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STATE OF CALIFORNIA

Energy Resources Conservation and Development Commission

In the Matter of: APPLICATION FOR CERTIFICATION FOR THE PALEN SOLAR ENERGY GENERATING SYSTEM	DOCKET NO. 09-AFC-7C

INTERVENOR CENTER FOR BIOLOGICAL DIVERSITY

Exhibit 3128

Testimony of K. Shawn Smallwood, Ph.D.

Summary of Testimony

The Palen Solar Electric Generating System ("Palen") would destroy 4,024 acres of wildlife habitat and would put in its place thousands of heliostat mirrors and two power towers that will kill flying birds. I reviewed the Revised Staff Assessment (RSA), Final Staff Assessment (FSA), and related documents to assess project impacts, mostly as they are caused by collisions and thermal injuries to birds. I determined that, given the fatality rates reported for Solar One and given the numbers of fatalities being found at Ivanpah, the fatality rates that would be caused at Palen could far exceed the fatality rates in the Altamont Pass Wind Resource Area, even though the 500 MW of installed capacity at Palen would be smaller than the 580 MW capacity of wind turbines in the Altamont Pass. The numbers of fatalities coming from Ivanpah reports suggest that avian fatality rates could exceed 20,000 per year. Curtailment and avian deterrent strategies have been proposed as mitigation measures as part of adaptive management at Palen, but these strategies have no record of success and probably would not yield measureable reductions in fatalities. The avian deterrent strategies might increase bird fatalities by scaring birds into heliostat mirrors. I also recommended monitoring methods and mitigation measures to minimize project impacts from Palen, if approved and constructed, and to learn from the impacts so that mistakes are not repeated.

Qualifications

My qualifications for preparing expert comments are the following. I earned a Ph.D. degree in Ecology from the University of California at Davis in 1990, where I subsequently worked for four years as a post-graduate researcher in the Department of Agronomy and Range Sciences. My research has been on animal density and distribution, habitat selection, habitat restoration, interactions between wildlife and human infrastructure and activities, conservation of rare and endangered species, and on the ecology of invading species. I have authored numerous papers

on special-status species issues, including "Using the best scientific data for endangered species conservation," published in Environmental Management (Smallwood et al. 1999), and "Suggested standards for science applied to conservation issues" published in the Transactions of the Western Section of The Wildlife Society (Smallwood et al. 2001). I served as Chair of the Conservation Affairs Committee for The Wildlife Society – Western Section. I am a member of The Wildlife Society and the Raptor Research Foundation, and I've been a part-time lecturer at California State University, Sacramento. I was also Associate Editor of wildlife biology's premier scientific journal, The Journal of Wildlife Management, as well as of Biological Conservation, and I was on the Editorial Board of Environmental Management.

I have performed avian surveys in California for twenty-four years (Smallwood et al. 1996, Smallwood and Nakamoto 2009). Over these years, I studied the impacts of human activities and human infrastructure on birds and other animals, including on Swainson's hawks, burrowing owls, and other species. I studied fossorial animals (i.e., animals that burrow into soil, where they live much of their lives), including pocket gophers, ground squirrels, kangaroo rats, voles, harvester ants, and many other functionally similar groups. I performed focused studies of how wildlife interact with agricultural fields and associated cultural practices, especially with alfalfa production. I have also performed wildlife surveys at many proposed project sites, including at a proposed large solar thermal project in the Mojave Desert. Finally, I have performed research and monitoring on renewable energy projects for fifteen years, and I have authored many peer-reviewed report, papers, and book chapters on fatality monitoring, fatality rate estimation, mitigation, and other issues related to biological impacts of renewable energy generation. I have also reviewed many reports, served for five years on the Alameda County Scientific Review Committee that was charged with overseeing the fatality monitoring and mitigation measures in the Altamont Pass Wind Resource Area, and prepared many comment letters on proposed renewable energy projects. I also collaborate with colleagues worldwide on the underlying science and policy issues.

My CV is attached.

IMPACT ASSESSMENT

Alternatives

I concur with CEC Staff that the Reduced Acreage Alternative would have the lowest level of direct, indirect, and cumulative impacts compared to the Proposed Project or to the other "build" alternatives; however, impacts to avian species could be substantially avoided under a distributed solar alternative which was not fully addressed in the RSA or FSA. The Reduced Acreage Alternative would be even more effective at minimizing project impacts if it was carefully sited to avoid areas most often used by flying birds that exhibit behaviors likely to result in collisions with heliostat mirrors or the zone of solar flux.

Special-status species

I disagree with CEC Staff that Impact Avoidance and Best-Management Practices (BIO-8), Pre-construction Nest Surveys (BIO-15), and the Avian Protection Plan (BIO-16) will "avoid"

impacts to migratory birds. These strategies would do no better than to minimize impacts. To avoid the impacts, the project would not go forward. It would be impossible for the proposed project or any of the alternatives evaluated in the RSA or FSA to be constructed in a manner to avoid impacts to birds.

I also disagree that BIO-17 would avoid project impacts to kit fox and American badger. Again, mitigation might minimize impacts, but avoiding impacts to these species would be impossible if the project goes forward. American badgers will likely be crushed by construction operations, and both the badger and kit fox would lose 4,024 acres of habitat.

Under "Summary of Impacts" beginning on page C.2-68 of the RSA, CEC Staff used percentages of habitat loss within the NECO planning area. These percentages can be misleading because they treat all acres as equivalent within the NECO planning area. Each species will uniquely use the landscape, targeting certain parts of it. For example, CEC Staff concluded that Palen would reduce burrowing owl habitat within the NECO planning area by 0.9%, but the basis of that percentage was 339,704 acres of planning area. In my experience, only a fraction of any region is usable by burrowing owls or any other species. For example, in hilly environments, the majority of burrowing owl nests are located at the zone of transition between valley bottom and slopes (Smallwood et al. 2009b). If 10% of the burrowing owl population happened to rely on the footprint of the Palen project, then the impact would be more than 10 times greater than claimed by CEC Staff.

Collision risk

According to the RSA (page C.2-118), "*Staff has concluded that the risk of such impacts* [collisions and heat injuries caused by Solar One] *is probably low, although very little research has been conducted on the risks of bird collisions at solar facilities*." It is true that it remains unknown to what degree fatality rates might differ from those measured at Solar One (McCrary et al. 1986), which was the first concentrating thermal power plant in California and the only such plant for which the results of scientific monitoring have been published. Fatality monitoring methods have improved since McCrary et al. (1986), and only one year of monitoring was performed at Solar One, which was also only 10 MW in size. Nevertheless, in the face of high uncertainty when assessing impacts to rare environmental resources, the accepted standard is to err on the side of caution (National Research Council 1986, Shrader-Frechette and McCoy 1992, O'Brien 2000). CEC Staff's conclusion would err on the wrong side of caution.

McCrary et al. (1986) remains the only published study of direct impacts to birds caused by a solar power plant (Solar One). McCrary et al. (1986) searched for dead birds amongst the heliostat mirrors and around the power tower, and they estimated a bird fatality rate caused by bird collisions with heliostat mirrors and the power tower, and by heat encountered when birds flew through the concentrated sunlight reflected toward the power tower. However, McCrary et al. (1986) appeared to have under-appreciated the magnitude of the impacts caused by Solar One, likely because McCrary et al. (1986) did not know as much as scientists know today about scavenger removal rates and searcher detection error.

McCrary et al. (1986) searched for dead birds during 40 visits to the 10 MW Solar One Project. Their search pattern was not fixed, so it was not as rigorous as modern searches at wind energy projects and other energy generation and transmission facilities. McCrary et al. (1986) placed 19 bird carcasses to estimate the proportion remaining over the average time span between their visits to the project site, though they provided few details about their scavenger removal trial. We know today that the results of removal trials can vary substantially for many reasons, including the species used, time since death, and the number of carcasses placed in one place at one time, and etc. (Smallwood 2007). McCrary et al. (1986) also performed no searcher detection trials, because they concluded that the ground was sufficiently exposed that all available bird carcasses would have been found. This conclusion would not be accepted today, based on modern fatality search protocols.

Because, scientists have performed many more scavenger removal trials and searcher detection trials, as well as many more bird carcass searches since the study of McCrary et al. (1986), I re-calculated the fatality rate estimate from that first study, but this time using national averages to represent scavenger removal rates and searcher detection rates (see Smallwood 2007, 2013). Based on the methods in Smallwood (2007), I have since reviewed more than 400 searcher detection trials and more than 400 scavenger removal trials across North America (Smallwood 2013). From these reviews, I estimated the average proportion of carcasses remaining after 9 days since the last carcass search. I used 9 days for the average search interval, because that was the average search interval in the McCrary et al. (1986) study.

The estimator I used was derived from Horvitz and Thompson (1952):

$$F_A = \frac{F_U}{R_C \times p},$$

where F_U was the unadjusted number of fatalities/MW/year (the found carcasses), and F_A was the fatality rate adjusted for the proportion of carcasses found amongst those that were available to be found, p, and by the average proportion of carcasses remaining since the last fatality search, R_C. The adjustments for p and R_C were estimated from searcher detection trials and scavenger removal trials. I assumed carcasses were deposited at a steady rate from heliostat mirrors and power towers, so I took the average proportion of carcasses remaining each sequential day between searches:

$$R_C = \frac{\sum_{i=1}^{I} R_i}{I},$$

where R_i was proportion of carcasses remaining by the ith day following the initiation of a scavenger removal trial. Thus, the expected proportion of carcasses remaining by the next fatality search should be R_C corresponding with the fatality search interval, I, which was 9 days in the McCrary et al. (1986) study. Note that McCrary et al. (1986) used R_i instead of R_C, which means their fatality rate estimate would have been inflated for this factor alone (their estimate was biased low, however, by assuming they experienced no searcher detection error).

McCrary et al. (1986) reported the mean and standard deviation (SD) of bird carcasses found per visit, but estimating rates for the purpose of extrapolation should include a standard error (SE), which can be approximated as:

$$SE = \frac{SD}{\sqrt{n}},$$

and which, in the case of McCrary et al. (1986), with a SD = 1.8 and n = 40 visits, was 0.28 (the calculated mean was 1.75).

Using SE also facilitates carrying of the error terms through the calculation of the fatality rate estimate. For this purpose, I estimated standard error of the adjusted fatality rate, $SE[F_A]$, using the delta method (Goodman 1960):

$$SE[F_A] = \sqrt{\left(\frac{1}{p \times R_C} \times SE[F_U]\right)^2 + \left(\frac{F_U}{p} \times \frac{-1}{R_C{}^2} \times SE[R_C]\right)^2 + \left(\frac{F_U}{R_C} \times \frac{-1}{p^2} \times SE[p]\right)^2}.$$

Using data reported by McCrary et al. (1986), and adopting their assumptions, their estimated fatality rate was 1.75 fatalities/visit divided by 70% to 90% of placed trial carcasses remaining between visits, or 1.75 ÷ 0.90 = 1.94 and 1.75 ÷ 0.70 = 2.5. Assuming a point estimate of 80% of placed carcasses remaining, then the estimated bird carcasses per visit would be 1.75 ÷ 0.80 = 2.19. Given that there were 40 visits in the year, then 2.19 × 40 = 87.6 bird fatalities per year, or on a per-MW basis, there were 87.6 fatalities/10 MW = 8.76 bird fatalities per MW per year. Because McCrary et al. (1986) did not report the SE of their proportion of placed trials carcasses remaining, and because they assumed $p = 1$, I could not carry the error terms, so the estimate from their study was 8.76 bird fatalities/MW/year with an 80% confidence interval (CI) of 6.96 to 10.55. The only real challenge remaining is to extrapolate this estimate to the 500 MW Palen Solar Project.

I predict that if the entire project was searched periodically for fatalities at a 9-day interval, then 4,375 bird fatalities would be found per year (80% CI: 3,480 to 5,275). However, these rates need to be adjusted for the proportion of fatalities not found by searchers. The results of my adjustment trials yielded national averages of $R_C = 0.48$ (SE = 0.12) for birds over a mean search interval of 9 days and $p = 0.676$ (SE = 0.029) when ground visibility was characterized as high or very high. Using these values, my estimated fatality rate at McCrary et al.'s project site was 21.57 fatalities/MW/year (80% CI: 7.15 to 36.00). Relying on these adjustments and extending them to the 500 MW size of Palen, then I predict that Palen will kill 10,787 birds per year (80% CI: 3,573 to 18,000). These fatality rates would equal or exceed the fatalities estimated at the Altamont Pass Wind Resource Area, which has become infamous worldwide as the most dangerous wind project in the world.

Are these fatality rates supportable? They come directly from the rates reported from the only published results of scientific monitoring at a solar thermal project. This project – Solar One – was not too distant from Palen, so should be relatively similar in bird species composition. The technology was very similar, consisting of a power tower receiving reflected light from heliostat

mirrors. Another solar thermal project with power towers was the Ivanpah Solar Electric Generating Station. I had predicted fatality rates there, too, using the same calculations I detailed herein, but applied to the planned 370 MW capacity of Ivanpah. I had predicted 7,981 bird fatalities/year (80% CI: 2,646 to 13,320). Fatality monitoring data coming out of the Ivanpah project, now that it has been built, have been difficult for me to interpret because I have been unable to determine for certain how the monitoring was performed, but the large numbers of birds found per month indicate that fatality rates have been very high.

Document TN 200642_20130930TO090221 included 70 avian fatalities found at Ivanpah. Seventy fatalities was the same number found at Solar One after a year of monitoring, but the Ivanpah fatalities were mostly incidental and did not appear to have come from a scientific monitoring program. The implication of so many incidental fatality records was that fatality rates were very high.

Scientific monitoring appears to have been completed in April and May 2014 (TN202368 _20140522T141156_ISEGS_Monthly_Compliance_Report_43_April_2014 and TN202461_ 20140616T145736_ISEGS_Monthly_Compliance _Report_No_44__May_2014). The April searches turned up 101 fatalities and the May searches discovered another 82 fatalities. If the searches were performed according to document TB201315, which summarized a monitoring plan for Ivanpah, then weekly searches were performed at 20% of the heliostat mirrors at Ivanpah during April and May 2014. Given the size range of the birds found, including many hummingbirds, swallows and warblers, I would predict that the overall adjustment rate for searcher detection and carcass persistence would be no greater than 20%. That means the number of fatalities found would be divided by 0.2 to arrive at an adjusted estimate of 473 fatalities per month within the search areas. This number then would be divided by 0.2 (corresponding with 20% of the project being searched) to extrapolate the fatality estimate to the rest of Ivanpah, yielding 2,365 birds per month during April and May 2014. If this rate persisted yearlong, then Ivanpah might be killing 28,380 birds, which would be 3.6 times greater than the fatality rate I predicted.

The calculations I just made of fatality rates at Ivanpah were back-of-the-napkin-level, and were based on assumptions that I cannot at this time verify as correct. If I was even close to correct, however, then I suggest that the CEC take a harder look at the potential impacts of Palen. If Ivanpah is killing as many birds as my quick calculations and my unverified assumptions suggest, then solar thermal in California's deserts will cause far greater impacts to wildlife than did the notorious Altamont Pass Wind Resource Area.

The two four-acre evaporative ponds would likely increase the fatality rates at Palen. These ponds might attract birds, which would then come into proximity of the heliostat mirrors and the zone of solar flux.

Clearly, the McCrary et al. (1986) fatality monitoring study resulted in a highly uncertain fatality rate estimate, which was revealed to be even more uncertain when considering national averages of the adjustment factors and when carrying the error terms through the calculations. The direct impact of Palen can be said to be highly uncertain at this point. It would be helpful to perform avian behavior surveys in advance of any approval, in order to characterize avian flight paths and

the types of behaviors of endemic species that could contribute to collision risk (Smallwood et al. 2009, 2010). If the project goes forward, it would be very important to require sound fatality monitoring. In designing pre- and post-construction monitoring, it should also be kept in mind that 70% of the bird fatalities at Solar One were caused by collisions with the heliostat mirrors and 30% were killed by solar flux between the mirrors and the power tower.

Wildlife Movement

CEC Staff focused on wildlife use of desert washes and ephemeral drainages as the sole portions of the landscape where wildlife move. In my experience, and I have a lot of experience recording the travel paths of wildlife, there has been little solid evidence that wildlife use linear features of the landscape, such as washes and drainages, any more than they use upland areas. Wildlife movements are not restricted to washes and drainages; if they were so constrained, then their movements would be too predictable and predators and competitors would too easily exploit these movement constraints.

The Palen project will disrupt the movement of non-volant wildlife in the region. The site will be fenced and the interior will lack a full complement of natural cover. The obvious conclusion should be that the project will disrupt movement of a large number of species.

Cumulative Effects

I agree with CEC Staff conclusions in the RSA regarding cumulative effects. I will add that the impacts of the Ivanpah Solar Electric Generating System include annually thousands of birds killed by heliostat mirrors and solar flux, just as will occur at Palen. My predicted impacts for both of these combined projects would be 18,768 bird fatalities per year (80% CI: 6,219 to 31,320). If the monitoring data at Ivanpah continue to support my calculations (see above), then the combined projects would cause >50,000 bird fatalities per year.

MITIGATION MEASURES

Designated Biological Monitor

The impacts caused by Palen if permitted and constructed will be larger and more complex than can be reasonably expected to be handled by a designated biological monitor and CEC compliance monitor. A Technical Advisory Committee (TAC) should be established, and the TAC members should be composed of experts on scientific monitoring and mitigation. The TAC should not be composed of members of regulatory agencies, unless those individuals are expert in scientific monitoring and have demonstrated records of success in testing the efficacy of mitigation plans. The TAC meetings, documents, and activities should be fully transparent to the public including being publicly noticed and accessible and provide an opportunity for public input.

Pre-construction Surveys to Predict and Mitigate Impacts

Other than one utilization survey effort in Fall 2014, I did not see any description of pre-construction bird and bat surveys to predict collision rates with heliostat mirrors in the RSA or FSA, to guide the siting of the facilities to minimize collision risks, or to serve as a baseline against which to measure displacement or attraction impacts after construction. The one bird count survey in Fall 2013 (TN 202002; Levenstein et al. (2014)) covered only a single season of one year – Fall 2013. According to Levenstein et al. (2014), "*The principal objectives of the fall studies were to: 1) provide site-specific fall bird resource and use data that would be useful in evaluating potential impacts from the proposed concentrated solar energy facility; 2) provide information that could be used in project planning and design of the facility to minimize impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted*." Levenstein et al. (2014) reported species richness, mean use (birds/hour) and each species' percent composition of the 185 bird species detected. However, Levenstein et al. made no attempt to account for the influence of bird size or distance from the observer when comparing detection rates or percent composition, so the reported results cannot be interpreted accurately. Whereas turkey vultures can be seen all the way out to the 1,000 meter maximum survey radius, tree swallows would not have been identified to species beyond about 100 meters from the observer. Given these profound biases, comparisons of mean use or percent composition were meaningless.

Levenstein et al. (2014) showed more promise when comparing birds per hour by time of day and by height above ground, because information about these variables could inform a curtailment strategy. Unfortunately, the observations were lumped by multiple species per group, such as "raptors," Buteos," and "Accipiters." Each species is unique, with unique natural histories and activity patterns. Lumping species into larger taxonomic groups will cloud understanding of how birds are actually using the airspace over the proposed project. I saw no value in the results presented on time of day or flight height, because they cannot help me decide whether or how curtailment or any other mitigation strategy should be implemented.

Levenstein et al. (2014) provided a seasonal analysis, which seemed absurd because the surveys only covered one season. Nothing could be said of bird activity over winter, spring, or summer.

A crude spatial analysis was attempted, but only mean use rates were compared. To be meaningful, mean use rates would need to be accompanied by estimates of variation, such as standard error or confidence ranges. When Levenstein et al. (2014) reported that mean use was greater at one or two of the observation stations, I have no way of knowing whether the report was true because the reporting lacked confidence ranges.

More important than the shortfalls in reporting the data, Levenstein et al. (2014) failed to achieve any of their stated objectives. They made no fatality predictions (obj. 1). They made no recommendations on project planning or design to minimize bird fatalities (obj. 2). They offered no recommendations on mitigation measures or on further studies (obj. 3). Levenstein et al. (2014) did not report what they initially promised. Furthermore, I have seen no evidence in any of the applicant or CEC staff documents that demonstrate that the plan for the Palen project was

changed one little bit as a result of the Fall 2014 utilization surveys. I could see no real value in the surveys that were performed.

The following is what I propose should be done to establish a proper baseline for predicting and measuring project impacts on volant wildlife.

A full year of behavior surveys prior to project development and approval should provide sufficient information to predict impacts (Smallwood et al. 2009a) and to serve as a baseline for estimating post-construction impacts such as displacement. Behaviors related to foraging, predator avoidance, social organization and mate acquisition are relatively stable, and are expressed consistently, so one year of surveys should suffice. The surveys need to be performed by behavioral ecologists familiar with the collision issues. Not only should the flight behaviors of birds be recorded, but their flight paths should be related to a digital elevation model of the project area and vegetation cover so that terrain and vegetation can be used to predict flight paths. It is important to predict the major flight paths of species of concern so that the project can be laid out to minimize collision hazard (Smallwood et al. 2009b).

In my experience, behavior surveys are most efficient when they last one hour. Any longer, and the observers grow disinterested and lose focus. Any less, and the efficiency of the surveys is compromised by the logistical demands of closing down surveys, relocating, and starting new surveys. A key point to behavior surveys is that they are not counts of abundance, but rather are supposed to be high-quality recording of flight behaviors. Therefore, quality tracking of individual birds or groups of birds is more important than tracking all of the birds available at any given time.

In the surveys I do, behavior attributes are recorded on point features for use in geographic information system (GIS), but the point features are recorded every few seconds rather than every minute as typical of the use surveys. The point features of course result in line features representing flight paths. It is the flight paths that we can intersect with interesting features of the landscape, proposed or existing solar arrays, fences, or gen-ties. Those point features closest to the intersections of the line features can inform of the height above ground and specific behaviors being performed by the bird. Our capacity for predictive modeling is therefore much greater.

Each survey session begins with wind and temperature measurements, so that I can later relate behavior rates to weather conditions. I record the station number, date, and start time on a handheld map and on two worksheets in an electronic spreadsheet format. These three variables are key variables that enable merging of the data in all three formats when it is time for analysis. As key variables, it is critical that special care be given to recording them consistently and without error. One sheet is for session attributes, such as observer's initials, temperature, wind direction, average and maximum wind speeds, and percentage cloud cover. These attributes are recorded at the start and end of each session, and the values averaged for session representation in analysis. The other sheet is for bird observations during the session, which the observers record into voice recorders during the survey. The first bird I see is assigned letter A, and the first recorded observation of bird A is assigned 1, and the second observation is 2, and so on (Figure 1). These observations are recorded on a field map as A1 and A2, and they are also

recorded in a spreadsheet with the same designations. Along with each record, I also record species, height above ground, behavior, number in group, and specific details about near or actual collisions with project infrastructure. The alphanumeric values assigned to birds also serve as key variables enabling the merging of data from field maps and the observation worksheet. All voice recordings must be transcribed to spreadsheets within 24 hours of survey.

Mapped behavior data should be digitized for use in GIS, preferably with the help of a GIS analyst. A simple form of analysis consists of overlaying flight paths of individual species under a range of conditions, such as wind speeds and wind directions, or time of day. Flight patterns should be evident, and potential impacts inferred from the flight paths. A more rigorous analysis would involve constructing predictive models based on associations between flight locations and mapped slope and vegetation measurements. Candidate modeling approaches could be Discriminant Function Analysis or Fuzzy Logic (Smallwood et al. 2009b).

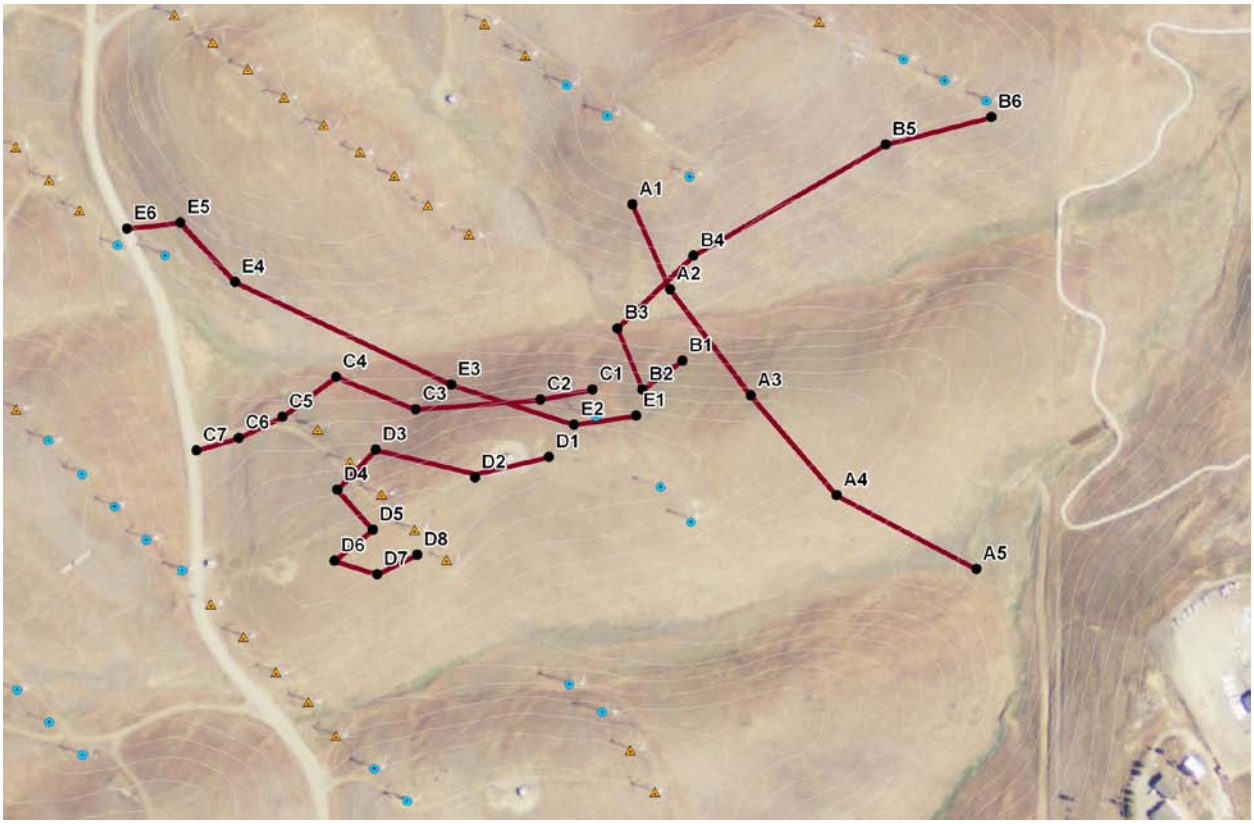

Figure 1. *Example bird flight paths and connecting point features where behavior attributes were recorded. These data were from one of my project sites in the Altamont Pass. The triangles and circles were 40-KW wind turbines*.

To quantify displacement and attraction impacts caused by the project if approved and constructed, the behavior surveys should be continued for a year after construction. A BACI design would help control for variation in behavior rates due to the change in years, although only one impact site will be possible in the design. The BACI design's power would be diminished by the existence of only one real plot representing the impact portion of the design, but it will still yield useful results.

Nocturnal Surveys

I have been using a FLIR T620 thermal imaging camera with an 84 mm lens for about 18 months. I can identify many of the targets to species or at least to larger taxonomic groups, including at distances out to 1,000 m. During hundreds of hours of surveys I have seen many bats flying within my study plots and interacting with the wind turbines in my plots, and I have watched the flights of hundreds of burrowing owls, great-horned owls, and barn owls. I also have observed common poorwills and species usually active during the day, such as cormorants, ducks, and songbirds. I also record mammalian species visiting the wind turbines to forage on birds and bats killed by the wind turbines or placed by my research team for detection trials. I can see where the striped skunks, coyotes, foxes, badgers, raccoons, house cats, and bobcats are going, which can help me tailor the detection trial to more accurately estimate the proportion of fatalities not found during searches (see below).

The FLIR T620 camera and 84 mm lens cost about $31,000 in 2011. Lesser equipment will not be nearly as effective as this camera and lens. The results, however, justify the cost. A tripod is also needed.

I record observations onto handheld map images of the study area. When I record data to the map, I use a red light to minimize my visibility to wildlife. I record attribute data into a voice recorder, which I transcribe to an electronic spreadsheet the next morning. The FLIR T620 also records still photos and video, and I often record my observations in both photo and video formats. The recordings often help me interpret what I saw during the surveys.

The thermal imaging equipment I use enables me to identify most animals to species, but also to observe their behaviors. Observing behaviors is much more useful than obtaining a flight trajectory from radar. I can see how birds and bats react to the renewable energy infrastructure, which is invaluable.

Similar to the diurnal behavior surveys, to quantify displacement and attraction impacts caused by the project, nocturnal surveys should be undertaken before any approval and construction and also continued for a year after construction. A BACI design would help control for variation in nocturnal behavior rates due to the change in years, although only one impact site will be possible in the design. The BACI design's power would be diminished by the existence of only one real plot representing the impact portion of the design, but it will still yield useful results.

Post-construction Fatality Monitoring

Very little is known of the types or magnitudes of impacts on wildlife caused by industrial solar projects. Qualified biologists should be funded to search the ground between arrays of heliostat mirrors on a weekly basis (every two weeks at the longest) for at least three years to determine the magnitude of collision fatalities. Searches should be done on foot. I suggest searching randomly or systematically selected arrays of heliostat mirrors to the extent that equals 33% or more of the project, including all ground between the power towers and the nearest array of heliostat mirrors. Detection trials should be integrated into the searches. At least 10 bird carcasses should be randomly placed within the search areas weekly (10 carcasses project-wide).

These carcasses should have been frozen very soon after death, so that the decay process was halted in the incipient stage. If collision fatalities are greater than predicted, then I suggest extending the fatality monitoring for at least another three years.

Furthermore, I would suggest performing an analysis of the pattern of fatalities to identify spatial or other trends that can inform mitigation measures to reduce fatality rates. Basic methods for fatality monitoring at a solar energy plant can be found in McCrary et al. (1986), and updated methodology can be found in Smallwood (2007, 2009, 2013), Smallwood and Karas (2009), Smallwood et al. (2013). A summary is provided below.

The essential elements of scientifically defensible fatality rate estimates include: (1) detecting as many of the available fatalities as possible; and, (2) adjusting the number of found fatalities by the proportion not found. The duration of the average search interval matters greatly to both of these factors. During the past two years I have worked with three search intervals at two studies, including 7 and 28 day intervals at one study and <5 day intervals at another. Also at the latter study, another monitor overlapped many of my study plots with an average search interval of 42 days. What I learned from these various search intervals is that the longer intervals can be more efficient for large bird carcasses, but short search intervals are crucial for obtaining reasonable fatality rate estimates of small birds and bats. I suggest a search interval of no longer than two weeks. A search interval of weekly would be appropriate for bats.

I recommend that at least a third of the project area be searched periodically for dead or injured birds and bats. The project area should be divided into grid cells or other sampling units (such as groups of heliostat mirrors) that are then sampled randomly or systematically (with a random starting point) for inclusion in the fatality monitoring. Standardization of the field and analytical methods should include the following for most species.

1. Periodic fatality searches at time intervals of no more than two weeks. Fatality searches should be conducted along transects separated by no more than 7 m in most environments, but closer if ground visibility is poor and farther apart if ground visibility is excellent. Trained dogs should be used to improve detection rates of bats and very small birds, if necessary. Search intervals should not be split between groups of heliostat mirrors or between seasons.

2. Fatality monitoring should last at least three years, and another three years if significant numbers of fatalities are found during the first year. Surveys should cover all seasons, in order to capture variation due to seasons and multi-annual cycles of abundance or weather conditions.

3. Detection trials should be integrated into routine fatality monitoring, whereby fresh carcasses (very short time between death and when the carcass was placed in a freezer) are marked discreetly and placed at random locations within the fatality search areas and at random times within periodic time intervals such as weekly. Carcasses should be placed at a rate that does not exceed new fatality finds by the searchers. Given the fatality finds of April and May 2014, placing 10 carcasses per week would suffice. The fatality searchers should be blind to the trial to the degree possible. All trial and found carcasses

should be left in the field so as not to disrupt the ecology of scavenging in the project area, and so that missed trial carcasses can potentially be found during later searches. Detection rates should be combined, rather than treated separately for searcher detection error and scavenger removal. The proportion of carcasses found should be the metric used to adjust fatality rates, and should not involve mean days to carcass removal.

For its simplicity and freedom from bias when the detection trial is implemented properly, I recommend the Horvitz and Thompson (1952) estimator:

$$F_A = \frac{F_U}{D},$$

Where F_U is the unadjusted number of fatalities/MW/year (the found carcasses), D is the proportion of placed carcasses that is detected by searchers performing standard searches, and F_A is the fatality rate adjusted for the proportion of carcasses found amongst those that were available to be found fatality throughout a given monitoring period. I calculate the standard error of the adjusted fatality rate, $SE[F_A]$, using the Delta Method (Goodman 1960):

$$\sqrt{\left(\left(\left(\frac{\mathbf{1}}{\boldsymbol{D}}\right)\times \boldsymbol{SE}(\boldsymbol{F_U})\right)^{\mathbf{2}} + \left(\left(\boldsymbol{F_U}\times\left(\frac{\mathbf{-1}}{\boldsymbol{D^2}}\right)\right)\times \boldsymbol{SE}(\boldsymbol{D})\right)^{\mathbf{2}}\right)}$$

where SE stands for standard error, F_A and F_U are adjusted and unadjusted fatality rates, and D is overall detection rate.

The proposed monitoring plan at Ivanpah described in the recent filings would be close to the plan I outlined above (see TN 201315). However, I am concerned that it will encounter some logistical challenges because it relies on many small plots. For Palen, I would recommend that it would be more practical to rely on a smaller number of larger plots so that driving time between plots is minimized. Also, found carcasses should not be used in scavenger removal trials because estimating time since death is highly inaccurate and attempting to do so results in the placement of carcasses that are no longer attractive to vertebrate scavengers. Not using fresh killed or fresh frozen carcasses will result in fatality rate estimates that are biased low.

Biological Resources Mitigation Implementation and Monitoring Plan

The public should have the opportunity to review the BRMIMP. This mitigation planning document is too important to defer its formulation until after the public has read other documents related to this proceeding. What I see in the RSA's summary of mitigation and the filings from the petitioner is frequent referral to the BRMIMP, which is a document on which I will not get to comment other than to say that it should have been circulated to the public prior to any decisions being made on whether the Palen project should be permitted.

Measures to Rectify Impacts

If the project is built, injured birds will sometimes be found alive (also see Kagan et al. 2014). Not all the birds will die immediately after flying into heliostat mirrors or through the zone of solar flux. Given the number of birds being found dead at Ivanpah, I predict that many birds will be found injured and alive at Palen, if Palen is built. The biological monitor will need a plan and a place to send injured birds. In the Altamont Pass Wind Resource Area, the wind companies pay nearby rehabilitation facilities $10,000 per year to handle injured birds as they are brought in from the Altamont Pass. Most of the birds brought to the facilities are euthanized, largely due to budget constraints. I know this first hand because I personally interviewed the rehabilitators to understand why so many of the injured birds were being euthanized, even when some of the injuries seemed relatively minor. If Palen is built, the responsible thing to do would be to provide an annual payment to local rehabilitation facilities. The amount paid would need to cover the number of birds and other wildlife being brought from the project, and it would need to cover sufficient time for the rehabilitators to give the injured animals a chance at recovery rather than a quick needle. The funding should also include an amount that is regarded as a donation for the use of deceased birds that will be needed in detection trials as part of fatality monitoring.

Measures to Reduce Impacts

Avian Protection Plan

Mitigation Measure BIO-16 was named the Avian Protection Plan. Its formulation, however, was deferred to a time subsequent to public participation with this proceeding on Palen. It appears that I will not get the opportunity to review the Avian Protection Plan, which is a shame because I have considerable experience with these types of plans. The summary of the Avian Protection Plan in the RSA provides no details on Plan elements. There was no description of what proportion of the project would be monitored, how it would be monitored, how often searches would be performed, whether detection trials would be implemented, or even anything about the monitoring objectives. In short, the summary of the Avian Monitoring Plan was uninformative and unacceptable.

Curtailment

If the fatality patterns observed at Solar One remain consistent at Palen, then curtailment would apply to only 30% of the fatalities. The other 70% of the fatalities would be caused by collision with heliostat mirrors, and would not be affected by curtailment. Curtailment would potentially reduce fatalities only within that 30% portion of the fatalities that happen within the zone of solar flux. The other 70% of the fatalities would not be affected by curtailment. Even if curtailment applied to 10% of the potential operating time, and assuming that birds die within the zone of solar flux at the same rates during all seasons, this curtailment would reduce the predicted number of 10,787 birds per year to 10,463 birds per year, because the 10% curtailment would apply to the 3,236 birds per year that are killed by solar flux. The net fatality reduction from a 10% curtailment would be 3%, which would probably go undetected in a test for a statistically significant difference.

If pre-construction behavior surveys informed me or another qualified ecologist that a seasonal curtailment could reduce solar flux fatalities by 50%, then the net fatality reduction across the project would be 15%. This fatality reduction might also be found to be statistically insignificant, which in my experience with these types of mitigation measures in the Altamont Pass Wind Resource Area, would fuel strong arguments against continuing the curtailment. Of course, one could assess the fatality reduction only within the zone of solar flux and ignore the collisions with heliostat mirrors. Assessing the mitigation measure this way would probably yield a statistically significant fatality reduction (50%). Either way it is done, however, the decision whether to implement curtailment would mean life or death of 1,618 birds, which is not a trivial number.

The decision over whether to implement curtailment can only be informed through carefully designed and executed pre-construction behavior surveys, or by post-construction fatality surveys. The trouble with relying on post-construction fatality surveys is that by the time the information is acquired, the project has already killed thousands of birds that could have been saved by implementing curtailment based on preconstruction surveys. This decision is also a very good example of why the project needs a qualified TAC that has the power to require monitoring and mitigation plans.

I was one of five members of the Alameda County Scientific Review Committee, which reviewed monitoring and mitigation involving >5,000 wind turbines and thousands of bird fatalities per year. The SRC had access to more monitoring data and more opportunities for mitigation experiments than any other wind resource area in the world, yet mitigation plans failed one after another (Smallwood 2008). After all conceivable measures had been rejected by the wind companies or by Alameda County, or had been implemented with confused results due to confounding factors and weak statistical signals, then Alameda County had the SRC implement adaptive management. Of course, by then (2009) there was no adaptive management to implement because there were no more mitigation measures to try. This is why a qualified TAC needs to be in place well before Palen is built, and the TAC has to have the time and the power to formulate measures that will be implemented according to a schedule that is tied to good monitoring data and which have realistic thresholds upon which to abandon initial measures or to initiate new ones.

I recommended curtailment in the Altamont Pass. In 2005 there was a series of meetings referred to as the Altamont Working Group meetings, and attended by CEC staff (I was working for staff at the time), US Fish and Wildlife Service law enforcement and biologists, California Department of Fish and Game biologists, environmentalists, Alameda and Contra Costa County staff, and the wind companies and their lawyers and consultants. During one of these meetings a consultant to the wind companies approached me during a break and proposed wintertime curtailment of the turbines. He pointed out that only 14% of the annual power was generated over winter, which is when I was estimating that nearly half of the raptors were found dead. I endorsed the idea and the Alameda County Board of Supervisors then wrote it into the new Conditional Operating Permits, which the SRC then reviewed and recommended modifications as information became available since that time. The SRC could only make recommendations; it lacked the authority to require measures or changes to monitoring. As a consequence, the curtailment never conformed to the SRC's recommended four month shutdown, and the fatality

monitoring was performed with a search interval that was too long to detect an effect of the shutdown. During the five years I was a member of the SRC, the SRC argued internally and with the wind companies over whether the curtailment was effective. Winter curtailment continued through the winter of 2013-2014, and still there has been no confirmation that the curtailment strategy worked. Again, strategies such as curtailment need good information at the start, as well as a qualified group of scientists who can assess the information and require changes as needed.

Avian Deterrent Strategies

Document TN 201838, entitled "*Palen Solar Holdings, LLC's Review of Potential Bird Deterrent Strategies for Large Scale Solar Facilities*," summarizes avian deterrent strategies. Any efforts to deter birds protected by the Migratory Bird Treaty Act could be interpreted as "take" or "pursuit," and may not be legal. Deterrents can even cause fatalities by scaring birds into the very facilities the measures were intended to keep birds away. Avian deterrents also have a poor record of success because birds readily habituate to deterrents.

Balloons were identified as a possible deterrent (Document TN 201838). It was even suggested that eyes could be painted on the balloons. A study was cited where balloons were tried, but it was not surprising to read that the results varied by species and were generally negative. In my experience, balloons would have little if any effectiveness at deterring birds.

Scarecrows were suggested next. However, we have a long history with scarecrows, which have not worked.

The document then introduced the Eagle Eye, a device that spins ever-changing light beams on nearby structures, but TN 201838 made no mention of measured results in any study. I would suspect that no mention of efficacy means that there has been no measure of efficacy. If it worked, trust me, it would have been deployed in the Altamont Pass Wind Resource Area. I warn that if it was deployed amongst heliostat mirrors, we would likely seen more fatalities rather than fewer because birds startled by light beams flashing off the heliostat mirrors would then fly into the mirrors.

Lasers were next. Just like the Eagle Eye, deploying lasers in an array of heliostat mirrors is likely to cause panic flights and confusion. I cannot recommend such a reckless measure.

Lights followed lasers. Again, flashing lights in a field of heliostat mirrors would be imprudent.

TN 201838 then suggested UV-reflective paint, which was acknowledged to have failed in its application at a wind project. Another problem with this approach would be the loss of reflected light after painting the mirrors with UV-reflective paint. This deterrent seems ludicrous.

The document then lists auditory deterrents, none of which have a proven record of success. These measures, such as gas canons, startle birds, which then settle back into the area they're not supposed to be using. Startling birds amongst heliostat mirrors is probably not a good idea.

The document lists pursuit strategies, such as using dogs, falcons and drones. However, it would be a violation of the Migratory Bird Treaty Act to pursue birds protected by this Act. It would also cause some birds to fly into heliostat mirrors, perhaps more often than if they were not pursued.

The document briefly summarizes expensive systems that detect incoming birds and then haze them. I have seen no scientific evidence that these systems are effective, and no good evidence was offered in TN 201838. And again, using such systems might very well scare birds into heliostat mirrors.

The document suggested that some yet-to-be-discovered method might be used to disorient the magnetic fields of birds. Another approach with just as much sense would be to cut off one or both wings of birds so that they cannot fly at all.

It was misleading to suggest that any of these bird deterrent strategies could contribute to an effective adaptive management program.

Compensatory Mitigation

I failed to find any compensatory mitigation measure to offset impacts caused by bird collisions with heliostat mirrors or by thermal injuries. Given what was found at Solar One and at Ivanpah, there is ample reason to conclude that fatalities will happen. There will be fatalities caused by Palen if permitted and constructed. A compensatory mitigation plan should be formulated to address these impacts, and the amounts of compensation should be linked to fatality levels and to monitoring to measure fatality levels.

Fencing

Cyclone fencing can entangle and kill wildlife (Photo 1). Care should be taken when planning and installing fencing. More details about fence construction should be provided in the environmental review documentation.

Photo 1. *A great-horned owl died after becoming entangled on the razor wire placed on top of this cyclone fence. Photo by Joanne Mount*.

DECLARATION OF K. SHAWN SMALLWOOD, Ph.D.

I, Shawn Smallwood, declare as follows:

1. I am a self-employed ecologist based in Davis, California.

2. My professional qualifications are given in the attached Curriculum Vitae.

3. I prepared the attached testimony relating to Biological Resources for the Committee Order Granting Petitioner's Motion to Reopen the Evidentiary Record and Setting Revised Schedule (California Energy Commission Docket Number 09-AFC-7C).

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

7. 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 21 June, 2014.

23 June 2014

Shawn Smallwood, Ph.D.

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Kenneth Shawn Smallwood
Curriculum Vitae

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Born May 3, 1963 in Sacramento, California.
Married, father of two.

Ecologist

Expertise

- Finding solutions to controversial problems related to wildlife interactions with human industry, infrastructure, and activities; and,

- Using systems analysis and experimental design principles to identify meaningful ecological patterns that can inform conclusions and management decisions.

Education

Ph.D. Ecology, University of California, Davis. September 1990.
M.S. Ecology, University of California, Davis. June 1987.
B.S. Anthropology, University of California, Davis. June 1985.
Corcoran High School, Corcoran, California. June 1981.

Experience

- 387 professional publications, including:
- 67 peer reviewed publications
- 24 in non-reviewed proceedings
- 287 reports, declarations, and book reviews
- 8 in mass media outlets
- 79 public presentations of research results at meetings
- Reviewed many professional papers and reports
- Testified in 4 court cases.

Guest Editor, *Wildlife Society Bulletin*, 2012-2013. Edited invited papers representing international views on the impacts of wind energy on wildlife and how to mitigate the impacts.

Associate Editor, *Journal of Wildlife Management*, March 2004 to 30 June 2007.

Editorial Board Member, *Environmental Management*, 10/1999 to 8/2004.

Associate Editor, *Biological Conservation*, 9/1994 to 9/1995. Administered independent scientific reviews of submitted, professional papers in ecology and conservation biology, and made

recommendations to the Editors.

Member, Alameda County Scientific Review Committee (SRC), 8/06 to 4/11. As part of a five member committee, I investigated the causes of bird and bat collisions in the Altamont Pass Wind Resource Area, and I recommended mitigation and monitoring measures. The SRC reviews the science underlying the Alameda county Avian Protection Program, and advises the County on how to reduce wildlife fatalities.

Research Ecologist, 2/06 to 12/07, under contract to East Bay Regional Parks District. Performed research of how fossorial mammals and raptors responded to grazing treatments and wind turbines at Vasco Caves Regional Preserve. I designed the study, trained the fatality monitors and behavior observers, mapped the burrows of fossorial mammals, analyzed the data, and took the lead on writing the report.

Consulting Ecologist, 7/04 to 12/07, California Energy Commission (CEC). In collaboration with Lawrence-Livermore National Lab, I performed independent research funded by the CEC on bird behavior in the Altamont Pass Wind Resources Area. I also provided consulting services as needed to the CEC. I produced several reports to the CEC and the CEC's Public Interest Energy Research program.

Consulting Ecologist, 11/99 to present, U.S. Navy. I provide endangered species surveys at multiple Navy facilities, hazardous waste site monitoring, and habitat restoration for the endangered Fresno kangaroo rat, California tiger salamander, California red-legged frog, California clapper rail, western burrowing owl, and other species. I have worked at Naval Air Station Lemoore; Naval Weapons Station, Seal Beach, Detachment Concord; Naval Security Group Activity, Skaggs Island; National Radio Transmitter Facility, Dixon.

Part-time Lecturer, 1/98 to 2005, California State University, Sacramento. I taught Contemporary Environmental Issues, Natural Resources Conservation (twice), Mammalogy, Behavioral Ecology, and Ornithology Lab.

Senior Ecologist, 1999 to 2005, BioResource Consultants. I planned and carried out research and monitoring projects, and analyzed complex data related to avian fatalities at wind turbines, avian electrocutions on electric distribution poles across California, and avian fatalities at transmission lines.

Systems Ecologist, 7/96 to present, Consulting in the Public Interest, www.cipi.com. I am part of a multi-disciplinary consortium of scientists facilitating large-scale, environmental planning projects and litigation. We provide risk assessments, assessments of management practices, and expert witness testimony.

Chairman, Conservation Affairs Committee, The Wildlife Society--Western Section, 1999-2001. I prepared position statements and led efforts directed toward conservation issues, including travel to Washington, D.C. to lobby Congress for more wildlife conservation funding.

Systems Ecologist, 1/95 until about 2000, Institute for Sustainable Development. I headed ISD's program on integrated resources management. I developed indicators of ecological integrity for large areas, using remotely sensed data, local community involvement and GIS.

Associate, 1997-1998, Department of Agronomy and Range Science, University of California, Davis. I worked with Shu Geng and Mingua Zhang on several projects related to wildlife interactions with agriculture and patterns of fertilizer and pesticide residues in groundwater across a large landscape.

Lead Scientist, 6/96 to 6/99, National Endangered Species Network. I headed NESN's efforts to inform academic scientists and environmental activists about emerging issues regarding the Endangered Species Act and other environmental laws pertaining to special status species. I also testified at public hearings on behalf of environmental groups and endangered species.

Ecologist, 1/97 to 6/98, Western Foundation of Vertebrate Zoology. I conducted field research to determine the impact of past mercury mining on the status of California red-legged frogs in Santa Clara County, California.

Senior Systems Ecologist, 7/94 to 12/95, EIP Associates, Sacramento, California. Provided consulting services in environmental planning. I also developed a quantitative assessment of land units for their conservation and restoration opportunities, using the ecological resource requirements of 29 special status species. I mapped vegetation and land use, and derived new spatial data from a GIS overlay of these variables with soil types, flood zones, roads, and other spatially referenced data. Using these derived data, I developed a set of indicators for prioritizing areas within Yolo County that will receive mitigation funds for habitat easements and restoration.

Post-Graduate Researcher, 10/90 to 6/94, with Dr. Shu Geng, Department of Agronomy and Range Science, *U.C. Davis*. Studied landscape and management effects on temporal and spatial patterns of abundance among pocket gophers and species of Falconiformes and Carnivora in the Sacramento Valley. I also developed and analyzed a data base of energy use in California agriculture, and I assisted with a landscape (GIS) study of groundwater contamination across Tulare County, California.

Co-teacher, 1/91 to 6/91 and 1/93 to 6/93, Graduate Group in Ecology, U.C. Davis. Co-taught conservation biology with Dr. Christine Schonewald.

Reader, 3/90 to 6/90, Department of Psychology, U.C. Davis. Assisted students of Psychobiology (taught by Dr. Richard Coss) with research and writing term papers.

Research Assistant, 11/88 to 9/90, with Dr. Walter E. Howard, Department of Wildlife and Fisheries Biology, U.C. Davis. Tested durable baits for pocket gopher control in forest plantations, and developed gopher sampling methods.

Fulbright Research Fellow, Indonesia, 7/88 to 11/88. Tested use of new sampling methods for monitoring the number of Sumatran tigers and six other species of endemic felids, and evaluated methods used by other researchers.

Research Assistant, 7/87 to 6/88, with Dr. Terrell P. Salmon, Wildlife Extension, Department of Wildlife and Fisheries Biology, U.C. Davis. Developed empirical models of mammal and bird invasions in North America, and a rating system for priority research and control of exotic species based on economic, environmental, and human health hazards in California.

Student Assistant, 3/85 to 6/87, with Dr. E. Lee Fitzhugh, Wildlife Extension, Department of Wildlife and Fisheries Biology, U.C. Davis. Developed and implemented a statewide mountain lion track count for long-term monitoring of numbers and distribution. I've continued the statewide track count since 1985 (the last count was in 2008). I also developed quantitative methods to identify individual mountain lions by their tracks, and to differentiate mountain lion and dog tracks.

Projects

Test of avian safety of new closed-bladed wind turbine. I designed and implemented a before-after, control-impact experimental design to test the avian safety of a new wind turbine model developed by FloDesign Wind Turbine Corporation. Supported by a $718,000 grant from the California Energy Commission's Public Interest Energy Research program and a 20% match share contribution from FloDesign, I manage a crew of seven field biologists and a GIS analyst who are performing periodic fatality searches and behavior surveys, carcass detection trials, nocturnal behavior surveys using a thermal camera, and spatial analyses. Field work began on 1 April 2012.

Behavior surveys for developing predictive models of avian flight behaviors to carefully site wind turbines in repowering in the Altamont Pass. Funded by NextEra Energy, LLC and East Bay Regional Park District, I manage a crew of five field biologists and a GIS analyst who perform behavior surveys focused on golden eagles and nocturnal surveys on bats and owls. The goal is to quantify flight patterns for development of predictive models to more carefully site new wind turbines in repowering projects. Field work began in May 2012.

Research to reduce avian mortality due to wind turbines at Altamont Pass. I used GPS and GIS to map and study environmental impacts of 5,400 wind turbines. I related the number of raptor fatalities at wind turbines to the degree of aggregation of prey species around the turbines, as well as many other factors related to where the turbines are located, how they are designed and operated, and how raptors behave in the Altamont Pass Wind Resource Area. I also serve on the Alameda County Scientific Review Committee, charged with recommending scientific monitoring methods and mitigation measures for reducing avian mortality.

Research to reduce avian mortality on electric distribution poles. From 2000 through 2007, I

directed research toward reducing bird electrocutions on electric distribution poles. I led fatality monitoring efforts at 10,000 poles multiple times in California, spanning Orange County to Glenn County, and I produced two large reports.

Cook *et al*. v. Rockwell International *et al*., No. 90-K-181 (D. Colorado). I provided expert testimony on the role of burrowing animals in affecting the fate of buried and surface-deposited radioactive and hazardous chemical wastes at the Rocky Flats Plant, Colorado. I provided expert reports based on four site visits and the most extensive document review of burrowing animals ever conducted. I conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. I also discovered substantial intrusion of waste structures by burrowing animals. I testified in federal court in November 2005, and my clients were subsequently awarded a $553,000,000 judgment by a jury.

Hanford Nuclear Reservation Litigation. I am providing expert testimony on the role of burrowing animals in affecting the fate of buried radioactive wastes at the Hanford Nuclear Reservation, Washington. I provided three expert reports based on three site visits and extensive document review. I predicted and verified a certain population density of pocket gophers on buried waste structures, as well as incidence of radionuclide contamination in body tissue. I conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. I also discovered substantial intrusion of waste structures by burrowing animals.

Expert Testimony and Declarations on Residential and Commercial Development Proposals. I have testified before the California Coastal Commission, California Energy Commission, County Boards of Supervisors, and City Councils, and I have participated with press conferences and have been deposed by attorneys. I prepared expert witness reports and court declarations, which are summarized under Reports (below).

Expert Testimony on Proposed Gas-fired Power Plants. I provided comments letters, declarations, expert reports, and oral testimony on the impacts and appropriate mitigation of about eight natural gas-fired power plants in California.

Expert Testimony on Proposed Wind Farms. I provided comment letters and oral testimony to administrative law courts in Klickitat and Skamania Counties, Washington, which convinced the court in Skamania County to require the replacement of a negative declaration with an EIS. I provided written testimony and deposition in support of litigation brought against the development of wind turbines in Cook County, Texas, which resulted in a settlement. I also provided written comments on the first EIR for the Buena Vista Wind Energy Project in Contra County, California, prompting the withdrawal of that EIR and the preparation of an improved EIR which was later certified.

Protocol-level endangered species searches and recovery efforts. I search for special-status species using Department of Fish and Game and US Fish and Wildlife Service protocols. I have searched for, or otherwise worked with, California red-legged frog, arroyo southwestern toad, California tiger salamander, blunt-nosed leopard lizard, western pond turtle, giant kangaroo rat,

Fresno kangaroo rat, San Joaquin kit fox, Sumatran tiger, willow flycatcher, least Bell's vireo, western burrowing owl, Swainson's hawk, Valley elderberry longhorn beetle and many other special-status species. I also help with recovery of the Fresno kangaroo rat at Lemoore Naval Air Station.

Conservation of the endangered Fresno kangaroo rat. Since 2000, I have performed applied research to identify the factors responsible for the decline of this endangered species at Lemoore Naval Air Station, and have implemented habitat enhancements designed to reverse the trend and to expand the area occupied by this species.

Impact of West Nile Virus on yellow-billed magpies. From 2005 through 2008, I worked under contract to the Sacramento-Yolo Mosquito and Vector Control District to gather post-West Nile Virus epidemic data to pre-epidemic data I had gathered on multiple bird species in the Sacramento Valley in the 1990s, but particularly on yellow-billed magpie and American crow, which are particularly susceptible to WNV.

Workshops on HCPs. Assisted Dr. Michael Morrison with organizing and conducting a 2-day workshop on Habitat Conservation Plans, sponsored by Southern California Edison, and another 1-day workshop sponsored by PG&E. These Workshops were attended by academics, attorneys, and consultants with HCP experience. We guest-edited a Proceedings published in Environmental Management.

Mapping of biological resources along Highways 101, 46 and 41. I used GPS and GIS to delineate vegetation complexes and locations of special-status species along 26 miles of highway in San Luis Obispo County, 14 miles of highway and roadway in Monterey County, and in a large area north of Fresno, including within reclaimed gravel mining pits.

GPS mapping and monitoring at restoration sites and at Caltrans mitigation sites. I am monitoring the success of elderberry shrubs at one location, the success of willows at another location, and the response of wildlife to the succession of vegetation at both these sits. I am also using GPS to monitor the response of fossorial animals to yellow star-thistle eradication and natural grassland restoration efforts at Bear Valley, Colusa County, and at the decommissioned Mather Air Force Base in Sacramento County.

Mercury effects on Red-legged Frog. I assisted Dr. Michael Morrison and US Fish and Wildlife Service in assessing the possible impacts of historical mercury mining on the federally listed California red-legged frog in Santa Clara County. I also measured habitat variables in numerous streams.

Opposition to proposed No Surprises rule. I wrote a white paper and summary letter explaining scientific grounds for opposing the incidental take permit (ITP) rules providing ITP applicants and holders with general assurances they will be free of compliance with the Endangered Species Act once they adhere to the terms of a "properly functioning HCP." I obtained 188 signatures of scientists and environmental professionals on the letter submitted to the US Fish

and Wildlife Service and the National Marine Fisheries Service. The letter was also provided to all US Senators. It helped change the prevailing view of HCPs as beneficial to listed species.

Natomas Basin Habitat Conservation Plan alternative. I designed narrow channel marsh to increase the likelihood of survival and recovery in the wild of giant garter snake, Swainson's hawk and Valley Elderberry Longhorn Beetle. The design included replication and interspersion of treatments for experimental testing of critical habitat elements. I provided a report to Northern Territories, Inc.

Assessment of Environmental Technology Transfer to China, and Assessment of Agricultural Production System. I twice traveled to China and interviewed scientists, industrialists, agriculturalists, and the Directors of the Chinese Environmental Protection Agency and the Department of Agriculture to assess the need and possible pathways for environmental clean-up technologies and trade opportunities between the US and China. I spent a total of five weeks in China, including in Shandong and Linxion Provinces and in Beijing.

Yolo County Habitat Conservation Plan. I conducted the landscape ecology study of Yolo County to identify the priority land units to receive mitigation so as to most improve the ecosystem functionality within the County from the perspective of 29 special-status species of wildlife and plants. I used a hierarchically structured indicators approach to apply principles of landscape and ecosystem ecology, conservation biology, and local values in rating land units. I derived GIS maps to help guide the conservation area design, and then I developed implementation strategies.

Mountain Lion Track Count. I developed and conducted the carnivore monitoring program throughout California since 1985. Species counted include mountain lion, bobcat, black bear, coyote, red and gray fox, raccoon, striped skunk, badger, and black-tailed deer. Vegetation and land use are also monitored. The transect was established on dusty, dirt roads within randomly selected quadrats. These roads are searched for tracks of the carnivores, which routinely use the roads for travel paths.

Sumatran Tiger and other Felids. I designed and conducted track counts for seven species of wild cats in Sumatra, including the Sumatran tiger, fishing cat, and golden cat. I spent four months on Sumatra and Java, and learned Bahasa Indonesia (the official Indonesian language). I was awarded a Fulbright Research Fellowship to complete the project.

Wildlife in Agriculture. Beginning as my post-graduate research, I have studied pocket gophers and other wildlife in 40 alfalfa fields throughout the Sacramento Valley, and I surveyed for wildlife along a 200 mile road transect for six years. The data were analyzed using GIS and methods from landscape ecology, and the results were published and presented orally to farming groups in California and elsewhere. I also conducted the first study of wildlife in cover crops used on vineyards and orchards.

Agricultural Energy Use and Tulare County Groundwater Study. I developed and analyzed a data

base of energy use in California agriculture, and collaborated on a landscape (GIS) study of groundwater contamination across Tulare County, California.

Pocket Gopher Damage in Forest Clearcuts. I tested various poison baits and baiting regimes for pocket gopher control in forest plantations, and I developed gopher sampling methods. I conducted the most extensive field study of pocket gophers ever, involving thousands of gophers in 68 research plots on 55 clearcuts among 6 National Forests in northern California.

Risk Assessment of Exotic Species in North America. I developed empirical models of mammal and bird species invasions in North America, as well as a rating system for assigning priority research and control to exotic species in California, based on economic, environmental, and human health hazards.

Representative Clients/Funders

Law offices and environmental groups	Government agencies
Law Offices of Stephan C. Volker	US Navy
Law Offices of Berger & Montague	US Department of Agriculture
Lozeau | Drury LLP	US Forest Service
Law Offices of Roy Haber	US Fish & Wildlife Service
Law Offices of Edward MacDonald	California Energy Commission
Law Office of John Gabrielli	California Office of the Attorney General
Law Office of Bill Kopper	California Department of Fish & Game
Law Office of Donald B. Mooney	California Department of Transportation
Law Office of Veneruso & Moncharsh	California Department of Forestry
Law Office of Steven Thompson	California Department of Food & Agriculture
California Wildlife Federation	Ventura County Counsel
Defenders of Wildlife	County of Yolo
Sierra Club	Tahoe Regional Planning Agency
National Endangered Species Network	Sustainable Agriculture Research & Education Program
Spirit of the Sage Council	Sacramento-Yolo Mosquito and Vector Control District
The Humane Society	East Bay Regional Park District
Hagens Berman LLP	County of Alameda
Environmental Protection Information Center	**Other organizations and Individuals**
Goldberg, Kamin & Garvin, Attorneys at Law	Don & LaNelle Silverstien
Californians for Renewable Energy (CARE)	Seventh Day Adventist Church
Seatuck Environmental Association	Escuela de la Raza Unida
Friends of the Columbia Gorge, Inc.	Susan Pelican and Howard Beeman
Save Our Scenic Area	Residents Against Inconsistent Development, Inc.
Alliance to Protect Nantucket Sound	Bob Sarvey
Friends of the Swainson's Hawk	Mike Boyd
Alameda Creek Alliance	Hillcroft Neighborhood Fund
Center for Biological Diversity	Joint Labor Management Committee, Retail Food Industry
Businesses	Lisa Rocca
FloDesign Wind Turbine	Kevin Jackson
NextEra Energy Resources, LLC	Dawn Stover and Jay Letto
Pacific Gas & Electric Co.	Nancy Havassy
Southern California Edison Co.	Catherine Portman (for Brenda Cedarblade)
Georgia-Pacific Timber Co.	**Businesses**
Northern Territories Inc.	
National Renewable Energy Lab	G3 Energy and enXco
David Magney Environmental Consulting	Comstocks Business (magazine)
Wildlife History Foundation	BioResource Consultants
Emerald Farms	EDF
Terry Preston, Wildlife Ecology Research Center	

Representative special-status species experience

Common name	Species name	Description
Field experience		
California red-legged frog	*Rana aurora draytonii*	Protocol searches; detected at multiple sites
Foothill yellow-legged frog	*Rana boylii*	Research; detections at multiple sites
Western spadefoot	*Spea hammondii*	Searches and search detections
California tiger salamander	*Ambystoma californiense*	Protocol searches; detected at multiple sites
Coast range newt	*Taricha torosa torosa*	Searches and multiple detections
Blunt-nosed leopard lizard	*Gambelia sila*	Detected in San Luis Obispo County
California Horned Lizard	*Phrynosoma coronatum frontale*	Searches; detected in San Luis Obispo Co.
Western pond turtle	*Clemmys marmorata*	Searches; detected at multiple sites
San Joaquin kit fox	*Vulpes macrotis mutica*	Protocol searches; detections
Sumatran tiger	*Panthera tigris*	Research in Sumatra
Mountain lion	*Puma concolor californicus*	Research and publications
Point Arena mountain beaver	*Aplodontia rufa nigra*	Remote camera operation
Giant kangaroo rat	*Dipodomys ingens*	Detected in Cholame Valley
Fresno kangaroo rat	*Dipodomys nitratoides*	Research, conservation at NAS Lemoore
Monterey dusky-footed woodrat	*Neotoma fuscipes luciana*	Non-target captures and mapping of dens
Salt marsh harvest mouse	*Reithrodontomys raviventris*	Habitat assessment, monitoring
Salinas harvest mouse	*Reithrodontomys megalotus distichlus*	Captures in Salinas area; habitat assessment
California clapper rail	*Rallus longirostris*	Surveys at Concord Weapons Station
Golden eagle	*Aquila chrysaetos*	Research in Altamont Pass
Swainson's hawk	*Buteo swainsoni*	Research in Sacramento Valley
Northern harrier	*Circus cyaeneus*	Research and publication
White-tailed kite	*Elanus leucurus*	Research and publication
Loggerhead shrike	*Lanius ludovicianus*	Research in Sacramento Valley
Least Bell's vireo	*Vireo bellii pusillus*	Detected in Monterey County
Willow flycatcher	*Empidonax traillii extimus*	Research at Sierra Nevada breeding sites
Burrowing owl	*Athene cunicularia hypugia*	Research at multiple locations
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Research and publication
Analytical		
Arroyo southwestern toad	*Bufo microscaphus californicus*	Research and report.
Giant garter snake	*Thamnophis gigas*	Research and publication.
Northern goshawk	*Accipiter gentilis*	Research and publication.
Northern spotted owl	*Strix occidentalis*	Research and reports.

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Mete, A., N. Stephenson, K. Rogers, M. G. Hawkins, M. Sadar, D. Guzman, D. A. Bell, J. Shipman, A. Wells, K. S. Smallwood, and J. Foley. 2014. Emergence of Knemidocoptic mange in wild Golden Eagles (Aquila chrysaetos) in California. Emerging Infectious Diseases: Accepted

Smallwood, K.S. 2013. Introduction: Wind-energy development and wildlife conservation. Wildlife Society Bulletin 37: 3-4.

Smallwood, K.S. 2013. Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin 37:19-33. + Online Supplemental Material.

Smallwood, K. S., L. Neher, J. Mount, and R. C. E. Culver. 2013. Nesting Burrowing Owl Abundance in the Altamont Pass Wind Resource Area, California. Wildlife Society Bulletin: 37:787-795.

Smallwood, K. S., D. A. Bell, B. Karas, and S. A. Snyder. 2013. Response to Huso and Erickson Comments on Novel Scavenger Removal Trials. Journal of Wildlife Management 77: 216-225.

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. DiDonato. 2010. Novel scavenger removal trials increase estimates of wind turbine-caused avian fatality rates. Journal of Wildlife Management 74: 1089-1097 + Online Supplemental Material.

Smallwood, K. S., L. Neher, and D. A. Bell. 2009. Map-based repowering and reorganization of a wind resource area to minimize burrowing owl and other bird fatalities. Energies 2009(2):915-943. http://www.mdpi.com/1996-1073/2/4/915

Smallwood, K. S. and B. Nakamoto. 2009. Impacts of West Nile Virus Epizootic on Yellow-Billed Magpie, American Crow, and other Birds in the Sacramento Valley, California. The Condor 111:247-254.

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Smallwood, K.S. and M.L. Morrison. 1999. Spatial scaling of pocket gopher (*Geomyidae*) density. Southwestern Naturalist 44:73-82.

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Smallwood, K.S., B. Wilcox, R. Leidy, and K. Yarris. 1998. Indicators assessment for Habitat Conservation Plan of Yolo County, California, USA. Environmental Management 22: 947-958.

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Magney, D. and K. S. Smallwood. 2000. Newhall Ranch Notice of Preparation Submittal. Prepared for Ventura County Counsel regarding our recommended scope of work for the Newhall Ranch Specific Plan EIR. 17 pp.

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Fitzhugh, E.L. and K.S. Smallwood. 1987. Methods Manual – A statewide mountain lion population index technique. California Department of Fish and Game, Sacramento.

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Comments on Environmental Documents

I was retained or commissioned to comment on environmental planning and review documents, including:

- Declaration on Tule Wind project FEIR/FEIS (2013; 24 pp);
- Sunrise Partners LANDPRO Solar Project Mitigated Negative Declaration (2013; 11 pp);
- Declaration in opposition to BLM fracking (2013; 5 pp);
- Rosamond Solar Project Addendum EIR (2013; 13 pp);
- Pioneer Green Solar Project EIR (2013; 13 pp);
- Reply to Staff Responses to Comments on Soccer Center Solar Project Mitigated Negative Declaration (2013; 6 pp);
- Soccer Center Solar Project Mitigated Negative Declaration (2013; 10 pp);
- Plainview Solar Works Mitigated Negative Declaration (2013; 10 pp);
- Reply to the County Staff's Responses on comments to Imperial Valley Solar Company 2 Project (2013; 10 pp);

- Imperial Valley Solar Company 2 Project (2013; 13 pp);
- FRV Orion Solar Project DEIR (PP12232) (2013; 9 pp);
- Casa Diablo IV Geothermal Development Project (3013; 6 pp);
- Reply to Staff Responses to Comments on Casa Diablo IV Geothermal Development Project (2013; 8 pp);
- FEIS prepared for Alta East Wind Project (2013; 23 pp);
- Metropolitan Air Park DEIR, City of San Diego (2013;);
- Davidon Homes Tentative Subdivision Map and Rezoning Project DEIR (2013; 9 pp);
- Analysis of Biological Assessment of Oakland Zoo Expansion Impacts on Alameda Whipsnake (2013; 10 pp);
- Declaration on Campo Verde Solar project FEIR (2013; 11pp);
- Declaration on North Steens Transmission Line FEIS (2012; 62 pp);
- City of Lancaster Revised Initial Study for Conditional Use Permits 12-08 and 12-09, Summer Solar and Springtime Solar Projects (2012; 8 pp);
- J&J Ranch, 24 Adobe Lane Environmental Review (2012; 14 pp);
- Reply to the County Staff's Responses on comments to Hudson Ranch Power II Geothermal Project and the Simbol Calipatria Plant II (2012; 8 pp);
- Hudson Ranch Power II Geothermal Project and the Simbol Calipatria Plant II (2012; 9 pp);
- Desert Harvest Solar Project EIS (2012; 15 pp);
- Solar Gen 2 Array Project DEIR (2012; 16 pp);
- Ocotillo Sol Project EIS (2012; 4 pp);
- Beacon Photovoltaic Project DEIR (2012; 5 pp);
- Declaration on Initial Study and Proposed Negative Declaration for the Butte Water District 2012 Water Transfer Program (2012; 11 pp);
- Mount Signal and Calexico Solar Farm Projects DEIR (2011; 16 pp);
- City of Elk Grove Sphere of Influence EIR (2011; 28 pp);
- Comment on Sutter Landing Park Solar Photovoltaic Project MND (2011; 9 pp);
- Statement of Shawn Smallwood, Ph.D. Regarding Proposed Rabik/Gudath Project, 22611 Coleman Valley Road, Bodega Bay (CPN 10-0002) (2011; 4 pp);
- Declaration of K. Shawn Smallwood on Biological Impacts of the Ivanpah Solar Electric Generating System (ISEGS) (2011; 9 pp);
- Comments on Draft Eagle Conservation Plan Guidance (2011; 13 pp);
- Comments on Draft EIR/EA for Niles Canyon Safety Improvement Project (2011; 16 pp);
- Declaration of K. Shawn Smallwood, Ph.D., on Biological Impacts of the Route 84 Safety Improvement Project (2011; 7 pp);
- Rebuttal Testimony of Witness #22, K. Shawn Smallwood, Ph.D, on Behalf of Intervenors Friends of The Columbia Gorge and Save Our Scenic Area (2010; 6 pp);
- Prefiled Direct Testimony of Witness #22, K. Shawn Smallwood, Ph.D, on Behalf of Intervenors Friends of the Columbia Gorge and Save Our Scenic Area. Comments on Whistling Ridge Wind Energy Power Project DEIS, Skamania County, Washington (2010; 41 pp);

- Evaluation of Klickitat County's Decisions on the Windy Flats West Wind Energy Project (2010; 17 pp);
- St. John's Church Project Draft Environmental Impact Report (2010; 14 pp.);
- Initial Study/Mitigated Negative Declaration for Results Radio Zone File #2009-001 (2010; 20 pp);
- Rio del Oro Specific Plan Project Final Environmental Impact Report (2010;12 pp);
- Answers to Questions on 33% RPS Implementation Analysis Preliminary Results Report (2009: 9 pp);
- SEPA Determination of Non-significance regarding zoning adjustments for Skamania County, Washington. Second Declaration to Friends of the Columbia Gorge, Inc. and Save Our Scenic Area (Dec 2008; 17 pp);
- Comments on Draft 1A Summary Report to CAISO (2008; 10 pp);
- Categorical Exemption of Hilton Manor Project, as determined by County of Placer (2009; 9 pp);
- Protest of CARE to Amendment to the Power Purchase and Sale Agreement for Procurement of Eligible Renewable Energy Resources Between Hatchet Ridge Wind LLC and PG&E (2009; 3 pp);
- Tehachapi Renewable Transmission Project EIR/EIS (2009; 142 pp);
- Delta Shores Project EIR, south Sacramento (2009; 11 pp + addendum 2 pp);
- Declaration of Shawn Smallwood in Support of Care's Petition to Modify D.07-09-040 (2008; 3 pp);
- The Public Utility Commission's Implementation Analysis December 16 Workshop for the Governor's Executive Order S-14-08 to implement a 33% Renewable Portfolio Standard by 2020 (2008; 9 pp);
- The Public Utility Commission's Implementation Analysis Draft Work Plan for the Governor's Executive Order S-14-08 to implement a 33% Renewable Portfolio Standard by 2020 (2008; 11 pp);
- Draft 1A Summary Report to California Independent System Operator for Planning Reserve Margins (PRM) Study (2008; 7 pp.);
- SEPA Determination of Non-significance regarding zoning adjustments for Skamania County, Washington. Declaration to Friends of the Columbia Gorge, Inc. and Save Our Scenic Area (Sep 2008; 16 pp);
- California Energy Commission's Preliminary Staff Assessment of the Colusa Generating Station (2007; 24 pp);
- Rio del Oro Specific Plan Project Recirculated Draft Environmental Impact Report (2008: 66 pp);
- Replies to Response to Comments Re: Regional University Specific Plan Environmental Impact Report (2008; 20 pp);
- Regional University Specific Plan Environmental Impact Report (2008: 33 pp.);
- Clark Precast, LLC's "Sugarland" project, Negative Declaration (2008: 15 pp.);
- Cape Wind Project Draft Environmental Impact Statement (2008; 157 pp.);
- Yuba Highlands Specific Plan (or Area Plan) Environmental Impact Report (2006; 37 pp.);

- Replies to responses to comments on Mitigated Negative Declaration of the proposed Mining Permit (MIN 04-01) and Modification of Use Permit 96-02 at North Table Mountain (2006; 5 pp);
- Mitigated Negative Declaration of the proposed Mining Permit (MIN 04-01) and Modification of Use Permit 96-02 at North Table Mountain (2006; 15 pp);
- Windy Point Wind Farm Environmental Review and EIS (2006; 14 pp and 36 Powerpoint slides in reply to responses to comments);
- Shiloh I Wind Power Project EIR (2005; 18 pp);
- Buena Vista Wind Energy Project Notice of Preparation of EIR (2004; 15 pp);
- Negative Declaration of the proposed Callahan Estates Subdivision (2004; 11 pp);
- Negative Declaration of the proposed Winters Highlands Subdivision (2004; 9 pp);
- Negative Declaration of the proposed Winters Highlands Subdivision (2004; 13 pp);
- Negative Declaration of the proposed Creekside Highlands Project, Tract 7270 (2004; 21 pp);
- On the petition California Fish and Game Commission to list the Burrowing Owl as threatened or endangered (2003; 10 pp);
- Conditional Use Permit renewals from Alameda County for wind turbine operations in the Altamont Pass Wind Resource Area (2003; 41 pp);
- UC Davis Long Range Development Plan of 2003, particularly with regard to the Neighborhood Master Plan (2003; 23 pp);
- Anderson Marketplace Draft Environmental Impact Report (2003: 18 pp + 3 plates of photos);
- Negative Declaration of the proposed expansion of Temple B'nai Tikyah (2003: 6 pp);
- Antonio Mountain Ranch Specific Plan Public Draft EIR (2002: 23 pp);
- Response to testimony of experts at the East Altamont Energy Center evidentiary hearing on biological resources (2002: 9 pp);
- Revised Draft Environmental Impact Report, The Promenade (2002: 7 pp);
- Recirculated Initial Study for Calpine's proposed Pajaro Valley Energy Center (2002: 3 pp);
- UC Merced -- Declaration of Dr. Shawn Smallwood in support of petitioner's application for temporary restraining order and preliminary injunction (2002: 5 pp);
- Replies to response to comments in Final Environmental Impact Report, Atwood Ranch Unit III Subdivision (2003: 22 pp);
- Draft Environmental Impact Report, Atwood Ranch Unit III Subdivision (2002: 19 pp + 8 photos on 4 plates);
- California Energy Commission Staff Report on GWF Tracy Peaker Project (2002: 17 pp + 3 photos; follow-up report of 3 pp);
- Initial Study and Negative Declaration, Silver Bend Apartments, Placer County (2002: 13 pp);
- UC Merced Long-range Development Plan DEIR and UC Merced Community Plan DEIR (2001: 26 pp);
- Initial Study, Colusa County Power Plant (2001: 6 pp);
- Comments on Proposed Dog Park at Catlin Park, Folsom, California (2001: 5 pp + 4

photos);
- Pacific Lumber Co. (Headwaters) Habitat Conservation Plan and Environmental Impact Report (1998: 28 pp);
- Final Environmental Impact Report/Statement for Issuance of Take authorization for listed species within the MSCP planning area in San Diego County, California (Fed. Reg. 62 (60): 14938, San Diego Multi-Species Conservation Program) (1997: 10 pp);
- Permit (PRT-823773) Amendment for the Natomas Basin Habitat Conservation Plan, Sacramento, CA (Fed. Reg. 63 (101): 29020-29021) (1998);
- Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). (Fed. Reg. 64(176): 49497-49498) (1999: 8 pp);
- Review of the Draft Recovery Plan for the Arroyo Southwestern Toad (*Bufo microscaphus californicus*) (1998);
- Ballona West Bluffs Project Environmental Impact Report (1999: oral presentation);
- California Board of Forestry's proposed amended Forest Practices Rules (1999);
- Negative Declaration for the Sunset Skyranch Airport Use Permit (1999);
- Calpine and Bechtel Corporations' Biological Resources Implementation and Monitoring Program (BRMIMP) for the Metcalf Energy Center (2000: 10 pp);
- California Energy Commission's Final Staff Assessment of the proposed Metcalf Energy Center (2000);
- US Fish and Wildlife Service Section 7 consultation with the California Energy Commission regarding Calpine and Bechtel Corporations' Metcalf Energy Center (2000: 4 pp);
- California Energy Commission's Preliminary Staff Assessment of the proposed Metcalf Energy Center (2000: 11 pp);
- Site-specific management plans for the Natomas Basin Conservancy's mitigation lands, prepared by Wildlands, Inc. (2000: 7 pp);
- Affidavit of K. Shawn Smallwood in Spirit of the Sage Council, et al. (Plaintiffs) vs. Bruce Babbitt, Secretary, U.S. Department of the Interior, et al. (Defendants), Injuries caused by the No Surprises policy and final rule which codifies that policy (1999: 9 pp).

I also issued formal comments on the following documents:

- Draft Program Level EIR for Covell Village (2005; 19 pp);
- Bureau of Land Management Wind Energy Programmatic EIS Scoping document (2003: 7 pp.);
- NEPA Environmental Analysis for Biosafety Level 4 National Biocontainment Laboratory (NBL) at UC Davis (2003: 7 pp);
- Notice of Preparation of UC Merced Community and Area Plan EIR, on behalf of The Wildlife Society—Western Section (2001: 8 pp.);
- Preliminary Draft Yolo County Habitat Conservation Plan (2001; 2 letters totaling 35 pp.);
- Merced County General Plan Revision, notice of Negative Declaration (2001: 2 pp.);
- Notice of Preparation of Campus Parkway EIR/EIS (2001: 7 pp.);
- Draft Recovery Plan for the bighorn sheep in the Peninsular Range (*Ovis candensis*) (2000);

- Draft Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*), on behalf of The Wildlife Society—Western Section (2000: 10 pp.);
- Sierra Nevada Forest Plan Amendment Draft Environmental Impact Statement, on behalf of The Wildlife Society—Western Section (2000: 7 pp.);
- State Water Project Supplemental Water Purchase Program, Draft Program EIR (1997);
- Davis General Plan Update EIR (2000);
- Turn of the Century EIR (1999: 10 pp);
- Proposed termination of Critical Habitat Designation under the Endangered Species Act (Fed. Reg. 64(113): 31871-31874) (1999);
- NOA Draft Addendum to the Final Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, termed the HCP 5-Point Policy Plan (Fed. Reg. 64(45): 11485 - 11490) (1999; 2 pp + attachments);
- Covell Center Project EIR and EIR Supplement (1997).

Position Statements I prepared the following position statements for the Western Section of The Wildlife Society, and one for nearly 200 scientists:

- Recommended that the California Department of Fish and Game prioritize the extermination of the introduced southern water snake in northern California. The Wildlife Society--Western Section (2001);
- Recommended that The Wildlife Society—Western Section appoint or recommend members of the independent scientific review panel for the UC Merced environmental review process (2001);
- Opposed the siting of the University of California's 10th campus on a sensitive vernal pool/grassland complex east of Merced. The Wildlife Society--Western Section (2000);
- Opposed the legalization of ferret ownership in California. The Wildlife Society--Western Section (2000);
- Opposed the Proposed "No Surprises," "Safe Harbor," and "Candidate Conservation Agreement" rules, including permit-shield protection provisions (Fed. Reg. Vol. 62, No. 103, pp. 29091-29098 and No. 113, pp. 32189-32194). This statement was signed by 188 scientists and went to the responsible federal agencies, as well as to the U.S. Senate and House of Representatives.

Printed Mass Media

Smallwood, K.S., D. Mooney, and M. McGuinness. 2003. We must stop the UCD biolab now. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 2002. Spring Lake threatens Davis. Op-Ed to the Davis Enterprise.

Smallwood, K.S. Summer, 2001. Mitigation of habitation. The Flatlander, Davis, California.

Entrikan, R.K. and K.S. Smallwood. 2000. Measure O: Flawed law would lock in new taxes. Op-

Ed to the Davis Enterprise.

Smallwood, K.S. 2000. Davis delegation lobbies Congress for Wildlife conservation. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 1998. Davis Visions. The Flatlander, Davis, California.

Smallwood, K.S. 1997. Last grab for Yolo's land and water. The Flatlander, Davis, California.

Smallwood, K.S. 1997. The Yolo County HCP. Op-Ed to the Davis Enterprise.

Radio/Television

FOX News, Energy in America: Dead Birds Unintended Consequence of Wind Power Development, August 2011.

KXJZ Capital Public Radio -- Insight (Host Jeffrey Callison). Mountain lion attacks (with guest Professor Richard Coss). 23 April 2009;

KXJZ Capital Public Radio -- Insight (Host Jeffrey Callison). Wind farm Rio Vista Renewable Power. 4 September 2008;

KQED QUEST Episode #111. Bird collisions with wind turbines. 2007;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. December 27, 2001;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. May 3, 2001;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. February 8, 2001;

KDVS Speaking in Tongues (host Ron Glick & Shawn Smallwood), California Energy Crisis: 1 hour. Jan. 25, 2001;

KDVS Speaking in Tongues (host Ron Glick), Headwaters Forest HCP: 1 hour. 1998;

Davis Cable Channel (host Gerald Heffernon), Burrowing owls in Davis: half hour. June, 2000;

Davis Cable Channel (hosted by Davis League of Women Voters), Measure O debate: 1 hour. October, 2000;

KXTV 10, In Your Interest, The Endangered Species Act: half hour. 1997.

Posters at Professional Meetings

Smallwood, K. S. and C. G. Thelander. 2005. Lessons learned from five years of avian mortality research in the Altamont Pass WRA. AWEA conference, Denver, May 2005.

Neher, L., L. Wilder, J. Woo, L. Spiegel, D. Yen-Nakafugi, and K.S. Smallwood. 2005. Bird's eye view on California wind. AWEA conference, Denver, May 2005.

Smallwood, K. S., C. G. Thelander and L. Spiegel. 2003. Toward a predictive model of avian fatalities in the Altamont Pass Wind Resource Area. Windpower 2003 Conference and Convention, Austin, Texas.

Smallwood, K.S. and Eva Butler. 2002. Pocket Gopher Response to Yellow Star-thistle Eradication as part of Grassland Restoration at Decommissioned Mather Air Force Base, Sacramento County, California. White Mountain Research Station Open House, Barcroft Station.

Smallwood, K.S. and Michael L. Morrison. 2002. Fresno kangaroo rat (*Dipodomys nitratoides*) Conservation Research at Resources Management Area 5, Lemoore Naval Air Station. White Mountain Research Station Open House, Barcroft Station.

Smallwood, K.S. and E.L. Fitzhugh. 1989. Differentiating mountain lion and dog tracks. Third Mountain Lion Workshop, Prescott, AZ.

Smith, T. R. and K. S. Smallwood. 2000. Effects of study area size, location, season, and allometry on reported *Sorex* shrew densities. Annual Meeting of the Western Section of The Wildlife Society.

Presentations at Professional Meetings and Seminars

Evaluation of nest boxes as a burrowing owl conservation strategy. Sacramento Chapter of the Western Section, The Wildlife Society. Sacramento, California, 26 August 2013.

Predicting collision hazard zones to guide repowering of the Altamont Pass. Conference on wind power and environmental impacts. Stockholm, Sweden, 5-7 February 2013.

Impacts of Wind Turbines on Wildlife. California Council for Wildlife Rehabilitators, Yosemite, California, 12 November 2012.

Impacts of Wind Turbines on Birds and Bats. Madrone Audubon Society, Santa Rosa, California, 20 February 2012.

Comparing Wind Turbine Impacts across North America. California Energy Commission Staff Workshop: Reducing the Impacts of Energy Infrastructure on Wildlife, 20 July 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. California Energy Commission

Staff Workshop: Reducing the Impacts of Energy Infrastructure on Wildlife, 20 July 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. Alameda County Scientific Review Committee meeting, 17 February 2011

Comparing Wind Turbine Impacts across North America. Conference on Wind energy and Wildlife impacts, Trondheim, Norway, 3 May 2011.

Update on Wildlife Impacts in the Altamont Pass Wind Resource Area. Raptor Symposium, The Wildlife Society—Western Section, Riverside, California, February 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. Raptor Symposium, The Wildlife Society—Western Section, Riverside, California, February 2011.

Wildlife mortality caused by wind turbine collisions. Ecological Society of America, Pittsburgh, Pennsylvania, 6 August 2010.

Map-based repowering and reorganization of a wind farm to minimize burrowing owl fatalities. California burrowing Owl Consortium Meeting, Livermore, California, 6 February 2010.

Environmental barriers to wind power. Getting Real About Renewables: Economic and Environmental Barriers to Biofuels and Wind Energy. A symposium sponsored by the Environmental & Energy Law & Policy Journal, University of Houston Law Center, Houston, 23 February 2007.

Lessons learned about bird collisions with wind turbines in the Altamont Pass and other US wind farms. Meeting with Japan Ministry of the Environment and Japan Ministry of the Economy, Wild Bird Society of Japan, and other NGOs Tokyo, Japan, 9 November 2006.

Lessons learned about bird collisions with wind turbines in the Altamont Pass and other US wind farms. Symposium on bird collisions with wind turbines. Wild Bird Society of Japan, Tokyo, Japan, 4 November 2006.

Responses of Fresno kangaroo rats to habitat improvements in an adaptive management framework. California Society for Ecological Restoration (SERCAL) 13th Annual Conference, UC Santa Barbara, 27 October 2006.

Fatality associations as the basis for predictive models of fatalities in the Altamont Pass Wind Resource Area. EEI/APLIC/PIER Workshop, 2006 Biologist Task Force and Avian Interaction with Electric Facilities Meeting, Pleasanton, California, 28 April 2006.

Burrowing owl burrows and wind turbine collisions in the Altamont Pass Wind Resource Area. The Wildlife Society—Western Section Annual Meeting, Sacramento, California, February 8, 2006.

Mitigation at wind farms. Workshop: Understanding and resolving bird and bat impacts. American Wind Energy Association and Audubon Society. Los Angeles, CA. January 10 and 11, 2006.

Incorporating data from the California Wildlife Habitat Relationships (CWHR) system into an impact assessment tool for birds near wind farms. Shawn Smallwood, Kevin Hunting, Marcus Yee, Linda Spiegel, Monica Parisi. Workshop: Understanding and resolving bird and bat impacts. American Wind Energy Association and Audubon Society. Los Angeles, CA. January 10 and 11, 2006.

Toward indicating threats to birds by California's new wind farms. California Energy Commission, Sacramento, May 26, 2005.

Avian collisions in the Altamont Pass. California Energy Commission, Sacramento, May 26, 2005.

Ecological solutions for avian collisions with wind turbines in the Altamont Pass Wind Resource Area. EPRI Environmental Sector Council, Monterey, California, February 17, 2005.

Ecological solutions for avian collisions with wind turbines in the Altamont Pass Wind Resource Area. The Wildlife Society—Western Section Annual Meeting, Sacramento, California, January 19, 2005.

Associations between avian fatalities and attributes of electric distribution poles in California. The Wildlife Society—Western Section Annual Meeting, Sacramento, California, January 19, 2005.

Minimizing avian mortality in the Altamont Pass Wind Resources Area. UC Davis Wind Energy Collaborative Forum, Palm Springs, California, December 14, 2004.

Selecting electric distribution poles for priority retrofitting to reduce raptor mortality. Raptor Research Foundation Meeting, Bakersfield, California, November 10, 2004.

Responses of Fresno kangaroo rats to habitat improvements in an adaptive management framework. Annual Meeting of the Society for Ecological Restoration, South Lake Tahoe, California, October 16, 2004.

Lessons learned from five years of avian mortality research at the Altamont Pass Wind Resources Area in California. The Wildlife Society Annual Meeting, Calgary, Canada, September 2004.

The ecology and impacts of power generation at Altamont Pass. Sacramento Petroleum Association, Sacramento, California, August 18, 2004.

Burrowing owl mortality in the Altamont Pass Wind Resource Area. California Burrowing Owl Consortium meeting, Hayward, California, February 7, 2004.

Burrowing owl mortality in the Altamont Pass Wind Resource Area. California Burrowing Owl

Symposium, Sacramento, November 2, 2003.

Raptor Mortality at the Altamont Pass Wind Resource Area. National Wind Coordinating Committee, Washington, D.C., November 17, 2003.

Raptor Behavior at the Altamont Pass Wind Resource Area. Annual Meeting of the Raptor Research Foundation, Anchorage, Alaska, September, 2003.

Raptor Mortality at the Altamont Pass Wind Resource Area. Annual Meeting of the Raptor Research Foundation, Anchorage, Alaska, September, 2003.

California mountain lions. Ecological & Environmental Issues Seminar, Department of Biology, California State University, Sacramento, November, 2000.

Intra- and inter-turbine string comparison of fatalities to animal burrow densities at Altamont Pass. National Wind Coordinating Committee, Carmel, California, May, 2000.

Using a Geographic Positioning System (GPS) to map wildlife and habitat. Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

Suggested standards for science applied to conservation issues. Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

The indicators framework applied to ecological restoration in Yolo County, California. Society for Ecological Restoration, September 25, 1999.

Ecological restoration in the context of animal social units and their habitat areas. Society for Ecological Restoration, September 24, 1999.

Relating Indicators of Ecological Health and Integrity to Assess Risks to Sustainable Agriculture and Native Biota. International Conference on Ecosystem Health, August 16, 1999.

A crosswalk from the Endangered Species Act to the HCP Handbook and real HCPs. Southern California Edison, Co. and California Energy Commission, March 4-5, 1999.

Mountain lion track counts in California: Implications for Management. Ecological & Environmental Issues Seminar, Department of Biological Sciences, California State University, Sacramento, November 4, 1998.

“No Surprises” -- Lack of science in the HCP process. California Native Plant Society Annual Conservation Conference, The Presidio, San Francisco, September 7, 1997.

In Your Interest. A half hour weekly show aired on Channel 10 Television, Sacramento. In this episode, I served on a panel of experts discussing problems with the implementation of the

Endangered Species Act. Aired August 31, 1997.

Spatial scaling of pocket gopher (*Geomyidae*) density. Southwestern Association of Naturalists 44th Meeting, Fayetteville, Arkansas, April 10, 1997.

Estimating prairie dog and pocket gopher burrow volume. Southwestern Association of Naturalists 44th Meeting, Fayetteville, Arkansas, April 10, 1997.

Ten years of mountain lion track survey. Fifth Mountain Lion Workshop, San Diego, February 27, 1996.

Study and interpretive design effects on mountain lion density estimates. Fifth Mountain Lion Workshop, San Diego, February 27, 1996.

Small animal control. Session moderator and speaker at the California Farm Conference, Sacramento, California, Feb. 28, 1995.

Small animal control. Ecological Farming Conference, Asylomar, California, Jan. 28, 1995.

Habitat associations of the Swainson's Hawk in the Sacramento Valley's agricultural landscape. 1994 Raptor Research Foundation Meeting, Flagstaff, Arizona.

Alfalfa as wildlife habitat. Seed Industry Conference, Woodland, California, May 4, 1994.

Habitats and vertebrate pests: impacts and management. Managing Farmland to Bring Back Game Birds and Wildlife to the Central Valley. Yolo County Resource Conservation District, U.C. Davis, February 19, 1994.

Management of gophers and alfalfa as wildlife habitat. Orland Alfalfa Production Meeting and Sacramento Valley Alfalfa Production Meeting, February 1 and 2, 1994.

Patterns of wildlife movement in a farming landscape. Wildlife and Fisheries Biology Seminar Series: Recent Advances in Wildlife, Fish, and Conservation Biology, U.C. Davis, Dec. 6, 1993.

Alfalfa as wildlife habitat. California Alfalfa Symposium, Fresno, California, Dec. 9, 1993.

Management of pocket gophers in Sacramento Valley alfalfa. California Alfalfa Symposium, Fresno, California, Dec. 8, 1993.

Association analysis of raptors in a farming landscape. Plenary speaker at Raptor Research Foundation Meeting, Charlotte, North Carolina, Nov. 6, 1993.

Landscape strategies for biological control and IPM. Plenary speaker, International Conference on Integrated Resource Management and Sustainable Agriculture, Beijing, China, Sept. 11, 1993.

Landscape Ecology Study of Pocket Gophers in Alfalfa. Alfalfa Field Day, U.C. Davis, July 1993.

Patterns of wildlife movement in a farming landscape. Spatial Data Analysis Colloquium, U.C. Davis, August 6, 1993.

Sound stewardship of wildlife. Veterinary Medicine Seminar: Ethics of Animal Use, U.C. Davis. May 1993.

Landscape ecology study of pocket gophers in alfalfa. Five County Grower's Meeting, Tracy, California. February 1993.

Turbulence and the community organizers: The role of invading species in ordering a turbulent system, and the factors for invasion success. Ecology Graduate Student Association Colloquium, U.C. Davis. May 1990.

Evaluation of exotic vertebrate pests. Fourteenth Vertebrate Pest Conference, Sacramento, California. March 1990.

Analytical methods for predicting success of mammal introductions to North America. The Western Section of the Wildlife Society, Hilo, Hawaii. February 1988.

A state-wide mountain lion track survey. Sacramento County Dept Parks and Recreation. April 1986.

The mountain lion in California. Davis Chapter of the Audubon Society. October 1985.

Ecology Graduate Student Seminars, U.C. Davis, 1985-1990: Social behavior of the mountain lion; Mountain lion control; Political status of the mountain lion in California.

Other forms of Participation at Professional Meetings

- Scientific Committee, Conference on Wind energy and Wildlife impacts, Stockholm, Sweden, February 2013.

- Workshop co-presenter at Birds & Wind Energy Specialist Group (BAWESG) Information sharing week, Bird specialist studies for proposed wind energy facilities in South Africa, Endangered Wildlife Trust, Darling, South Africa, 3-7 October 2011.

- Scientific Committee, Conference on Wind energy and Wildlife impacts, Trondheim, Norway, 2-5 May 2011.

- Chair of Animal Damage Management Session, The Wildlife Society, Annual Meeting, Reno, Nevada, September 26, 2001.

- Chair of Technical Session: Human communities and ecosystem health: Comparing perspectives and making connection. Managing for Ecosystem Health, International Congress on Ecosystem Health, Sacramento, CA August 15-20, 1999.

- Student Awards Committee, Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

- Student Mentor, Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

Reviews of Journal Papers (Scientific journals for whom I've provided peer review)

Journal	**Journal**
American Naturalist	Journal of Animal Ecology
Journal of Wildlife Management	Western North American Naturalist
Auk	Journal of Raptor Research
Biological Conservation	National Renewable Energy Lab reports
Canadian Journal of Zoology	Oikos
Ecosystem Health	The Prairie Naturalist
Environmental Conservation	Restoration Ecology
Environmental Management	Southwestern Naturalist
Functional Ecology	The Wildlife Society--Western Section Trans.
Journal of Zoology (London)	Proc. Int. Congress on Managing for Ecosystem Health
Journal of Applied Ecology	Transactions in GIS
Ecology	Tropical Ecology
Biological Control	The Condor

Committees

- Scientific Review Committee, Alameda County, Altamont Pass Wind Resource Area
- Ph.D. Thesis Committee, Steve Anderson, University of California, Davis
- MS Thesis Committee, Marcus Yee, California State University, Sacramento

Other Professional Activities or Products

Testified in Federal Court in Denver during 2005 over the fate of radio-nuclides in the soil at Rocky Flats Plant after exposure to burrowing animals. My clients won a judgment of $553,000,000. I

have also testified in many other cases of litigation under CEQA, NEPA, the Warren-Alquist Act, and other environmental laws. My clients won most of the cases for which I testified.

Testified in Skamania County Hearing in 2009 on the potential impacts of zoning the County for development of wind farms and hazardous waste facilities.

Testified in deposition in 2007 in the case of O'Dell et al. vs. FPL Energy in Houston, Texas.

Testified in Klickitat County Hearing in 2006 on the potential impacts of the Windy Point Wind Farm.

Memberships in Professional Societies

The Wildlife Society
Raptor Research Foundation

Honors and Awards

Certificate of Appreciation, The Wildlife Society—Western Section, 2000, 2001
Fulbright Research Fellowship to Indonesia, 1987.
Northern California Athletic Association Most Valuable Cross Country Runner, 1984.
J.G. Boswell Full Academic Scholarship, 1981 (Paid expenses for undergraduate education).
American Legion Award, Corcoran High School, 1981, and John Muir Junior High, 1977.
CIF Section Champion, Cross Country in 1978 and Track & Field 2 mile run in 1981.
National Junior Record, 20 kilometer run, 1982.
National Age Group Record, 1500 meter run, 1978

Community Activities

District 64 Little League Umpire, 2003-2007
Dixon Little League Umpire, 2006-07
Davis Little League Chief Umpire and Board member, 2004-2005
Davis Little League Safety Officer, 2004-2005
Davis Little League Certified Umpire, 2002-2004
Davis Little League Scorekeeper, 2002
Davis Visioning Group member
Petitioner for Writ of Mandate under the California Environmental Quality Act against City of Woodland decision to approve the Spring Lake Specific Plan, 2002

Served on campaign committees for City Council candidates