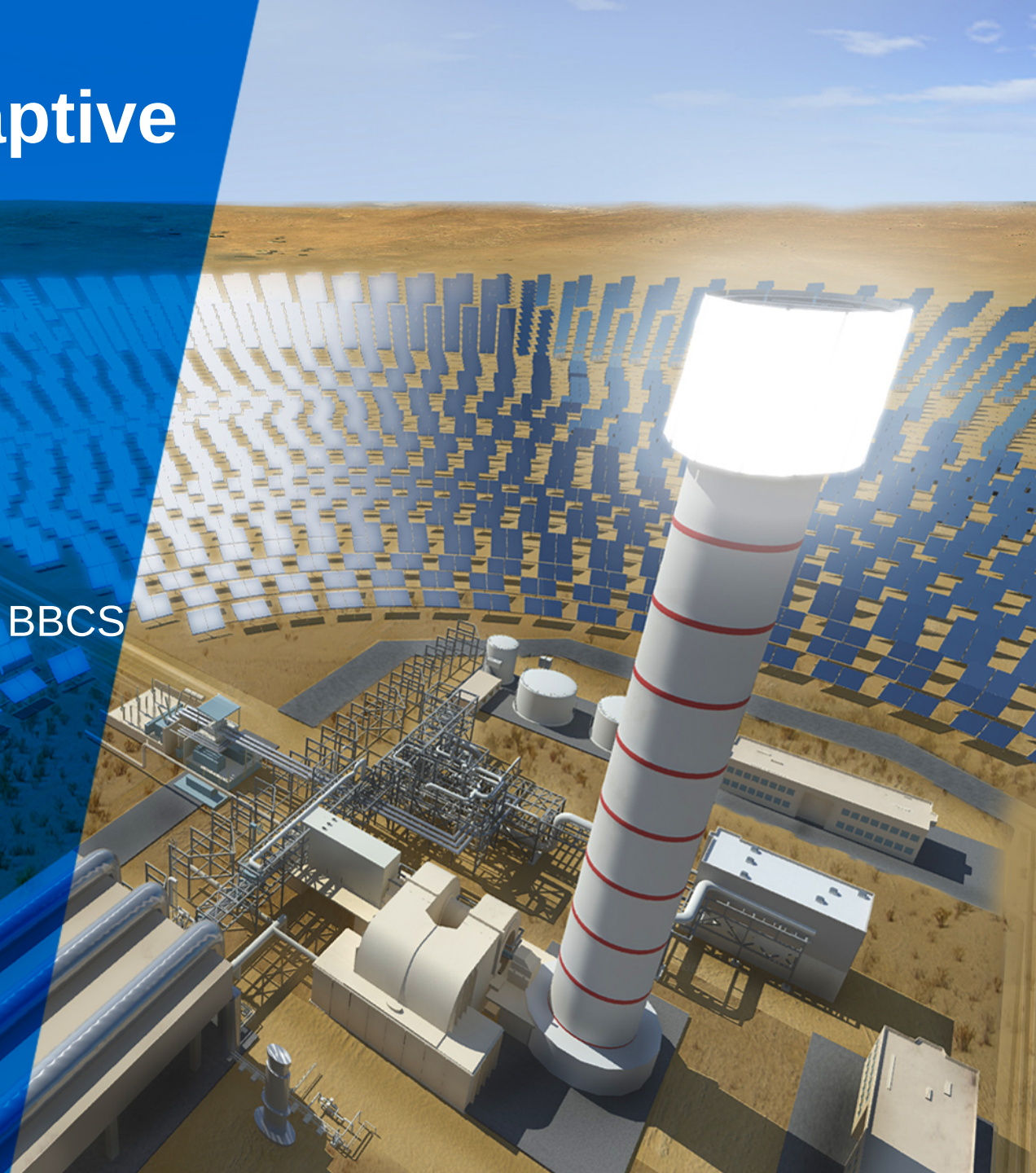
process has been used by the wind energy industry to reduce risk to birds and bats and is an important part of the U.S. Fish and Wildlife Service's Land-based Wind Energy Guidelines. I have been involved in numerous projects where an adaptive process is in place similar to the one proposed here to guide management of the facility if unforeseen or higher than anticipated impacts occur.

For example, there was uncertainty regarding the potential impacts of two wind projects along the Texas Gulf Coast on migrating birds, especially with regard to mortality. To address this uncertainty, a monitoring program was put into place to determine the extent of avian fatalities and an early warning system using avian radar was experimentally tested to see if fatalities could be reduced through facility management.

Attachment A

Potential Adaptive Management Measures

Palen SEGS
Potential Approaches to BBCS



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Overview

- Adaptive Management (AM) measures
  - Implemented to address potential avian impacts at a concentrating solar power (CSP) facility
    - Documented in several reports
    - Focusing on deterring avian activity near airports, artificial ponds, waste or spill sites, and powerlines or towers

Avian Deterrence Measures

1. Passive or automated visual deterrence techniques
2. Automated auditory / bio-acoustic techniques
3. Onsite or adjacent area habitat and prey controls
4. Localized perch and nest-proofing measures
5. Netting and other enclosures
6. Deploying dogs or raptors to deter avian use
7. Radio-controlled aircraft, water cannons, shotgun blasts, ATVs, full scale aircraft to deter avian activity
8. Radar or similar long-range detection methods

Summary of Potential Avian Adoptive Management Measures by Category

AM Category	Potential Effectiveness	Difficulty of Implementation
1. Passive or automated visual deterrence	Initially effective, but subject to rapid habituation	Easy and well understood
2. Automated auditory, bio-acoustics deterrence	Initially effective, but subject to rapid habituation	Easy to Moderate and well understood
3. Facility habitat and prey control	Medium to high	Moderate; may require changes to existing CoC's
4. Perch and nest-proofing	High for immediately-affected area; medium as attractive deterrent	Easy to Moderate and well understood

Summary of Potential Avian Adoptive Management Measures by Category *(cont.)*

AM Category	Potential Effectiveness	Potential Cost, Other Factors
5. Netting or other enclosures	High for immediately-affected area	Easy to Moderate and well understood
6. Dog, raptor other animal related deterrence	Medium to high depending on avian species, flight heights, etc.	Moderate; may require additional research
7. Actively managed radio-controlled aircraft, water cannons, shotgun blasts, ATVs	Medium to high depending on accessibility, extent of onsite monitoring and frequency of deployment	Moderate; may require additional research
8. Radar and long-range focused, bio-acoustics or visual deterrence	Potentially high to very high if ability to consistently locate and direct long range deterrence measures is confirmed	Moderate to Difficult; may require additional research.

Adoptive Management Measures in Detail

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1. Passive or Automated Visual Measures

- Used at agricultural fields, industrial sites and to deter birds from temporary hazards such as oil spills
- Include:
  - Strobe, revolving and amber barricade lights
  - Reflective Mylar tape mounted as streamers or spans
  - Stationary or mechanical pop-up scarecrows or effigies
  - Black, white or other colored plastic flags

1. Passive or Automated Visual Measures *(cont.)*

- Reflective Mylar balloons, including balloons marked with predator “eyespots” or that include suspended kites shaped like a hawk or an eagle
- Laser light emitted including hand-held units
- Kites, and kite-hawks and other mobile predator models
- Stationary predator models

1. Passive or Automated Visual Measures: *Implementation Considerations*

- Visual deterrence methods can be highly effective for short periods
  - Deterring migrating, temporarily resident avian populations
- Resident birds likely to become habituated to repeated deployment within a few days
- Flashing lights and hand-held lasers may also have limited daytime effect
- Visual AM measures would likely need to be rotated or implemented with other approaches
  - Reducing habituation risks and maintaining effectiveness

2. Automated Auditory Measures

- Auditory and bio-acoustic measures
  - to deter avian crop depredation or use of problematic sites
- Include
  - Pyrotechnics; shell crackers, noise, claw, bird, racket, whistle bombs, bird whistlers, noise rockets and rope-firecrackers
  - Automated or manual propane cannons
  - Wailers or similar broadcasting devices transmitting dog barking, siren, gunfire, music, human screams or other deterrent sounds
  - Bio-acoustic broadcasts of recorded or synthesized avian alarm, distress or predator calls

2. Automated Auditory Measures: *Implementation Considerations*

- Resident avian species habituate rapidly to most forms of repeated (e.g., periodic propane cannon blasts) or generally broadcast deterrence measures
- Certain bio-acoustic distress, alarm or predator call broadcasts may be more effective and less prone to habituation over time
- Pyrotechnic methods are generally effective only for temporary periods can also generate fire and safety risks
- Loud, unfocused sound broadcasts may adversely affect non-avian wildlife or individuals within hearing distance
- Auditory AM measures would need to be frequently rotated or concurrently used with other approaches to reduce habituation risks and effectively deter birds

3. Habitat and Prey Control

- Native vegetation will be maintained within the heliostat field of each facility
  - May encourage avian foraging, roosting and nesting activity
  - May also support avian prey, such as reptiles, rodents, and rabbits that could stimulate raptor use
- Habitat controls, including vegetation removal, has effectively reduced avian activity at airports and similar facilities
  - If indicated by avian monitoring data, onsite vegetation could be significantly reduced by more frequent and aggressive mowing
  - Implementation of avian prey reduction measures within the fence-line

3. Habitat and Prey Control: *Implementation Considerations*

- Additional vegetation or prey controls could potentially conflict with a project's state or federal environmental analysis
- Limited land clearing has been identified as a comparative benefit of CSP technology. Despite this assertion, however, state and federal project environmental assessments performed to date appear to assume that the habitat functions and values within the entire solar field will be fully impacted and require mitigation at a minimum 1:1 acreage ratio. More frequent and / or lower vegetation mowing, or avian prey control within the facility fence-line, would not appear to conflict with this analytical conclusion. If such measures do not generate additional permitting complexity, onsite habitat and prey management could reduce the propensity of birds to occur within the project facility. This measure may be appropriate if birds associated with the vegetation and prey appear to be impacted by project operations

4. Perch and Nest Proofing

- Perching, roosting, or nesting activity on and within certain facility structures or locations can be reduced or avoided
- Tactics include:
  - Porcupine wire or bird spikes at perching or nesting locations
  - Springs or coils to generate moving substrate to deter bird use
  - Pastes or liquids on ledges and roosting structures deter birds
  - Enclosing discrete areas, i.e., tower cavities, prevent avian entry

4. Perch and Nest Proofing: *Implementation Considerations*

- Perch and nest proofing using metallic barriers and discrete area enclosure relatively effective
  - Requiring limited maintenance after initial deployment
- Paste and liquid deterrence measures less effective and persistent
- Installation of perch and nest proofing equipment can be labor intensive
  - Difficult to complete in certain higher-risk areas

4. Perch and Nest Proofing: *Implementation Considerations (cont.)*

- Incomplete installation could divert birds from treated areas to untreated locations that might otherwise be avoided
  - However, persistent monitoring of onsite bird activity could effectively reduce avian perching and nesting within the facility
- Certain portions of the facilities may require perch or nest proofing as a condition of state or federal approval
  - Additional perch or nest proofing could be implemented as necessary in response to project monitoring data

5. Larger Area Exclusion Measures

- Various devices could be deployed to prevent avian use of larger portions of the project, including:
  - Netting (proposed for project ponds)
  - Overhead wire or monofilament lines strung in a grid or parallel pattern
    - Known to deter bird movement

5. Larger Area Exclusion Measures: *Implementation Considerations*

- Potential AM measures such as these are not likely to be feasible for larger project areas
  - Heliostat field
  - Significant portion of the central towers, power generation facilities, and other major structures
- Netting could be used to prevent avian access to discrete tower or building locations
  - Will be deployed to prevent bird use of facility cooling ponds, if present
- Overhead lines are effective at deterring bird movement (although the precise reason why birds avoid such areas is not yet known)
  - Can also cause avian collision injury or mortality
  - As a result, wire or monofilament line deployment does not appear to be a feasible AM option for the projects

6. Dogs and Raptors

- Border collies
  - Trained to pursue (but not capture or harm) birds have successfully deterred avian activity at several civilian and military airports, golf courses and farms
    - Certain studies suggest that even one dog can significantly reduce bird populations over relatively large areas
- Trained falcons
  - Have also been deployed above airports and military installations to deter bird activity

6. Dogs and Raptors *(cont.)*

- Relative effectiveness
  - Avian habituation risks are generally avoided or reduced because dogs and raptors can actively pursue birds that may initially ignore their presence
    - Dogs typically more effective at deterring on and near ground avian activity
    - Falcons more effectively reduce bird activity above and within the project facilities

6. Dogs and Raptors: *Implementation Considerations*

- Dog and raptor avian control measures labor intensive
  - Requiring significant animal maintenance
  - Must be continuously deployed to remain effective
- Dog use as an AM measure would require that potential canine distemper or other disease introduction risks be addressed
- Falcon deployment
  - Additional avian species may be undesirable and potentially counterproductive
  - Yet if flight paths can be controlled and limited to perimeter areas, falcon deployment could be considered as an appropriate AM response

7. Actively Managed ATVs, Model Aircraft and Other Human Deterrence

- Various human activities can effectively deter birds from specific locations, including:
  - ATVs or visible ground vehicles towards or in avian-use areas
  - Aircraft or helicopters to disperse birds from large areas
  - Radio-controlled model aircraft to deter avian use
  - Triggering noises, pyrotechnics, blank shells, lasers and similar measures in response to observed avian activity
  - Water cannons or mist
  - Regular human activity in high avian risk areas

7. Actively Managed ATVs, Model Aircraft and Other Human *Deterrence: Implementation Considerations*

- Actively managed AM measures capable of enhancing the effectiveness of passive visual or auditory measures
- Human presence also one of the most effective general methods for deterring avian use
- Challenges:
  - All actively managed measures require significant training and staffing commitments, equipment acquisition and maintenance
  - Must be frequently or continuous deployed to effectively restrain bird use
- Certain activities could be potentially hazardous
  - To human operators (e.g., ATV use, aircraft flight, pyrotechnics)
  - To avian species (e.g., running over nests, helicopter blade or model aircraft collisions)
- Water cannons or mist may not effectively deter birds
  - Use of locally limited water resources for deterrence purposes may be infeasible or controversial

8. Long-range Radar and Acoustic or Visual Deterrence Methods

- Integrated radar and long-range acoustic or laser projection systems
  - Technologically sophisticated method for deterring avian activity over larger landscapes
- Commercially available systems
  - Designed to detect avian activity before birds approach a facility's airspace
    - Linked with bio-acoustic speakers and/or laser array
    - Emit high-intensity, focused sound / light beams towards approaching birds
    - Speakers can produce up to 120 decibels over one mile
      - Can be programmed to transmit avian distress calls, alarms, or other recorded or synthesized sounds

8. Long-range Radar and Acoustic or Visual Deterrence Methods *(cont.)*

- Secondary deterrence measures
  - Lights, pop-up effigies and propane cannons
    - Deployed throughout a site
    - Coordinated with the radar system to provide additional deterrence capability
  - Effective over smaller areas and likely deployed near higher-risk

8. Long-range Radar and Acoustic or Visual Deterrence Methods: *Implementation Considerations*

- Integrated long range radar and deterrence system possibly highly effective at preventing birds from entering a facility's airspace
  - Could generate observational records that might support an AM monitoring program
- If performs as designed, would generate a largely automated detection and focused response management approach
  - Deployed throughout a solar facility
    - To deter both low- and higher-flying birds
- Deterrence measures triggered only in response to radar detection
  - Studies of earlier system designs using less sophisticated deterrence methods (cannons, tear gas aerosols and pyrotechnics)
    - Found that such measures avoided habituation and substantially reduced bird use of the protected sites

8. Long-range Radar and Acoustic or Visual Deterrence Methods: *Implementation Considerations*

- Technology relatively new; effectiveness within solar field has not been tested
- Cost of equipment acquisition, long-term deployment of likely to be relatively high
- Deployment of integrated long-range radar and deterrence system
  - Considered a late-stage AM measure
    - Utilized only if relatively substantial impacts are documented (to avoid acquisition and start-up costs)
  - Or leased and implemented from outset to document system effectiveness
    - If confirmed, could reduce long term monitoring and control expenses potentially associated with visual, auditory, actively managed or other more conventional methods

Avian Measures: Conclusions

- Several AM approaches could be utilized to deter birds from using CSP facility structures or entering facility airspace
  - Effectiveness or utility of any specific measure partially dependent on resident avian species, physical attributes of each site
- Promising approaches include:
  - Relatively simple, passive or automated visual and auditory deterrence measures deployed on a rotating, changing basis to reduce avian habituation
  - Onsite vegetation and avian prey control consistent with project environmental approvals
  - Strategic (e.g., high-risk area) perch and nest proofing or netting enclosures

Avian Measures: Conclusions *(cont.)*

- Trained dog harrier deployment, subject to addressing distemper and similar imported canine disease risks
- Active ATV, model or smaller aircraft, or other human activities to deter bird use
- Installation of integrated long-range detection and bio-acoustics, light and secondary deterrence system

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PROFESSIONAL EXPERIENCE

1991-Present	*Chief Operating Office/Senior Biometrician*, Western EcoSystems Technology, Inc., Cheyenne, Wyoming
1990-1991	*Research Assistant,* University of Wyoming, Laramie, Wyoming
1990-1991	*Field Scientist,* University of Alaska, Fairbanks, Alaska
1989	*Research Assistant,* Alumni Office, Winona State University, Winona, Minnesota

EDUCATION

M.S.
University of Wyoming
Laramie, Wyoming
1992
Statistics

B.S.
Winona State University
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1989
Statistics and Mathematics

SCIENTIFIC ORGANIZATION MEMBERSHIPS

Biometrics Society

The Wildlife Society

The National Audubon Society

SPECIALTY AREAS

Mr. Wallace P. Erickson has been a statistician/project manager with WEST since 1991. He has a M.S. in Statistics from the University of Wyoming. He has over 23 years of consulting experience related to the design and analysis of environmental and wildlife studies. His primary research interests include habitat selection methodology with applications to GIS, and study designs and analysis for detecting impacts from environmental perturbations. He has been lead statistician and WEST project manager for baseline studies, environmental permitting, and/or operational monitoring/research at wind energy projects in over 30 states He is an author/co-author on over 40 professional journal articles, book chapters or peer reviewed proceedings papers, and is co-author of the 2nd edition of the book "Resource Selection by Animals". He has presented over 40 papers/posters at national/regional meetings. He has worked on numerous projected funded by the USFS, USFWS, USGS BRD as well as projects funded by industry.

His duties with WEST Inc. involve using current state-of-the-art statistical principles in designing ecological studies and analyzing subsequent data. He has taught workshops on the following topics: 1) Statistics for Spatially Correlated GIS Data, 2) Resource Selection, 3) Computer Intensive Statistics, and 4) Basic Statistics for Biologists and Field Ecologists. He has developed methods and models for assessing wind turbine risk of impacts to Threatened and Endangered and other sensitive species, including marbled murrelets, whooping cranes, golden eagles, prairie grouse, songbirds and other species, and has participated in authoring Biological Assessments for bald eagles and whooping cranes. He has participated in numerous assessment and monitoring projects related to understanding and assessing the effects of wind turbines on birds and bats, and in avian and bat risk reduction studies. He has been involved in studies involving use of radar, and other remote sensing methods for detecting birds and bats at wind facilities, and with methods used to reduce or minimize impacts such as prey reduction, accoustic and visual deterrents and other methods. He has developed Avian and Bat Protection Plans (ABPP), Bird and Bat Conservation Strategies (BBCS) and Eagle Conservation Plans (ECP) for several wind projects. He has reviewed and contributed to the development of BBCS's and monitoring plans for solar facilities.

ADDITIONAL TRAINING AND CERTIFICATION

Generalized Linear Models	Logistic Regression
Sampling Theory	Multivariate Statistics
Experimental Design	Randomization/Permutation Tests
Spatial Statistics	Monte Carlo Methods (e.g., Bootstrap)
Non-Parametric Statistics	Geographic Information Systems
Resource/Habitat Selection	Good Laboratory Practices (GLP)
Wind Project Permitting	

SELECTED PROFESSIONAL PUBLICATIONS

Erickson, W., A. Merrill, M. Sonnenberg and P. Rabie. 2013 in review. A Simple Method for Estimating Bird and Bat Fatality Rates at Wind Energy Facilities and Comparison of Statistical Properties of Other Estimators. PLOS ONE.

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Erickson, W.P. 2013**.** A Simple Method for Estimating Bird and Bat Fatality Rates at Wind Energy Facilities and Comparison of Statistical Properties of Other Estimators. NWCC Wildlife and Wind Energy Research Meeting.

Erickson, W.P. 2011. Faculty presentation on golden eagle impacts from wind power projects. CLE conference, Austin Texas.

Erickson, W.P. 2011. Evaluation of Study Design, Biases, and Limitations of Post-construction Studies Includes plot layout, bias trials. April 2011. Western Bat Working Group Meeting, Las Vegas Nevada.

Erickson, W.P. and M. Sonnenberg 2011. Post-construction Fatality Studies & Estimators of Wildlife Fatality. April 2011. Western Bat Working Group Meeting, Las Vegas Nevada.

Erickson, W.P. 2010. Texas Gulf Coast Avian and Bat Fatality and Curtailment Approaches. National Wind Coordinating Collaborative Research Meeting VII. Lakewood Colorado.

Erickson, W.P. NEPA Environmental Review for Federal Projects. 2009. Invited presentation at the WEATS Workshop at the National Renewable Energy Laboratory, Golden Colorado

Erickson, W.P. Overview of Wind and Wildlife Interactions. 2008. Invited presentation at the 2008 TWS meeting in Miami Florida.

Erickson, W.P. Overview of Wind and Wildlife Interactions. 2008. Invited presentation at the Oregon Wind and Wildlife Symposium, fall 2008.

Erickson, W.P. Updating summaries of avian and bat mortalities from wind energy facilities. Presentation at the NWCC Wind Wildlife Research Meeting VII October 28-29, 2008

Erickson, W.P. Overview presentation of impacts of wind turbines on wildlife and several case study presentations. 2007. Invited presentations at the NWCC Probability of Impacts Workshop, Golden Colorado. Nov 2007.

Erickson, W.P. Objectives, Uncertainties and Biases in Bat Mortality Studies at Wind Facilities. 2007 & 2008. Invited presentation at the Pennsylvania Wind Collaborative. Harrisburg Pennsylvania, and at the Oregon Wind Wildlife Symposium in the Dalles Oregon, fall 2008.

Erickson, W.P. Statistical methods in impact assessment at wind projects. Invited paper at the 2006 "Towards Wildlife Friendly Wind Projects", Toledo, OH. Organized by the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Great Lakes Basin Ecosystem Team, Great Lakes National Program Office, Illinois Natural History Survey, U.S. Geological Survey. June 27-29th, 2006.

Erickson, W.P. Approaches to Assess Impacts at Risk at Wind Power Projects. Invited paper at the 2006 Colorado Wind Power and Wildlife Symposium, Colorado Division of Wildlife. January 2006. Fort Collins Colorado.

Erickson, W.P. Approaches to Assess Impacts at Risk at Wind Power Projects. Invited paper at the 2006 AWEA/Audubon Wind Power and Wildlife Symposium. January 2006. Pasadena California.

Erickson, W.P., Direct Impacts to Birds from Wind Energy Facilties. Invited paper at the 2006 Colorado Wind Power and Wildlife Symposium, Colorado Division of Wildlife.

Erickson, W.P. Wildlife Impact and Risk Assessment Methods for Wind Energy Projects. Presentation at the 2005 American Wind Energy Association. Denver, CO.

Erickson, W.P. Prevention and Mitigation of Avian Impacts at Wind Energy Projects. Invited presentation at the 2005 Grassland Birds Conference, Fort Collins, CO.

Erickson, W.P. Bat Fatalities at Two Eastern Wind Power Projects. Invited Presentation at the 2005 Western Bat Working Group Meeting. Portland OR.

Erickson, W.P. Update on Bird and Bat Impacts at Wind Energy Projects. Presentation at the 2004 TWS Conference, Calgary.

Erickson, W.P. Bat Fatality Monitoring Methods, Fall 2004. Mountaineer and Meyersdale. Invited presentation at the 2004 NWCC Research Meeting, November, Washington D.C.

Erickson, W.P. Preliminary Fatality Results:, Meyersdale Wind Energy Facility Fall 2004. Invited presentation at the 2004 NWCC Research Meeting, November, Washington D.C.

Erickson, W.P. 2004. Direct and Indirect Impacts of Wind Projects on Wildlife. Invited presentation at the Michigan Audubon Societies Annual Meeting. East Lansing Michigan, March 5th and 6th, 2004.

Erickson, W.P. 2004. Update of Bird and Bat Mortality and Collision Risk at Wind Projects, the Latest Data and Science. AWEA 2004 Conference, Chicago, Illinois.

Erickson, W.P. 2004. Perspectives Regarding Avian Mortality, What Are the Messages?Invited Presentation to Environment Canada's National Wind Power and Environmental Assessment (EA) Workshop on May 11-12, 2004. Montoc, New Brunswick.

Erickson, W.P. Update on Bird and Bat Mortality and Risk at wind projects. Paper at the 2003 Biological Significance Workshop, NWCC Wildlife Working Group, Washington, Washington, D.C. November 2003.

Erickson, W.P. Bird mortality at wind projects. Invited paper at the 2002 American Bird Conservancy Policy Council Meeting, Washington, D.C. December 2002.

Erickson, W.P. Bird Mortality at Wind Projects and from Other Anthropogenic Sources. Invited paper at the 2002 Minnesota Ornithological Union Conference, Minneapolis, MN. December 2002.

Erickson, W.P. Avian collisions with wind turbines: a summary of existing data and a comparison to other sources of bird mortality. Contributed paper at the Windpower 2002 Conference, Portland, OR, June 2002.

Erickson, W.P. Summary of anthropogenic causes of avian mortality. Invited paper at the 2002 International Partner's In Flight Meeting, March, 2002. Monterrey, California.

Erickson, W.P. Avian collisions with wind turbines. Invited paper at the International Conference on Utility Structures, March, 2002. Fort Collins, Colorado.

Erickson, W.P. Avian mortality from anthropogenic causes. Invited paper at the Washington State Audubon Meeting, September 2001, Walla Walla, WA.

Erickson, W.P. Statistical methods for estimating wildlife fatality rates. 2001 TWS Meeting, Reno, NV.

Erickson, W.P. Modeling moose habitat. January 2000. Workshop organizer and presenter for state and federal agency personnel in Alaska.

Erickson, W.P. 1999. Statistical issues in resource selection studies. Invited paper presented at the symposium "Modeling Species Occurrences", Snowbird, UT.

Erickson, W.P. 1999. Statistical issues in resource selection studies with radio-marked animals. Invited paper in the radio-telemetry session at the Wildlife Society Meeting, Dallas TX.

Erickson, W.P., October 1999. Use of GIS in monitoring impacts of windplants on wildlife. Invited paper presented at the EPPL7 User's Conference, St. Paul, MN.

Erickson, W.P., and M.D. Strickland. 1997. Assessing Impacts to Birds from the Buffalo Ridge, Minnesota Windplant Development. Invited paper presented at the AWEA Meeting, Austin, TX.

Erickson, W.P., M.D. Strickland, G. Johnson, and J. Kern. 1998. Examples of Risk Assessment Methods for Studying Impacts of Birds from Windplants. Invited paper presented at the NWCC Meeting, San Diego, CA.

Erickson, W.P. and M.D. Strickland. 1997. Assessing impacts to birds from the Buffalo Ridge, Minnesota Windplant Development. Invited paper presented at the AWEA Meeting, Austin, TX.

Erickson, W.P. 1997. Resource selection techniques with GIS data. Invited talk presented at the BLM/DU Satellite Imagery Conference, Anchorage, AK.

Erickson, W.P. 1997. Design and analysis issues when assessing environmental impacts to wildlife populations. Invited talk at Winona State University, Winona MN.

Erickson, W.P. 1997. Statistical considerations in observational field studies: What can you infer? Invited paper at the Northwest Chapter of the Wildlife Society Meeting, Sun River, Oregon.

Erickson, W.P. and T. McDonald. 1996. Resource selection techniques using GIS. Poster presented at the National Wildlife Society Meeting in Cincinnati, OH.

Erickson, W.P. and T. Nick. 1996. Investigating flight response of brant on the Izembek NWR, Alaska, using logistic regression techniques. Poster presented at the ASA meeting in Chicago.

Erickson, W.P., November 1995. Habitat selection by moose on the Innoko National Wildlife Refuge in West-Central Alaska. Invited paper presented at the EPPL7 User's Conference, St. Paul, MN.

Erickson, W.P., M.D. Strickland and L. Sharp. September 1995. Experimental design for the study of wind power effects on wildlife. Poster presented at the National Wildlife Society Meeting in Portland, Oregon.

Erickson, W.P. and L.L. McDonald. July 1995. Practical aspects of adaptive sampling. Invited paper presented at the Western North American Region of the Biometrics Society, Stanford, CA.

McDonald, L.L. and **W.P. Erickson**. November 1994. A shift in paradigm for statistical analysis in risk assessment. Paper presented at the Society of Environmental Toxicology and Chemistry, Denver, CO.

Erickson, W. P. November 1994. An approximate solution to the Behran-Fisher's problem with application to NRDA and toxicity testing. Paper presented at the Society of Environmental Toxicology and Chemistry, Denver, CO.

Erickson, W. P. and L. L. McDonald. November 1992. Formulations of hypotheses of assumed effect in bioassay. Paper presented at the Society of Environmental Toxicology and Chemistry, Cincinnati, OH.

Clay Jensen, P.E., M.B.A, LEED AP

Education

Bachelor of Science, Civil Engineering, May 1996
University of Nevada, Las Vegas

Master's Business Administration, December 2001
University of Nevada, Las Vegas

Employment

June 2009 - Present
BrightSource Energy, Las Vegas, Nevada
Senior Director of Project Development
Responsible for identifying and advancing opportunities for a portfolio of solar projects in Nevada and California. Manage BrightSources interests in all Development Activities, from origination to EPC hand off, associated with the 3200acre 500MW Hidden Hills SEGS and the 3700 acre 500MW Palen SEGS projects. Manage responsibilities include permitting, project finance, engineering, accounting and EPC negotiations. Serve on key advisory committees to the Nevada Legislature and Congressman Horsford Energy committee. Opened Brightsource's Las Vegas Office and manage day to day business activities. http://www.brightsourceenergy.com/hidden-hills http://www.brightsourceenergy.com/palen.

January 2007 - June 2009
Wingfield Nevada Group, Las Vegas, Nevada
Executive Vice President of Development & Construction
Responsibilities included design, entitlements, market analysis and construction of the 42,000 acre Coyote Springs Masterplan. This Masterplan includes 14,000 acres land dedicated to renewable energy development. Worked with BrightSource energy to secure land lease terms, conduct feasibility efforts and identify key infrastructure services. Established strong relationships with key government officials, local contractors and key stakeholders which help support the development process for multiple commercial facilities, multi-family product designs, utility projects and major civil infrastructure. For full information please visit http://www.coyotesprings.com.

December 2004 - January 2007
Landtek, LLC (Focus Property Group Affiliate), Las Vegas, Nevada *Project Manger*
Responsibilities included overseeing a team of professionals through entitlement, engineering design, and commencement of construction for the Inspirada Master Plan in Henderson, Nevada.

Responsible for the creation and maintenance of the six year project schedule, $387 million infrastructure budget, and resulting project cash flow. Provided direction to numerous consultants and created processes and procedures to communicate information to owners/builders. The Inspirada Master Plan is a 1900+ acre New Urbanism Mixed Use Community which will eventually include a 300 Commercial Town Center, 15,000 residential units, full scale programmable parks and multiple recreation facilities. For full information please visit http://www.inspirada.com.

April 1997-
December 2004

City of Henderson, Public Works, Nevada
Project Engineer 1I
Managed the design and construction of numerous major infrastructure projects including water, sewer, power, storm drain, open channels, roadways and bridges. Established aggressive schedules and budgets to keep up with a rapidly growing population during a time of low municipal resources. Examine civil improvement plans for compliance to water, sewer and off-site construction standards. Review and coordinate master-planned communities major infrastructure improvements including water and sewer transmission mains, reservoirs and pumping stations. Serve as Public Works representative at the City of Henderson Planning Commission.

April 1996-
April 1997

Hunsaker and Associates, Las Vegas, Nevada
Project Supervisor
Supervised the design and construction of multiple projects under the supervision of three registered Professional Engineers. Managed a team of four individuals in the design of commercial, multi-family and single-family projects throughout the Las Vegas valley. Design included grading, utility design, plan and profiles sheets and horizontal control.

August 1994-
April 1996

City of Henderson, Public Works, Nevada
Contracted Plans Checker
Examined improvement plans for compliance to water, sewer and off-site construction standards. Reviewed improvement plans to ensure compliance with approved tentative maps for street R.O.W. and utility easements. Computed fees for building permits for commercial, multi-family and single-family developments.

April 1994-
August 1994

WMK (CRS) Materials, Las Vegas, Nevada
Soils Analyst
Engineering materials testing including concrete cylinders, gradation analysis, water content and compaction testing. Primary

responsibility included validating quality of concrete being used in various major structures in the Las Vegas area.

Professional Affiliation

- Urban Land Institute (ULI)
- Large Scale Solar Association (LSA)
- Greater Las Vegas Association of Realtors (GLVAR)
- Southern Nevada Home Builders Association (SNHBA)
- American Society of Civil Engineers (ASCE)
- American Public Works Association (APWA)

Registration

E.I.T., April 1995 (No.2911 Nevada)
Nevada Professional Engineer, No 14316
LEED Accredited Professional
Nevada Real Estate License, 54804
References available upon request

Michael Kuehn, Ph.D. | Statistical Analyst

Qualifications

Dr. Kuehn is an avian ecologist with experience conducting field research throughout the Americas from Ecuador to Alaska. He also has a solid working knowledge of the other terrestrial vertebrate groups (amphibians, reptiles, and mammals), and has taught courses about their ecology and identification at UC-Santa Barbara. He is familiar with the fauna and flora of coastal California and the Mojave/Sonoran Desert regions. He has studied nesting birds for 15 years, principally in California, Nevada, Arizona, Montana, Idaho and Alaska, but also in Ecuador. Dr. Kuehn has been responsible for a wide variety of biological, ecological, and conservation studies ranging from local biological assessments to studies aimed at understanding specific stressors on regional avian communities. He has designed avian field studies and supervised field crews during the implementation of these studies. Dr. Kuehn served on a Technical Advisory Committee for a Walton Family Foundation funded initiative to restore habitat for Southwestern Willow Flycatchers in the Colorado Basin in the wake of Tamarisk biocontrol beetle introduction during 2011 and 2012.

Professional Experience

As a biologist at Bloom Biological, Dr. Kuehn has worked for two years as an avian specialist, conducting nest searching and monitoring for the Sunrise Powerlink Project in San Diego and Imperial counties in California. He has also assisted in creating burrows and conducting surveys for Burrowing Owls. Recently, he has developed survey protocols for a variety of wind and solar projects and conducted complex statistical analyses to review ecological issues for a number of BBI's projects,

Dr. Kuehn also has the following experience:

As a research assistant at the Western Foundation of Vertebrate Zoology, conducted surveys for Loggerhead Shrikes on Santa Cruz Island and for all bird species along the Santa Clara River (Ventura County).

As a research associate at the University of California, Santa Barbara, designed and directed a two-year study investigating the effects of a tamarisk biocontrol agent on avian communities using riparian habitat in southern Nevada.

Conducted independent research on reproductive strategies of birds breeding at high latitudes in central Alaska.

As a graduate student at UC Santa Barbara, conducted seven years of field research in Alaska, Idaho and Montana to investigate the behavioral defenses of hosts against Brown-headed Cowbird parasitism.

Participated for four years in a long-term ecological investigation of landscape effects on nesting success of riparian birds in Western Montana

Participated in a study of nesting birds in the cloud-forests of central and southern Ecuador.

Education

Ph.D., University of California, Department of Ecology, Evolution and Marine Biology, Santa Barbara

B.S., Fisheries and Wildlife Management, Lake Superior State University, Sault Ste. Marie, Michigan

Awards

Worster Award for Graduate/Undergraduate Collaborative Research, Department Ecology, Evolution and Marine Biology, University of California, Santa Barbara ($6000). 2007

Frank M. Chapman Memorial Grant, American Museum of Natural History ($2500). 2007
Student Research Award, Animal Behavior Society ($1000). 2007

Exploration Fund Award, Explorer's Club ($1200). 2007

Paul A. Stewart Research Award, Wilson Ornithological Society ($500). 2007

Ralph Schreiber Ornithology Research Award, Los Angeles Audubon Society ($2500). 2006

Student Research Award, American Ornithologist's Union ($1800). 2003

Permits & Certifications

USFWS Sci. Collector's Permit (MB085567-0)

USGS Bird Banding Subpermitee (22905-F)

Selected Publications

Peer, B. D., M. J. Kuehn, S. I. Rothstein and R. C. Fleischer. 2011. Persistence of host defence behavior in the absence of avian brood parasitism. Biology Letters. 7(5): 670-673.

Peer, B. D., C. E. McIntosh, M. J. Kuehn, S. I. Rothstein and R.C. Fleischer. 2011. Complex biogeographic history of lanius spp. shrikes and its implications for the evolution of defenses against avian brood parasitism. Condor. 113(2): 385-394.

Bateman, H.L., T.L. Dudley, D.W. Bean, S.M. Ostoja, K.R. Hultine, and M.J.Kuehn. 2010. A river system to watch: documenting the effects of saltcedar (Tamarix spp.) biocontrol in the Virgin River Valley. Ecological Restoration. 28:405-410.

Rivers, J. W., and M. J. Kuehn. Predation of eared grebe by great blue heron. 2007. Wilson Journal of Ornithology. 118(1): 112-113.

Peer, B. D., S. I. Rothstein, M. J. Kuehn and R. C. Fleischer. 2005. Host defenses against cowbird Molothrus spp. parasitism: implications for cowbird management. Pp. 84-97 in C. P. Ortega, J. F. Chace and B. D. Peer eds., Management of cowbirds and their hosts: balancing science, ethics and mandates. Ornithological Monographs. No. 57.

Tewksbury, J. J., T. E. Martin, S. J. Hejl, M. J. Kuehn and W. J. Jenkins. 2002. Parental care of a cowbird host: caught between the costs of egg-removal and nest predation. Proc. R. Soc. Lond. B. 269: 423-429.

Dobbs, R.C., P.R. Martin, and M. J. Kuehn. 2001. On the nest, eggs, nestlings, and parental care in the Scaled Antpitta (Grallaria guatimalensis). Ornithologia Neotropical 2:225-233