BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of Firelands Wind, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Wind-Powered Electric Generation Facility in Huron and Erie Counties, Ohio.	)))))	Case No: 18-1607-EL-BGN

DIRECT TESTIMONY OF K. SHAWN SMALLWOOD ON BEHALF OF THE LOCAL RESIDENT INTERVENORS

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1. Provide your name and address.

My name is Kenneth Shawn Smallwood, Ph.D., and I live and work at 3108 Finch Street, Davis, California, 95616.

2. On whose behalf are you testifying?

I am testifying on behalf of the Black Swamp Bird Observatory, 13551 West State Route 2, Oak Harbor, Ohio 43449.

3. What are your qualifications for offering testimony on this matter?

I was conferred a Ph.D. degree in Ecology from the University of California at Davis in 1990. Since 1985, I performed research on animal density and distribution, habitat selection, conservation of rare and endangered species, and interactions between wildlife and human infrastructure and activities. I have performed research and monitoring on renewable energy projects for 21 years, and I have authored numerous peer-reviewed reports, papers, and book chapters on fatality monitoring, fatality rate estimation, mitigation, micro-siting, and other issues related to biological impacts of wind energy generation. I served for five years on the Alameda County Scientific Review Committee (SRC) that was charged with overseeing the fatality monitoring and mitigation measures in the Altamont Pass Wind Resource Area (APWRA). I prepared many comment letters on proposed renewable energy projects. I collaborate with colleagues worldwide on the underlying science and policy issues related to renewable energy impacts on wildlife.

Most of my field research on wildlife and wind energy has been in the APWRA, which is where much of the research funding has been directed to understanding factors related to wind turbine collisions and to finding solutions. The APWRA is the longest-monitored wind resource area in the world for collision fatalities and relative abundance and behaviors of affected species. In the APWRA, I have performed research on bat behavior around wind turbines, estimation of fatality rates, detection trials used in fatality monitoring and activity levels relative to terrain, season, time of night, and wind and weather conditions. My studies have involved acoustic detectors, but most of my direct observations of bats around wind turbines have been through a telephoto lens mounted on a thermal-imaging camera, which I manned for 995 hours over 7 years. My studies of bat fatality monitoring have focused on the effects of the fatality search interval, the performance of scent-detection dogs versus human searchers at finding dead bats, and the methods of estimation of the undetected proportion of bat fatalities.

I have also collected and analyzed data from bat studies performed by others at many wind projects. I have been involved with renewable energy impacts on all fronts – study design, fieldwork on fatalities and use and behavior and ecological relationships, study administration, hypothesis-testing, report-writing, presentations at meetings, formulation of mitigation, micro-siting, study review, policy review and decision-making, and public outreach. And I have worked on wind and wildlife issues for county, state and federal government agencies, environmental organizations, consulting firms, individuals, and wind companies.

My CV is attached as Exhibit A.

4. What sources have you relied upon to draw conclusions about the studies of baseline conditions and risk analysis of the Emerson Creek wind project's potential impacts to bats?

I reviewed all reports of bat acoustic monitoring and mist-net surveys provided by Firelands Wind, LLC as part of its Application for a Certificate of Environmental Compatibility and Public Need to Construct a Wind-Powered Electric Generation Facility in Huron and Erie Counties, Ohio, Case No. 18-1607-EL-BGN regarding the proposed Emerson Creek Wind Energy project (Firelands Wind 2019). I will refer to this wind project as the "Emerson Creek wind project" or as the "Project." The specific reports I reviewed are cited in my testimony where appropriate and appear in my list of References Cited. I reviewed the testimony on the Project of Chris Leftwich and Rhett Good. I also relied upon my own research data and the data and reports of others where I needed to refer to patterns that are relevant to this project, as appropriate.

5. Were the goals and objectives of the bat studies appropriate for the needs to inform decision-makers and the public about potential project impacts to bats and how to mitigate the impacts?

The stated purpose of Tetra Tech's (2011) preconstruction bat study was to "provide data as to the presence/absence of the federally endangered Indiana bat, and bat species composition within the Project Area." The purpose of Tetra Tech's (2012) studies were to: (1) Provide information on bat activity within the Project Area; (2) Compare relative levels of bat activity among stations; (3) Identify peak periods of bat activity, and how these peaks may relate to weather conditions; and, (4) Maybe to assess potential risk to bat species from the proposed wind Project. The objective of Ritzert et al. (2011) was to quantify bat use in the study area. The objectives of Sichmeller et al. (2012) were to: (1) Determine the presence/absence of the endangered Indiana bat; (2) Describe roosting and foraging habitat of the Indiana bat (if present); and, (3) Document the occurrence of other bat species. The survey goals of Baer et al. (2017a,b) and Wetzel et al. (2018) were to: (1) Document bat species diversity and abundance within the Project boundary; (2) "Inform understanding of roosting habitat, foraging range, and spatial distribution of federally listed Indiana bats (*Myotis sodalis*) and northern long-eared bats (*Myotis septentrionalis*), and state listed Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) and eastern small-footed bats (*Myotis leibii*)."

As evident in the preceding paragraph, goals and objectives varied considerably among the investigator teams, ranging from an early focus on bat activity in general to a later focus on the presence of particular species. The shift in focus might have reflected an emerging understanding of wind energy's direct and cumulative impacts to particular species of bats. Whatever the reasons for the shift in focus, changes in goals and objectives also require changes in interpretation of survey results because the study design, field methods and levels of survey effort would have been tailored toward the study's goals and objectives. However, sometimes new objectives can be added opportunistically to data collected for other purposes, so long as the data were suitable to the new objectives.

Parallel with the shift in focus of bat studies in the Project Area was a shift in understanding of the Project. In 2011, the Project was characterized simply as a wind project to be constructed within a 45,920-acre study area (Ritzert et al. 2011), or as 62 wind turbines for 99 MW on 43,000 acres (Tetra Tech 2012). In 2012, it was characterized as 85 turbines for 150 MW on 43,000 acres (Sichmeller et al. (2012). In 2017 and 2018, it was characterized only as wind projects occurring within study area boundaries (Baer et al. 2017a,b; Wetzel et al. 2018).

In 2019, it turned out the Project would be up to 87 turbines for 297.66 MW on 32,000 acres, but probably 66 to 71 turbines if size is 4.2 MW or 4.5 MW (Firelands Wind 2019). Apparently unknown to the preconstruction bat investigators, the new turbines would range in hub height from 105 to 125 m, in rotor diameter from 145 m to 150 m, in total height at 12:oo from 180 to 199.5 m, and in height at 06:00 from 30 to 50.5 m These characterizations of the project, and how they changed, could have affected the scope of bat surveys to be implemented and whether certain of the stated goals and objectives could have been achieved. For example, had any of the preconstruction bat investigators been aware of turbine blades rotating up to 199.5 m, it is doubtful they would have been content placing their acoustic detectors no higher than 40 to 50 m above ground.

Information on bat activity.--The first objective pursued by Tetra Tech (2012) and the only objective of Ritzert et al. (2011) was so vague as to have been of little value. Information on bat activity can consist of just about any observation, including glances skyward at twilight or a review of natural history compendia. Information on bat activity in the Project Area might consist of a list of species potentially occurring in the area, or a detailed account of the numerical and behavior patterns of each and every bat species in the area. It could mean just about anything, so it is too vague to serve as a useful objective.

Comparing bat activity between stations.--Tetra Tech's (2012) second objective of spatially comparing bat activity levels was more specific. Although left unstated in the report, the usefulness of this information is in the relative risk that proposed turbine locations pose to bats. The implication is that bat collision risk varies among wind turbines based on where the turbines are located on the landscape and where their rotors are placed relative to the ground, i.e., the turbine rotor's height domain between the rotor's maximum reaches of the blade-tip at the

06:00 and 12:00 positions. A spatial comparison of bat activity levels is relevant to micro-siting to minimize impacts. The objective was therefore appropriate.

Peaks in bat activity.--Tetra Tech's (2012) third objective of identifying peak periods of bat activity and whether and how those peaks relate to weather conditions is also much more specific. Also left unstated in the report, the usefulness of this information is in the relative risk that turbine operations pose to bats. The implications are that bat activity levels are predictive of collision fatality rates, and both activity levels and collision risk vary with weather conditions. The usefulness of this information would be the identification of seasonal or weather-related periods when turbine operations could be curtailed or bat deterrence methods implemented to minimize collision fatality rates. The objective was appropriate.

Risk assessment.--Tetra Tech's (2012) fourth objective of possibly assessing risk to bat species was the most appropriate of all the study objectives. The uncertainty expressed over its implementation was therefore curious.

Presence/absence of Indiana bat.--Sichmeller et al.'s (2012) first objective of determining presence or absence of Indiana bat was sufficiently specific, though unrealistic in regard an absence determination. Determining presence is certainly an achievable objective when presence is indeed determined. Determining absence, however, is much more difficult. "Detection surveys" are typically used to either detect a species when the species is present or to support an absence determination when the surveys failed to detect the species. Detection surveys typically reflect an agency's or professional organization's opinion that sufficient effort was committed to justify an absence determination from a negative finding. In truth, however, absence cannot be proven; only presence can be proven. This distinction is especially relevant to species of bats, some of which are extremely difficult to detect. A mist net spans a tiny fraction of the airspace visited by bats, and the same is true of the airspace that is monitored by an acoustic detector.

Describe roosting and foraging habitat.--Both Sichmeller et al.'s (2012) and Baer et al. (2017a,b) and Wetzel et al.'s (2018) second objective was specific, but it required specific types of methods to locate roosting habitat and to compare use to availability to infer foraging habitat. Methods were not implemented to locate roosts or to infer foraging habitat, so the second objective seemed out of place. And although the locations of roosts and foraging habitat intuitively might seem relevant to wind turbine collision risk, no scientific foundation has yet been established for either relationship. The second objective would be appropriate for primary research, but less so for applied research. Presumably, roost sites and foraging habitat might factor into a micro-siting strategy, but no such connection was made in the report. The second objective was probably inappropriate at the project-level.

Presence/absence of other bat species.--Sichmeller et al.'s (2012) third objective was specific, but deficient. Documentation of the presence of other bat species is achievable, but unless an effort is made to document the presence of all bat species, it is unclear what this objective would accomplish. What would documentation of the presence of big brown bat and eastern red bat tell the risk analyst about the Project's potential risk to Rafinesque's big-eared bats? The objective is appropriate, but incomplete in its formulation.

Document bat species diversity and abundance.--The first goal of Baer et al. (2017a,b) and Wetzel et al. (2018) was to document bat species diversity and abundance. It was unclear why this objective was relevant to risk assessment, as there is no established relationship between species diversity and wind energy impacts, nor between abundance and wind energy fatality rates. Any variation in the effects of abundance on collision mortality could easily by offset by variation in the effects of behavior on collision mortality. Nor was it clear that the objective was achievable by the field methods used, as species diversity and numerical abundance might express variation in detectability more than in true variation in diversity and numerical abundance. Until relationships are established between collision mortality and diversity or numerical abundance, the objective's appropriateness remains unclear.

6. Did the data convincingly achieve the goals and objectives of preconstruction bat studies?

One study goal the reports clearly acknowledged having achieved was a procedural goal. According to Baer et al. (2017a) and Wetzel et al. (2018), "The goal was accomplished by completing surveys in accordance with the 2017 *Range-wide Indiana Bat Summer Survey Guidelines* (USFWS 2017), 2009 Ohio Department of Natural Resources (ODNR) *On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio* (ODNR 2009), and the most recent *Ohio Division of Wildlife Guidance for Bat Permitted Biologist* (ODNR-DOW 2017)." Although it helps to achieve the minimum standards of existing survey protocols, the point of doing so is to achieve worthier goals such as the gathering of data useful for analyzing the Project's risk to bats.

Information on bat activity.--Both Ritzert et al. (2011) and Tetra Tech (2012) achieved their first objective to provide information on bat activity. However, this objective was too broad to be meaningful.

Comparing bat activity between stations.--Tetra Tech (2012) minimally achieved their second objective to compare relative bat activity levels among sampling stations. Only 4 locations were sampled, 2 at ground-level and 2 on met towers, each of which hosted 2 detectors, 1 at 5 m and 1 at 40 m above ground. Patterns in the data from the 6 detectors were largely confounded between location and height above ground, because the detectors sampled airspace at 3 heights among 4 locations. Thus, at any given height sampled, only 2 locations were comparable laterally within a study area of thousands of acres and between 66 and 85 wind turbines. Between the 2 met towers sampled, only 2 heights were comparable, and neither height was within the rotor zone of one of the turbines currently under consideration. Tetra Tech (2012) could have increased the capacity of their analysis by 50% had they included data collected by Ritzert et al. (2011), but no reference was even made to Ritzert et al. (2011). Whereas relative bat activity levels were compared among sampling locations, their comparison was grossly inadequate. Inference drawn from the small number of sites sampled could not be confidently extended to predict impacts among the Project's wind turbines.

It would have been, of course, impossible for Ritzert et al. (2011) to compare survey results spatially. Their acoustic detectors were mounted on a single met tower. Combined with the data of Tetra Tech (2012), however, the capacity for spatial analysis of the acoustic data could have been increased.

The mist net surveys were better suited for comparing results spatially, but mist net locations were not randomized and they targeted forest patches at the expense of other portions of the environment. It was helpful of the reports to include completed data sheets. It was unfortunate, however, that the data sheet including the capture of an Indiana bat was omitted from Baer et al. (2017b). It was also unfortunate that no effort was made to generate a comprehensive GIS coverage of mist net locations and acoustic detection sampling stations for comparison of results to proposed wind turbine locations. A GIS map layer of results could also have been compared to other coverages useful for modeling the relative abundances of particular bat species across the Project Area.

Peaks in bat activity.--Tetra Tech (2012) achieved their third objective to identify peaks in bat activity levels and relate those peaks to weather conditions. Their third objective was achieved for the northern met tower sampled in 2011, but a data gap appears to have prevented the identification of an activity peak at the southern met tower (see Figure 5 of Tetra Tech 2012). Tetra Tech's (2012) activity peak was between about 18 and 24 July 2011 at the northern met tower, but it was between about 25 August and 2 September among all acoustic detectors. The activity peaks weakly correlated with wind speed and temperature, but the relationships between bat activity and weather variables resembled those I documented in my own work (Smallwood and Bell 2020b). Nevertheless, the correlations were too weak for informing an operational curtailment strategy, nor could the dates of the peaks in bat activity serve as a reliable basis for a curtailment strategy.

Adding to the unreliability of the dates of peak bat activity measured in 2011, Ritzert et al. (2011) identified an all-bat activity peak from about 23 July to 12 August 2010, which was a time period largely in between the dates of activity peaks documented by Tetra Tech (2012). Therefore, activity peaks appeared to have been complex in 2011 and differed from one year to the next. After 2 years of acoustic detection surveys in the Project Area, the date-span of an operational curtailment strategy intended to balance between a reduction of bat fatalities and minimization of lost energy generation could not be more resolved than about July 1 through September 15. Many more surveys would be needed to further resolve the span of dates that would be appropriate for a curtailment strategy.

Presence/absence determination.--According to Sichmeller et al. (2012), their first study objective was achieved. They concluded, "The results of the 2012 survey indicate that this species [Indiana bat] is not present within the ECWRA." However, as I pointed out earlier, absence is difficult to prove. And in fact, Sichmeller et al. (2012) was later proven wrong. Baer et al. (2017b) captured an Indiana bat on the study area in 2017. To support a presence/absence determination, a much larger survey effort was needed than the effort that had been committed through 2011. For example, the pattern in the mist-net capture data indicates a tenth bat species should be present in the study area, but a model fit to the capture data through 2018 also indicates that another 31,264 net-nights using the same protocol would be needed to capture an individual of that tenth species (Figure 1). Through 2011, members of only 6 of the 10 species likely present had been captured in mist nets, a deficiency later proven by additional mist-netting efforts in 2017 and 2018 (Figure 1).

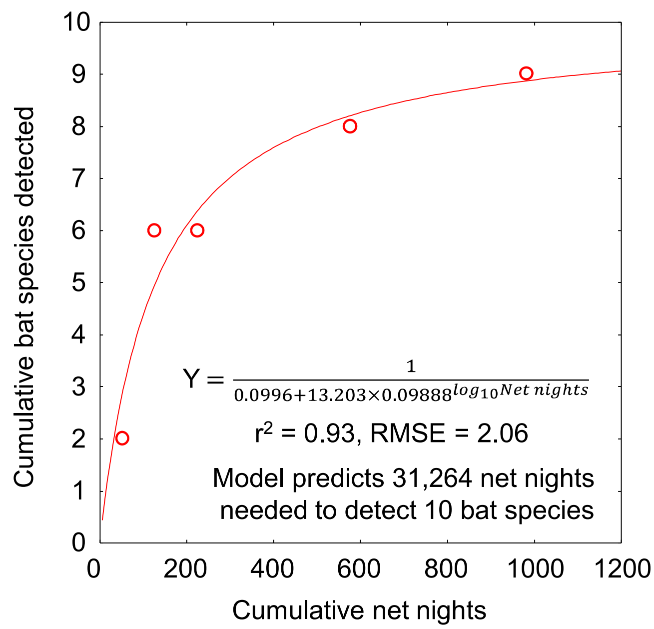


Figure 1. The number of bat species represented in mist net captures is a function of cumulative net nights (Data from Ritzert et al. 2011, Tetra Tech 2011, Sichmeller et al. 2012, Baer et al. 2017a,b, Wetzel et al. 2018). Based on the methods used between 2010 and 2018 in the Project Area, many thousands of net nights would be needed to capture members of 10 bat species that are present in the area.

Bat species diversity and abundance.--Although the first objective of Baer et al. (2017a,b) and Wetzel et al. (2018) was to document bat species diversity and abundance within the Project boundary, their field methods were less capable of achieving this objective than were the earlier mist-netting studies of 2011 and 2012 (Figure 2). By adding net-nights per station, these later investigators might have diluted the metric with less productive nights, possibly because bats learn to avoid the nets.

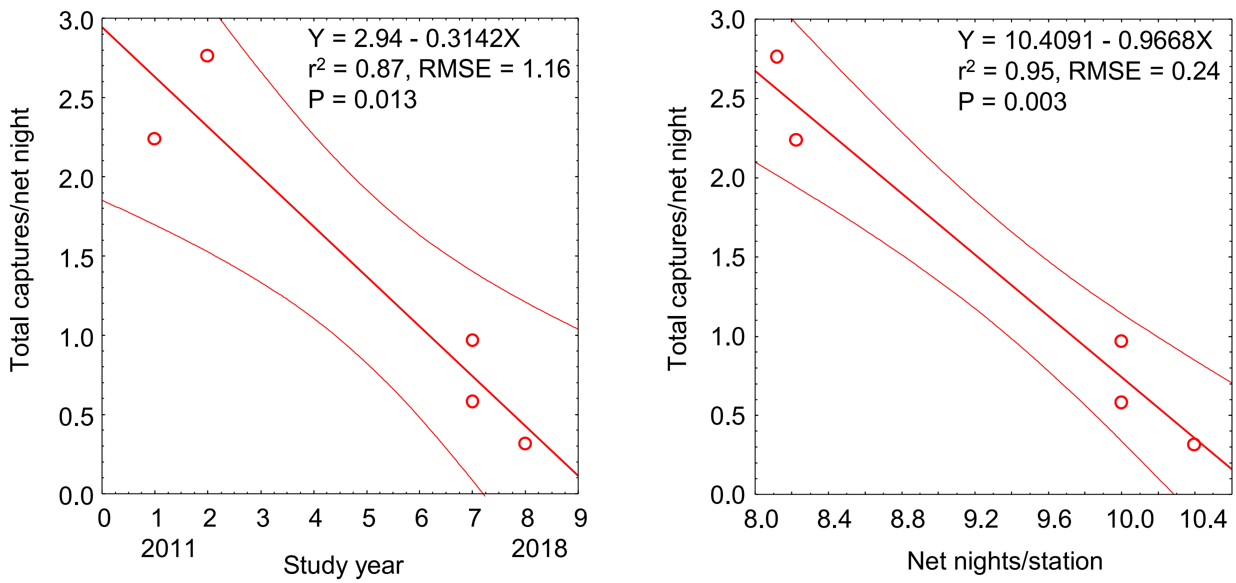


Figure 2. Bat captures/night declined in later study years (left graph), but this decline was better explained by the number of net nights/station, which had increased in later survey efforts (right graph).

Roosting and foraging habitat.--Sichmeller et al. (2012), Baer et al. (2017a,b) and Wetzel et al. (2018) devoted little effort to achieving their second objective of describing roosting and foraging habitat of the Indiana bat and other special-status species of bats, unless they thought that mist net captures could achieve this objective. However, almost all of the mist nets were placed within or adjacent to forest patches, and all of them were within the lowest few meters of the atmosphere in which bats forage. It appears the investigators had already decided where foraging habitat was located, and they sampled only that part of the environment. Whether and to what degree bats forage over agricultural fields of the Project Area remains unknown. Similarly, whether and to what degree bats forage at altitudes much higher than where mist nets were placed remains unknown because higher portions of the airspace were not sampled. No information was collected on spatial variation in foraging intensity across the Project Area or how that variation might affect wind turbine collision risk.

Mist nets alone could not inform of roosting habitat. Sichmeller et al. (2012) located a maternity roost inhabited by hundreds of little brown bats, and Baer et al. (2017b) located roost sites of Indiana bat by tracking the one bat they captured. Otherwise, nothing new was revealed about bat roosting habitat in the Project Area. No information was collected on spatial variation in roosting intensity across the Project Area or how that variation might affect wind turbine collision risk.

Risk assessment.--Tetra Tech, (2012) was the only report that included a stated objective of performing a risk assessment. Because Tetra Tech (2012) did not detect Indiana bat, they adopted little brown bat as a surrogate species for Indiana bat. And because little brown bats were detected much more often among ground stations, Tetra Tech (2012) speculated that it was "…reasonable to expect that potential direct collision or barotrauma impacts to little brown bat from the proposed Project will be low…" Tetra Tech (2012) implicitly defines impacts as fatalities, and speculates that fatalities will be few for their surrogate species because they rarely observed the surrogate species at the highest acoustic detection stations. However, if the few collision fatalities of Indiana bat happen to be the same few Indiana bats that reside in the Project Area, then the population-level impact would be devastating.

The other reports offered conclusions that were brief forms of risk analysis, even though they did not identify risk analysis as one of their study objectives. According to Ritzert et al. (2011:i), "Assuming a relationship between pre-construction bat activity and post-construction bat fatality rates exists, fatality rates at the ECWRA may be higher than…" certain named projects and lower than certain other named projects where fatality monitoring had been performed. However, Ritzert et al.'s (2011) comparison of bat passes per detector night to fatalities/MW/year were based on an assumption that did not bear scrutiny in later research. Not long after the survey of Ritzert et al. (2011), Hein et al. (2012) reported on their failed attempt to relate bat fatality rates to use rates measured in preconstruction surveys. More recently, I found only weak correlation between bat fatality rates based on surveys by scent-detection dogs and my previous night's thermal-imaging measurement of bat passage rates through rotors of the same turbines searched by the dogs (Smallwood and Bell 2020b). That I could only manage a weak correlation, even though I used the most effective fatality survey method available and fatality searches only hours separated from observed bat activity at the turbine, indicates there is little likelihood that bat fatality rates can be predicted from preconstruction use rates. Adding to this low likelihood of establishing such a relationship, Tetra Tech (2012) measured twice the bat passes/night in the same study area the very next year. Based on only two years of acoustic detection surveys in 2010 and 2011, variation in use rates appears to be very high at a given site.

Other reports presented overly confident risk assessments based on scant empirical foundation. Based on a survey effort that captured 16 bats of 2 species, Wetzel et al. (2018) concluded, "Results of this survey suggest probable summer absence of the target species; therefore, risk of the Project impacting these species during the summer maternity period (May 15 to Aug 15) is not evident." Based on a survey effort that captured 58 bats of 3 species, Baer et al. (2017a) concluded, "Results of this survey suggest that the target species are either absent, or present in such low densities that they were not detected; therefore, risk of the Project impacting these species during the summer maternity period (May 15 to Aug 15) is very low." According to Baer et al. (2017b), "The lack of northern long-eared bat captures suggests this species is either absent, or present in such low densities during the summer maternity period that current survey techniques failed to detect them." As demonstrated in Figure 1, these conclusions could not be supported from the level of survey efforts involved.

Another problem with the cursory risk assessments in the preceding paragraph was their extensions to the summer maternity period. The conclusions imply that bats killed by wind turbines during the summer maternity period are the only bats that could contribute to significant biological impacts. In fact, any bat killed by a wind turbine will be absent from the next summer maternity period, and hence will contribute nothing to productivity.

In another example of unfounded risk analysis, Baer et al. (2017b) conclude, "Following the recommendations put forth in the *Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects* (USFWS 2011) setting turbines at least 1,000 feet from suitable habitat in the southeastern portion of the Project Area would avoid the potential risk of Indiana bat collision." The 1,000-foot distance threshold likely served as an interim threshold until empirically-founded distance thresholds could be established for individual species. And then it might prove effective so long as it is applied as a distance threshold from suitable habitat. What is suitable habitat? Baer et al. (2017b) captured and tracked the movements of a single Indiana bat for 4 nights. Unfortunately, Baer et al. (2017b) provided no habitat analysis based on this bat's locations or the area it used. A review of the bat's locations indicates that the bat, in one way or another, used most or all of the landscape features and vegetation covers over which it traversed, including all of types of the landscape features and vegetation covers that compose the Project Area. If most or all of the Project Area is suitable habitat, then the 1,000-foot distance threshold would predict that there would be collision risk to Indiana bat posed by every wind turbine of the Project. Furthermore, the shortest nightly movement of this one Indiana bat was 692 m, or 2.3 times the 1,000-foot distance threshold. The farthest nightly distance traveled by this bat was 46.3 times farther than the 1,000-foot distance threshold. The 1,000-foot distance threshold relied upon by Baer et al. (2017b) in their risk assessment was clearly unreliable.

7. What are the appropriate goals and objectives of preconstruction bat studies?

Collision risk analysis is the obvious primary goal of any preconstruction bat study. Decision-makers and the public need to be aware of the risks in order to make informed decisions about the suitability of a project site and about micro-siting and other impact minimization measures. The risk to species that is posed by a project also needs to be analyzed with understanding of cumulative impacts contributed by wind energy and other sources of harm, injury and mortality. One should know which species of bats are susceptible to wind turbine collision mortality, and which species would become vulnerable to wind turbine collision should the project go forward and should wind turbines be built at preferred versus alternative sites within the project boundary. One should know how collision risk of proposed turbine sites is affected by nearness of the site to forest patches and water bodies, among other potential landscape settings affecting bat behavior. One should know the degree to which each species is attracted to operative wind turbines. One should also know the degree to which bat mortality is likely to be reduced by implementing various operational curtailment strategies or by implementing deterrents; that is, candidate mitigation measures need to be presented along with what is known of their efficacies. One should also know the accuracy to which post-construction mortality monitoring can be measured and whether and the degree to which efficacy of mitigation measures can be tested experimentally (Sinclair and DeGeorge 2016). One should know whether the building of the proposed wind project at the preferred location is worth the risk to bats and the costs of having to implement measures to reduce bat collision mortality.

These goals I listed in the preceding paragraph are all the more important for a group of animals of great ecological and economic importance. See Exhibit B, which is an article from the U.S. National Park Service entitled "Benefits of Bats" (found on the internet at https://www.nps.gov/subjects/bats/benefits-of-bats.htm). Due to their nocturnal activity and crypticity, scientists have struggled to learn more about bat ecology. Advances in understanding have come from technology, but also from breaking free of long-held assumptions. Bats continue to surprise us with their behaviors, movement patterns, and geographic range. Declining trends have caused concern for particular species, including for species that occur in the project area such as hoary bat (Frick et al. 2017, Rodhouse et al. 2019) and species that have been assigned special status such as Indiana bat and northern long-eared bat. This concern has even reached the Governor of Ohio, who recently proclaimed 24-31 October to be 'Bat Week'. See Exhibit C. According to Governor Mike DeWine, "Studies have shown that the loss of bats could cost the nation's agricultural industry more than $3.7 billion per year because of the pest-control benefits they provide." The source of the Governor's figure can be found in Boyles et al. (2011), who further resolved the potential economic loss to Ohio's agricultural industry at more than $740 million per year should bats be extirpated. With about 300,000 acres of farmland between Huron and Erie Counties, the findings of Boyles et al. (2011) would predict that the loss of bats would cost the agricultural industry in these Counties $22.2 million per year.

With the foregoing in mind, another appropriate goal would have been the achievement of objectives outlined by the US Fish and Wildlife Service's Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects revised in 2011. These objectives were "to: 1) determine anticipated take levels, 2) to develop monitoring plans, 3) to track take, and 4) to develop appropriate adaptive management plans." The most critical of these objectives in the context of preconstruction studies is the prediction of anticipated take, but of course the ability to predict take levels also depend on accurate estimation of take in other studies.

8. Are preconstruction use rates predictive of fatality rates at a proposed new wind project such as the Emerson Creek wind project?

Preconstruction studies measured bat use rates as a means of predicting post-construction fatality rates (Ritzert et al. 2011, Tetra Tech 2012). According to Ritzert et al. (2011), "…the expectation among the scientific and resource-management communities is that an association may exist for preconstruction activity and post-construction fatalities." However, *expectation* was perhaps too strong a term in this context for three reasons. First, there was no empirical foundation for this relationship in 2010-2011, nor is there foundation for it now. Second, the sources of error and bias are numerous, potentially of large magnitude, and largely unquantified (Table 1). Third, bats are known to be attracted to wind turbines (Cryan et al. 2014), and bats are known to actively forage within and close to the rotor-swept airspace of a turbine (Horn et al. 2008, Foo et al. 2017). If bats often go out of their way to visit wind turbines, then whatever bats were measured doing before construction is of little relevance other than documenting their presence in the project area. In my experience, bats do indeed go out of their way to visit operative wind turbines (Smallwood and Bell 2020b).

Researchers have worked for decades to increase the accuracy of fatality estimates at wind projects (for citations of papers and reports of this effort, see Smallwood 2007, 2013, 2017; Smallwood et al. 2018, 2020). Only recently have I felt that reasonably accurate fatality estimates are possible by using scent-detection dogs and integrating carcass detection trials into routine fatality monitoring (Smallwood et al. 2018, 2020). Metrics representing preconstruction use rates, on the other hand, have undergone much less scrutiny over estimation accuracy. Acoustic detection rates of bats, for example, are typically presented without error terms, such as a confidence interval. Mist-net captures of bats are presented without any information of the numbers and types of bats not captured. The uncertainties and potential biases are compounded when using one metric to predict another, such as using a metric representing preconstruction use rates to predict post-construction fatality rates. Substantial noise in either metric can prevent the recognition of a predictive relationship, but substantial noise in both metrics would leave little prospect of predicting fatalities from preconstruction use rates. Table 1 lists the sources of error and bias of which researchers are so far aware. Table 1 is intended to demonstrate just how daunting a task it is to predict fatalities from preconstruction surveys. I add that Table 1 does not address natural variation in interannual use rates and fatality rates, which can also prevent recognition of a predictive relationship even if fatality rates and use rates were both estimated with high accuracy and precision.

Table 1. Summary of factors affecting measurement and interpretation of fatality rates and use rates, including the main effects of factors, ranges of variation, and effect sizes. "APWRA" refers to research results from the Altamont Pass Wind Resource Area, which has been subject to more research than other wind resource areas.

Factor	**Effect**	**Range of variation**	**Effect size**
SAMPLING OF WIND PROJECTS			
Spatial distribution of monitored projects relative to available projects	Comparability	Publicly reported studies are geographically concentrated	Likely large
Temporal distribution of monitored projects relative to that of constructed projects	Comparability	USA installed capacity increased exponentially while monitoring reports increasingly unavailable	Unknown
Selection of projects with full range of fatality rates	Represent-ativeness	Only low fatality rates	Likely large
Selection of projects with deficient field methods	Comparability	Varies widely on various methods	Very large
WIND PROJECT FOOTPRINT			
Number of monitored wind turbines in project and monitoring duration	Fatality count	1 to hundreds of turbines per project	Very large
Selection of fatality and use survey plots within project	Comparability	High variation in coverage using multiple methods	Likely large
Number of wind turbines	Expansion	1 to thousands of turbines	Very large

Factor	Effect	Range of variation	Effect size
Tower type	None	3 types, mostly tubular	Likely none
Tower height	None	14 to 90 m, but mostly 80 m	Likely none
Rotor diameter	Unknown	8 m to 150 m	Unknown
Painting scheme	None	Mostly white in USA	Likely none
Rated capacity	Metric	40 KW to 3 MW, but increasing	Large
Terrain setting	Fatalities	Flat to mountainous	Very large
Construction grading	Fatalities	None to excavating pads into slopes	Very large
Nearness to met towers, utility lines, trees, rock formations	Fatalities	High variation	Large
Available prey base	Fatalities, Use rates	None to abundant prey items	Unknown, but often speculated
Overlap of nest territories	Fatalities	None vs nesting nearby or onsite	Unknown
Demographic composition of eagles	Fatalities	Varies among sites, with various implications for interactions	Likely large
FATALITY MONITORING			
Monitoring duration (years)	Fatality count	<1 year to >10 years	Very large
Maximum search radius	Fatality count	27.5 m to 126 m	Very large
Number of turbines monitored	Coverage, Fatality count	1 to hundreds	Very large
Use of finds outside max search radius	Fatality count	Included, excluded	18% of APWRA detections
Inter-transect spacing	Fatality count	4 m to 20 m	Unknown
Dog vs human searchers	Fatality count	Binary	Very large
Time limit on searches	Fatality count	1 hour per turbine at one project	Likely large
Unsearchable areas	Fatality count	Unknown	Large
Search interval	Fatality count	1-90 days	Very large
Multiple search intervals	Fatality estimate	Varies by how analysts combine estimates from different intervals	Likely varies
Incidental finds	Fatality count	Included, excluded	21% of APWRA detections
Whether counting injured animals (crippling bias)	Fatality count	Mobile, injured eagles often excluded	Likely large
Estimation of death date	Fatality count	Unknown	Unknown
Clearing search	Fatality count	Included, excluded	21% of APWRA detections

Factor	Effect	Range of variation	Effect size
Threshold of carcass remains for fatality determination	Fatality count	Not quantified	Large
Enforcement of searcher detection standard	Fatality count	4-fold variation in searcher detection, but no feasible means of enforcing standard without being able to readily recruit more searchers	Large
Whether estimating probability of false zero finding	Fatality adjustment	Usually not done	Likely large
CARCASS DETECTION TRIALS			
Trials for overall detection or separate trials for searcher error and carcass persistence	Fatality adjustment	Trials integrated into routine monitoring or performed separately	Large
Proportion trial carcasses placed upwind vs downwind	Fatality adjustment	None; placements have been randomized without regard to prevailing winds	Unknown
Placements beyond max search radius	Fatality adjustment	None; all placed within search radius	Likely moderate
Randomization by grid cell vs distance and bearing from turbine	Fatality adjustment	Both approaches used	Unknown
Searcher error trials			
Searcher awareness of trials	Fatality adjustment	Fully aware, suspicious, blind	Likely large
Searcher trial sample sizes	Fatality adjustment	A few to hundreds	Likely large
Number of searcher trials	Fatality adjustment	1 to many	Likely large
Days between carcass placement and searcher trial	Fatality adjustment	Usually 0 to 1, but increasingly randomized by days intervening each search	Modest
Species used in detection trials	Fatality adjustment	Never eagles, but just about every other species rock pigeons or larger	Large
Binning of trial carcasses by body size	Fatality adjustment	Sometimes geese and wild turkeys, but bin representing eagles can include species as small as rock pigeons	Large
Searcher accuracy in species identification	Fatality adjustment	Reported in two APWRA studies	Potentially large
Whether searcher trial carcasses confirmed available upon search	Fatality adjustment	Typical of more recent studies	Moderate to large

Factor	Effect	Range of variation	Effect size
Detection by distance from turbine	Fatality adjustment	Reported in two APWRA studies	Large
Carcass persistence trials			
Persistence trial duration	Fatality adjustment	7 days to 670 days (1 APWRA study), but usually 14-60 days	Large
Persistence trial carcass status check schedule and level of binning time periods between checks	Fatality adjustment	Varies, but days to next status check typically increase with days into trial	Small
Whether right-censuring for remaining carcasses at trial end	Fatality adjustment		Modest
Carcass status check errors	Fatality adjustment	Reported in two APWRA studies	Modest
Species placed in persistence trials as surrogates for eagles	Fatality adjustment	Rock pigeons to wild turkeys	Large
Placing fresh vs found/old carcasses	Fatality adjustment	Unknown due to use of found birds of unknown death dates	Modest
Number of carcasses placed per trial or per time period	Fatality adjustment	Few to dozens of larger carcasses representing eagles	Likely modest
Binning of trial carcasses by body size and whether surrogates are smaller than eagle carcasses	Fatality adjustment	Sometimes geese and wild turkeys, but bin representing eagles can include species as small as rock pigeons	Large
Seasonal representation of persistence trials	Fatality adjustment	1 to 4 seasons	Unknown
FATALITY ESTIMATOR			
Estimator	Fatality adjustment	Multiple estimators of fatality count adjusted for undetected	Small
Carcass persistence metric	Fatality adjustment	Mean days to removal, proportion carcasses remaining	Potentially large
Whether assuming exponential rate of carcass removal	Fatality adjustment	Linked to carcass persistence metric	Potentially modest to large
Background mortality	Fatality adjustment	Never addressed	Small
USE RATE MONITORING			
Terrain settings of survey stations	Relevance	Flat to hilly	Modest
Spatial coverage and grain within project area	Relevance, comparability	Vantage points, views of turbine sites, even coverage of project	Likely large
Nearness of stations to turbine sites	Relevance	High variation	Likely large

Factor	**Effect**	**Range of variation**	**Effect size**
Seasonal representation	Relevance, comparability	1 month (April) to 4 seasons, some covering same season over ≥2 years	Large
Time of day representation	Relevance, comparability	Most studies neglect to report distribution of start times	
Wind speed representation	Relevance, comparability	Most studies neglect to report distribution of wind speeds during surveys	Very large
Extreme weather representation	Relevance, comparability	Unreported, but APWRA required all biologists leave field in winds >55 KPH or in electrical storms	Potentially very large
Coverage of terrain & wind conditions most hazardous with wind turbines	Relevance	Only in several APWRA studies	Large
Monitoring duration (months or years)	Use count	1 month (April) to >10 years	Very large
Number of stations	Use count	1 to 201	Large
Selection of stations	Use count, comprability	Random, systematic, and arbitrary	Large
Number of surveys per station	Use count	3 to 152	
Height of bat stations above ground	Represent-ativeness	1.5 m to 80 m	Large
Maximum survey radius (scans)	Use count	100 m to 1600 m	Very large
Maximum height above ground (ceiling)	Use count	Usually not reported	Large
Enforcement of detection standards	Use count	Unknown; observer skills untested	Potentially large
Whether estimating probability of false zero	Use rate adjustment	None	Unknown
		USE DETECTION RATES	
Species identification error in use detection trials	Comparability	Observer accuracy trials reported once (McClure et al. 2018)	31% of eagles misidentified as non-eagles
Variation in observer skill	Comparability	Unknown	Very large
Visual background composed of terrain vs sky	Comparability	Unreported	Modest
Error in placing eagles inside or outside maximum survey radius	Comparability	Unreported	Modest
Detection by distance from observer	Use rate adjustment	Reported only in the APWRA	Large
Detection by duration of survey session	Comparability	3 to 360 minutes	Modest
Survey interval/station	Comparability	3.5 to 70 days	Modest to large

Factor	Effect	Range of variation	Effect size
Detection by hours survey/day	Comparability	Unknown	Unknown
Detection by number of species targeted in surveys	Comparability	Eagles to all birds	Unknown
Principal type of survey	Comparability	Visual scan, point count, migration count, behavior	Unknown
Error in estimating height above ground	Comparability	Not reported	Large
USE RATE ESTIMATOR			
Estimator	Use rate adjustment	All studies implicitly assume observers detect all detectable members of the speciecs	Very large
Use rate metric	Comparability	Minutes, passages, abundance	Very large
Inter-station overlap of surveyed airspace	Comparability	0% to 60% for birds	Unknown
Airspace visible within maximum survey radius of visual scans	Comparability	0.1299 to 0.1919 km^3 in one study area using 600 m max radius and 140 m ceiling (53% range of variation)	Large
Height above ground measured once or more often along flight path	Relevance	Most studies report flight height at first sighting, and implicitly assume height unchanged throughout recorded flight path	Very large

Furthermore, if preconstruction use rates were indeed predictive of post-construction fatality rates, one would expect use rates based on acoustic detection to be predictive of mist net captures. But they are not – not in the year following acoustic detection surveys and not concurrent with acoustic detection surveys (Figure 3). Acoustic surveys and mist-net captures were uncorrelated in the Project Area. Therefore, acoustic detection rates and fatality rates, which would be much further separated in time from each other than were the surveys efforts contributing to the hypothesis tests in Figure 3, should not be expected to be correlated.

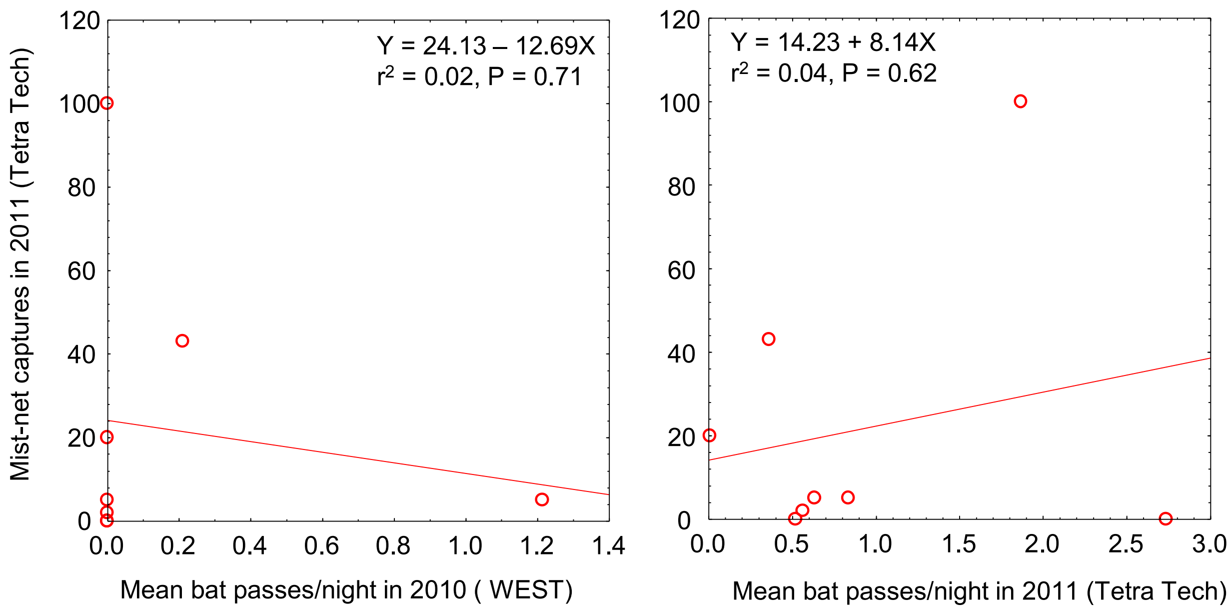


Figure 3. Mist-net captures of bat species could not be predicted by acoustic detection rates the preceding year (left graph) nor concurrently (right graph) in the project area.

9. Are fatality rates estimated at existing wind projects predictive of fatality rates at a proposed new project such as the Emerson Creek wind project?

Fatality rates estimated at other wind projects can be predictive so long as the same fatality rate estimates are comparable. In my experience, fatality estimates are often not comparable due to substantial variation in field methods (Smallwood 2007, 2013, 2017; Smallwood et al. 2018, 2020; Table 1 above). However, so long as sufficient detail has been reported about the fatality monitoring at each wind project, steps can be taken to adjust fatality estimates based on a more consistent suite of assumptions and known relationships between field methods and fatality estimates (Smallwood 2013, 2020). As an example, below I will demonstrate how I adjusted the bat fatality rates that were reported at the Wolfe Island Energy Project, Ontario. I selected Wolfe Island for two reasons. First, Wolfe Island was built within the same ecoregion and on a similar landscape as the Emerson Creek project area, including a similar matrix land cover consisting of agricultural field crops intersected by streams and interspersed by forest fragments. Second, I wish to use the adjusted fatality estimates to answer another important question following this one.

Wolfe Island's fatality estimates for bats were based on the same basic fatality estimator used at wind projects across North America:

$$\hat{F} = \frac{F}{\delta},$$

where the fatality estimate $\hat{F}$ is simply F, number of fatalities found, divided by δ, the proportion of fatalities not found. Investigators typically represent δ with multiple measurable terms: $\delta = SrAd$, where S represents the probability the searcher will detect a carcass that is available to be found, r represents the probability the carcass will persist to the next fatality search, A represents proportion of the area within the maximum search radius that is actually searchable, and d represents the proportion of carcasses found within the maximum search radius (carcasses are often found beyond the maximum search radius). S and r are typically measured from trial carcass placements (along with many sources of error and bias – see Table 1). I prefer to measure δ as D, which represents the proportion of trial carcasses placed randomly into routine fatality searches, including into unsearchable areas as well as beyond the maximum search radius (Smallwood et al. 2018). Trial outcomes informing D are simply whether the trial carcasses were found or not, and it does not matter to the fatality adjustment whether trial carcasses were missed due to searcher detection error or scavenger removal. Each of the terms in the denominator range 0 to 1, whether they be S, r, A, d, or D, and the smaller the value the larger the adjustment to the fatality estimate. Values of 1 would result in no adjustment.

Investigators have debated over variations of the basic derivation of the estimator, mostly over how to measure carcass persistence and confidence ranges. Most of the variation that matters, however, is in the field methods used to detect fatalities and to test searchers for their carcass detection probabilities (Smallwood 2007, 2017; Smallwood et al. 2018). Some have argued that implementation of industry standards or available guidelines is valuable for comparability of fatality estimates (fatality monitoring at Wolfe Island followed Canada's and Ontario's guidelines (Kingsley and Whittam 2003, Ontario Ministry of Natural Resources 2011), but the point of fatality monitoring is to generate accurate fatality estimates. Comparing accurate fatality estimates is far more valuable than comparing consistently inaccurate estimates.

Fatality count, *F*

The estimator shows where one can go wrong when performing fatality monitoring at a wind project, where wrong means the estimate is inaccurate or biased. The most fundamental shortfall is missing fatalities, and then trying to make up for the misses with adjustment terms in δ. However, the more one relies on the adjustment terms, the more likely the fatality estimates will be inaccurate or biased because it is in these terms where the greatest sources of error and bias lurk due to added assumptions (Smallwood 2007, 2017, Smallwood et al. 2018). Missing fatalities that result in false zero estimates representing entire species can also pose a fundamental problem because, although Huso et al. (2015) developed a handy method for estimating the probability of a false zero for a particular species, the Huso method would likely prove impractical when attempting to implement it for all species not found as fatalities but that could have conceivably been killed by the project's wind turbines.

Bias and error introduced by not detecting available fatalities can be reduced by searching for fatalities more often, searching farther from the turbine, searching over longer time periods, and searching with scent-detection dogs. Budgets often mitigate the degrees to which monitoring can maximize the likelihood of finding more of the available fatalities, but often decisions over short maximum search radii or long search intervals are justified as "industry standards" intended to foster comparability among studies. Comparability is indeed important, but comparability improves when the fatality estimates are accurate instead of when they are repeatedly biased and inaccurate to various degrees in order to meet methodological standards that are not specified in the estimator.

Proportion of the year searched

Fatality searches at Wolfe Island were performed for only half of each year, and therefore could not have represented all periods of the year or all species. No adjustment was truly possible for this shortfall because one cannot know how many fatalities would have been found had the turbines been searched throughout the year. Therefore, fatality estimates from Wolfe Island cannot be entirely comparable to those of projects in the USA where fatality monitoring was likely year-round.

Maximum search radius, *d*

In 2009 and 2010-11, respectively, fatality rate estimates at Wolfe Island were based on 50-m and 60-m maximum search radii around 2.3 MW turbines mounted on 80-m towers. A typical maximum search radius for these types of wind turbines is more like 105 m to 120 m, which means the Wolfe Island effort covered less than half the search radius and only 20% of the search area used in the USA (Figures 4 and 5). But even a maximum search radius of 120 m will result in searchers missing bat fatalities deposited beyond 120 m. In a study using skilled dogs, which unlike human searchers showed no decline in detection rates with increasing distance from the turbine (Smallwood et al. 2020), I fit logistic models to the patterns of found fatalities with increasing distance from the turbine and found that to have a chance at finding all of the available bats at the same-sized turbines as at Wolfe Island, one would need to search out to 184 m. According to the models fit to the data, searching to Wolfe Island's maximum search radius of 50 m would overlap 35.6% of the available bat fatalities. Searching out to 60 m would overlap 44% of the available bat fatalities. The adjustment factors for maximum search radius, *d*, are therefore 2.81 at 50 m and 2.27 at 60 m for bats (e.g., first adjustment factor = 1/0.356). Yet, the Wolfe Island fatality rates were not adjusted at all for maximum search radius bias, which is why to be comparable the Wolfe Island fatality rates need to be adjusted by *d*.

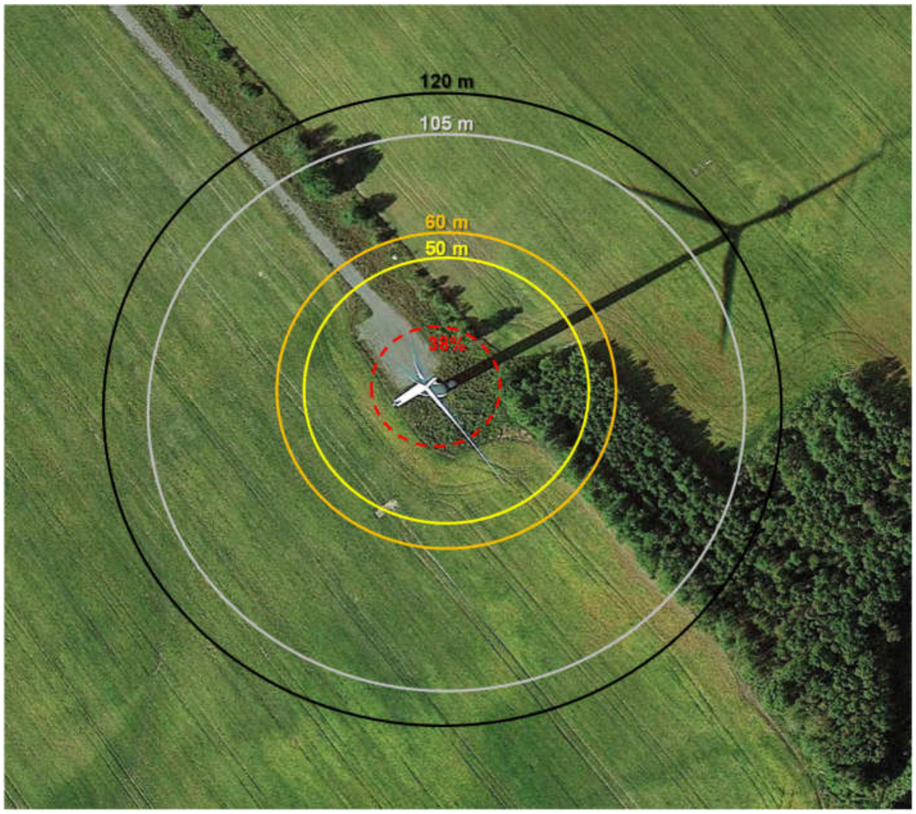


Figure 4. Each wind turbine at Wolfe Island was monitored for fatalities within 50 m (yellow ring) of the turbine in the first year and within 60 m (orange ring) over the last two years, whereas searches at the same-sized 2.3 MW turbines on 80 m towers were searched to 105 m (gray ring) and 120 m (black ring) at projects across the USA. Given the average searchable area of 38% of the area within a 60 m radius, the effective search radius at Wolfe Island was only 23 m (dashed red circle) and the area searched averaged only 3.6% of the area searched at wind turbines in the USA.

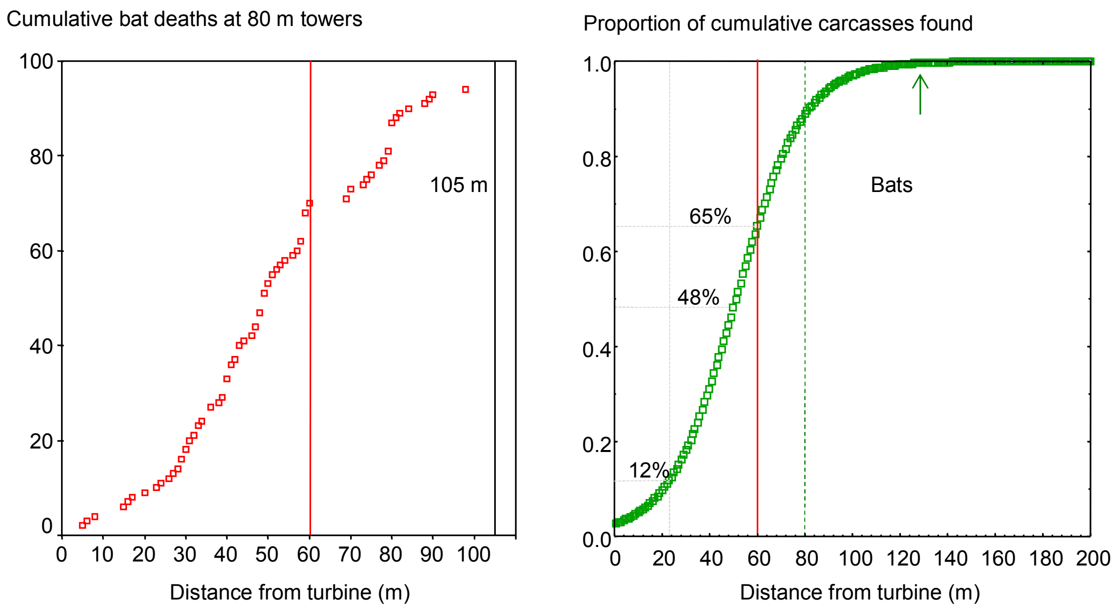


Figure 5. Cumulative sum carcasses of bats found at North American wind projects with 105-m maximum search radius (vertical black line) around turbines on 80 m towers (Smallwood 2013). The vertical red line represents the maximum search radius used at Wolfe Island, and the green arrow points to the asymptote of the logistic model fit to the data. All cumulative bat carcass data to the right of the red line were found at other wind projects with a maximum search radius of 105 m, but they were unlikely to have been found at Wolfe Island.

<u>Available search area actually searchable, *A*</u>

From July through September only 57.3% of the area within the 50 m search radius was searchable and actually searched at Wolfe Island, and from October through December the maximum search radius was extended to 60 m but only 85.5% of the area within this radius was searched. Adjustment factors for unsearchable areas were therefore 1.73 and 1.17 for fatality rates estimated from searches out to 50 m and 60-m maximum search radii. Stantec (2010a,b, 2011a,b,c, 2012a) reported high variation in searchable area within the 60-m search radius of turbines, ranging from 0.17 to 1.00, the latter value applied to snow-covered ground in January and February. I applied these adjustment values to Stantec's fatality data, just as Stantec had, but my examination of the adjusted fatality rates led me to conclude that there exists a substantial bias of unknown direction in the adjustment (Figure 6). The pattern could have resulted from

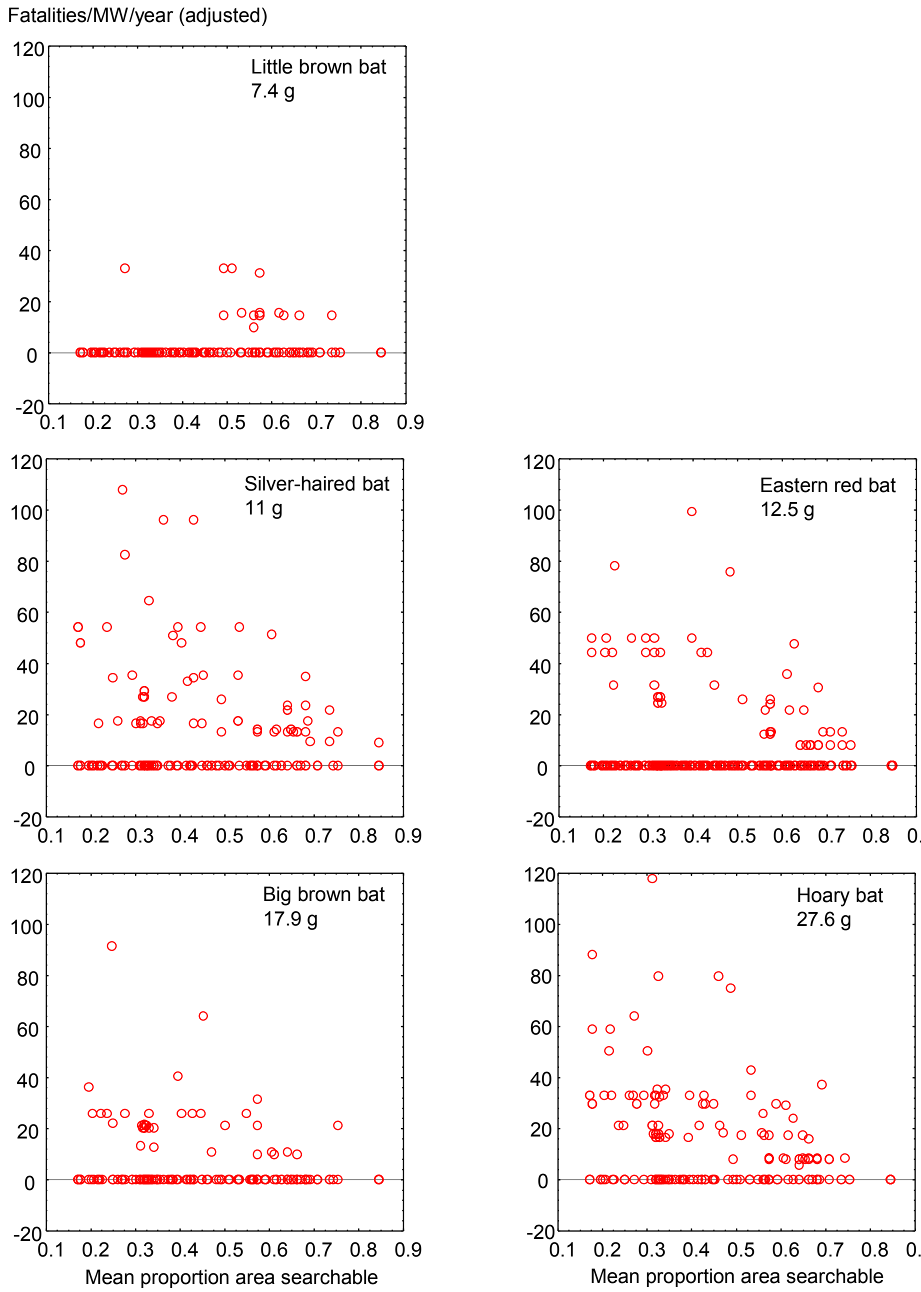


Figure 6. The larger and more conspicuous species of bat were found across all mean proportions of searchable area (lower 4 graphs), whereas the smaller, less conspicuous bats were found at wind turbines only with large proportions of searchable area (top graph).

confounding caused by bats falling onto searchable areas more often than unsearchable areas for some yet inexplicable reason. A more likely explanation is that the likelihood of detection increased with greater searchable area because larger areas included more dead bats and therefore more chances for detection. One thing is for sure, and that is that the larger-bodied bat species (e.g., Hoary Bat) were found throughout the range of proportions of searchable area, *A*, whereas carcasses of the smallest-bodied bat species – little brown bat -- were found only at turbines with large proportions of searchable area. The search conditions at Wolfe Island were biased against finding small bats, and therefore prone to generating false zeros and underestimating fatality rates of small bats. The implication is obvious for the tiny Indiana bat.

<u>Searcher detection, *S* and Carcass persistence, *r*</u>

Stantec reported values of *r* ranging from 0.176 to 0.935 for bats, but it was never clear in the reports how these values were derived. To give an idea of what this value range means for bat fatality estimates, a single bat fatality adjusted by the extremes of this range would equal 1.07 bats to 5.68 bats. Stantec did not explain how they derived carcass persistence rates, nor did they report the species used in trials or how long since death trial carcasses had decayed by the time they were placed. Decayed carcasses are less attractive to vertebrate scavengers, and so tend to persist longer and hence bias fatality rates low. Another common mistake is to recycle carcasses found in fatality monitoring by placing them in persistence trials, thereby feeding the more readily-found larger carcasses back into trials used to adjust fatality rates of smaller species. For example, detection rates of hoary bats are typically higher than they are for myotine bats because hoary bats are larger and easier to see. Because hoary bats are found more often as fatalities, they also are more often placed in trials representing ‘all bats,’ inclusive of myotine bats. However, hoary bats persist longer than myotine bats, on average, and are easier for human searchers to detect in trials as well. As a result, myotine bat fatalities are often adjusted for *S* and *r* values more representative of hoary bats.

Data collected as part of a carefully controlled series of trials in the APWRA yielded mean daily carcass persistence rates of 0.75 at 3.5 days and 0.60 at 7 days (Figure 7). Note that my use of R_C represents the same carcass persistence rates as r. Also note that the curves depicted in Figure 7 typify the curves observed at most wind projects in North America (Smallwood and Neher 2017). Some may argue that carcass persistence rates will vary among wind projects due to variation in scavenger communities and ecological conditions, but this argument would be speculative because it has not been supported by any study to date. Any difference in persistence rates between the curves in Figure 7 and those from other wind projects were more likely due to differences in study methods.

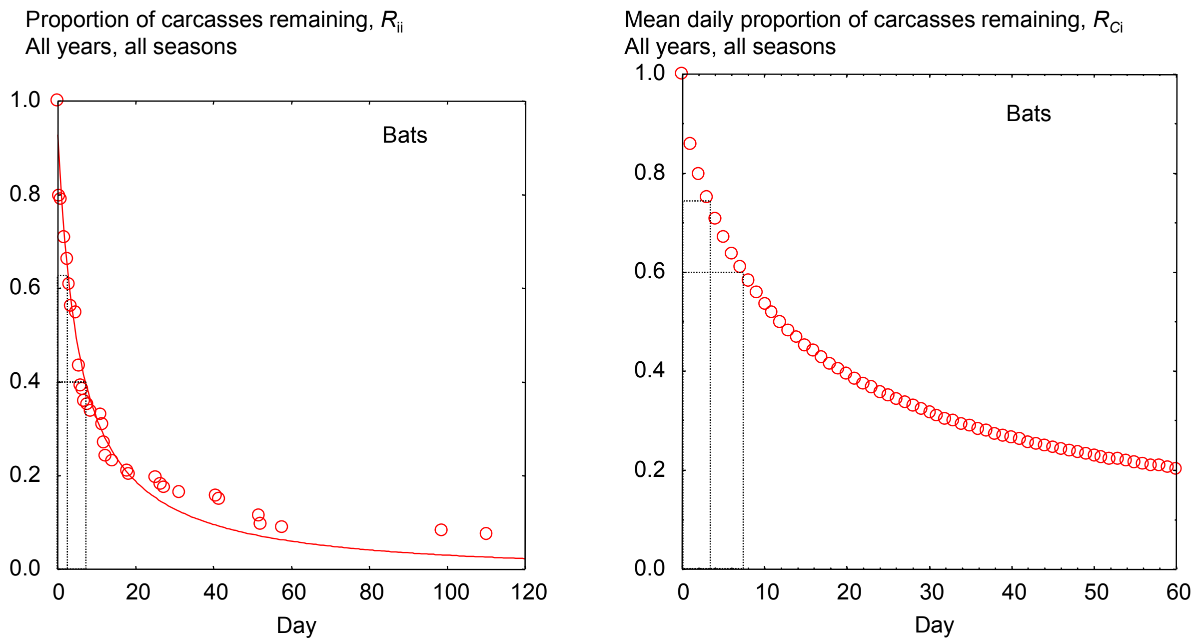
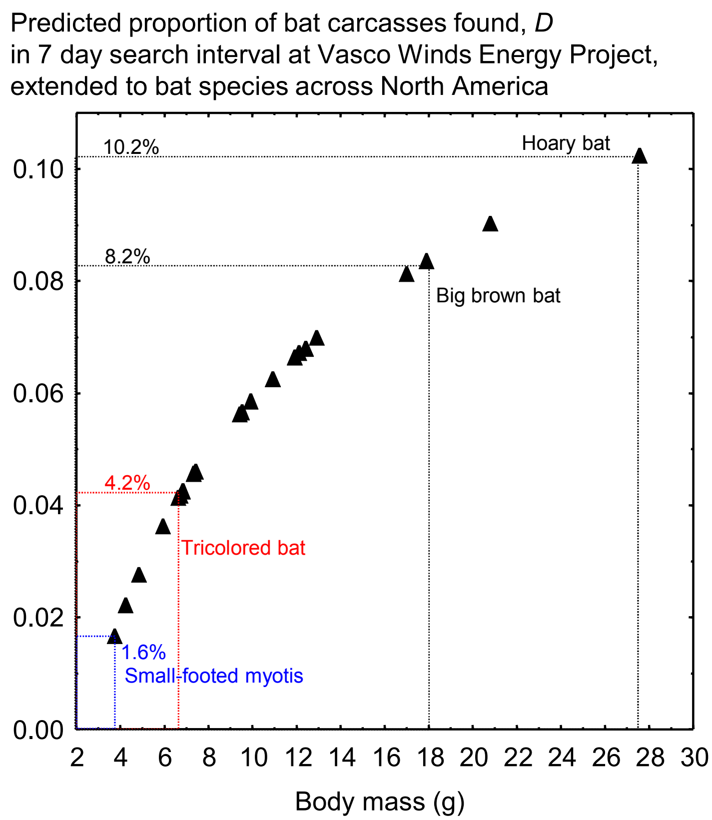


Figure 7. Carcass persistence curves developed from three years of trial placements of nearly 200 frozen-fresh (and thawed) bat carcasses within fatality search areas of wind turbines on short-stature annual grasslands of the Altamont Pass Wind Resource Area. The graph on the left represents proportions of carcasses remaining on each day into a trial, typical of how carcass persistence rates were derived at Wolfe Island, whereas the graph on the right averages the proportion remaining by day based on the assumption that wind turbines will deposit carcasses at a steady rate. The dotted lines show values of carcass persistence at average search intervals of 3.5 and 7 days, which were used at Wolfe Island.

<u>Estimated fatality rates, $\hat{\boldsymbol{F}}$</u>

I tabulated all the fatality data reported in Stantec (2010a,b, 2011a,b,c, 2012a) and adjusted them using the terms described earlier. I made two sets of estimates, the first using onsite estimates of the adjustment terms (with a couple of changes as noted in the footnotes of Table 2), the second using an overall detection rate from integrated trials in place of separate adjustment terms for searcher detection and carcass persistence (Figure 8). The second approach I regard as more realistic, so I used it to estimate fatality rates at Wolfe Island. I followed the methods in Smallwood et al. (2018), including the estimation of *D* via logit regression of trial carcass outcomes (found or not found) on body mass. However, whereas I had a model developed from detection trials integrated into a 7-day fatality search interval, I lacked a similar model for the 3.5-day interval used at Wolfe Island. I extrapolated values of *D* from the 7-day interval model to a 3.5-day interval by adding 0.175 to the point predictions of the 7-day model. For bats I made the same adjustment to the lower bound of the confidence range tied to the model of *D*. The value 0.175 was the difference in the mean daily proportion of carcasses persisting between 3.5 and 7 days into detection trials. I assumed that at such an early period of carcass decay, most of the detection probability is in the persistence rate as compared to searcher detection rate, because the carcass would not have changed much in visibility to the searcher. I added the correction value to the lower bound estimates of the bat confidence range because nonlinear models fit the lower bound estimates better than they fit the upper bound estimates. I then added the difference between lower bound and mean point estimates for bats to obtain upper bound estimates for a symmetrical confidence interval.

Figure 8. A model was fit to carcass detection rates, *D*, regressed on body masses of nearly 200 frozen-fresh bats of multiple species that were thawed and placed over three years in fatality search areas around monitored wind turbines. The model was then projected to North American bat species based on body mass typical of each species. Four species that occur within the project area are identified in the graph and their predicted overall detection rates at 7-day search intervals are shown. Overall detection rates at 3.5 day search intervals would be higher – perhaps 2% for small-footed myotis, 6% for tricolored bat, 10.5% for big brown bat, and 12.5% for hoary bat. Use of scent-detection dogs would negate the need for this model.



Using on-site adjustment factors, my estimate was 9.07 bat fatalities per MW per year at Wolfe Island (Table 1). Adjusting for the other factors described above, my estimates were much higher, including 49.08 bat fatalities per MW per year (Table 2). Accounting for the proportion of fatalities not found due to the unusually short search radius, as well as for the other factors, resulting in a fatality estimate that was 5.6 times higher for bats. Fatality rates at Wolfe Island were grossly underestimated, and cannot be interpreted at face value. Without making these adjustments, comparisons of fatality rate estimates among existing wind projects cannot accurately predict fatality rates at a proposed new project.

Table 2. Fatality rate estimates of bats at Wolfe Island, 2009 through 2011, based on two approaches for adjusting the estimates for the proportion of fatalities not found during monitoring.

Group	Year	$\widehat{F}$/MW adjusted by factors estimated from:					
		On-site			Overall detection rate[a]		
		Mean	95% LB[b]	95% UB[b]	Mean	95% LB	95% UB
All bats	2009	8.01	6.80	9.22	24.36	18.25	34.01
All bats	2010	15.59	13.08	18.09	96.62	86.21	115.74
All bats	2011	3.62	2.64	4.61	26.26	22.10	34.65
All bats	Mean	9.07	7.98	10.17	49.08	42.19	61.47

[a] I used the overall detection rate, *D*, from Smallwood et al. (2018), where values of *D* were estimated from hundreds of trials performed in the Altamont Pass, and I used values for *d* from searches using dogs (Smallwood unpublished data) and *A* from on-site measurements.
[b] LB and UB represent lower and upper bounds of a 95% confidence interval.

Based on my analysis of the fatality monitoring data from Wolfe Island, I am able to estimate the number of bat fatalities that are likely to occur at the Emerson Creek wind project. Project-level impacts are large at Wolfe Island (Table 3), which at 197.8 MW was only 66% of the size of the proposed 297.66-MW Emerson Creek wind project. Average annual fatalities at Wolfe Island are estimated at 3,332 silver-haired bats, 2,487 eastern red bats, 265 little brown bats, 1,845 hoary bats, and 9,708 bats of all species. Assuming the larger wind turbines of the proposed Emerson Creek wind project would not increase fatality rates of bats (contrary to the finding of Smallwood 2020), an extrapolation of the Wolfe Island fatality rates to the larger proposed Project would predict 14,620 bat fatalities per year at the Emerson Creek wind project. However, the prediction would have been higher had the Wolfe Island monitoring study used scent-detection dogs instead of human searchers (Smallwood et al. 2020). It also might have been higher than I estimated had operational curtailment not been tested in fall 2011 at 32% of the turbines. The curtailment study lacked sufficient sample size to test for significance of a treatment effect, but the mean difference in fatality rates among turbines whose cut-in speeds were set to 4.5 and 5.5 m/s was 54% lower than among turbines in the control treatment. Accounting for the treatment effect increases my estimates from 26.26 to 36.13 bat fatalities/MW in 2011, from 49.08 to 52.37 bat fatalities/MW averaged across all 3 years, and from 9,708 (95% CI: 8,344-12,158) to 10,359 (95% CI: 8,904-12,973) fatalities/year project-wide. The revised fatality rate applied to the 297.66-MW Emerson Creek wind project would predict 15,588 (95% CI: 13,401-19,524) bat fatalities per year.

Table 3. Annual fatality estimates bats and birds documented as fatalities at the 197.8-MW Wolfe Island wind energy project, 2009 through 2011, based on methods in Smallwood et al. (2018) and results of dog searches for fatalities out to 105 m in the APWRA (Smallwood et al. 2020).

Species	**Annual fatalities at Wolfe Island wind project**		
	Mean	**95% LB** [a]	**95% UB** [a]
Silver-haired bat	3,332	2,900	3,941
Eastern red bat	2,487	2,241	2,922
Little brown bat	265	205	331
Hoary bat	1,845	1,490	2,654
Big brown bat	1,074	947	1,429
Bat	705	560	881
All bats	9,708	8,344	12,158

[a] LB and UB represent lower and upper bounds of a 95% confidence interval.

<u>Predicted fatality rates, $\widehat{\boldsymbol{F}}$, from national estimates</u>

Another source of fatality estimates is available other than Wolfe Island. Wolfe Island served as a useful example for the reasons I summarized earlier. A broader source of fatality estimates exists in Smallwood (2020), which also includes fatality estimates based on fatality search intervals of ≤10 days at turbines ≥0.66 MW (Table 4). This broader source would predict 5,861 bat fatalities per year at the Project, assuming no increase in fatality rates with the larger turbine size (contrary to the finding of Smallwood 2020).

Table 4. National-level fatality estimates based on monitoring with fatality search intervals of ≤10 days at turbines ≥0.66 MW (Smallwood 2020) and projected to the 297.66-MW Emerson Creek wind project. Blanks indicate no data were available through 2014 and consistent with the above conditions.

Species	USA-wide $\widehat{F}$/MW/year		$\widehat{F}$/year projected to project	
	Mean	**95% CI [a]**	**Mean**	**95% CI**
Big brown bat	0.981	0.774–1.274	292.0	230.4-379.2
Silver-haired bat	6.217	5.148–7.413	1,850.6	1,532.4-2,206.6
Hoary bat	5.307	4.034–6.795	1,579.7	1,200.8-2,022.6
Eastern red bat	3.635	1.759–5.968	1,082.0	523.6-1,776.4
Evening bat				
Tri-colored bat	1.588	0.924–2.317	472.7	275.0-689.7
Northern long-eared bat	0.241	0.171–0.310	71.7	50.9-92.3
Eastern small-footed bat				
Little brown bat	1.937	1.397–2.498	576.6	415.8-743.6
Indiana bat				
Rafinesque's big-eared bat				
Townsend's big-eared bat				
Mexican free-tailed bat	2.709	0.332–5.120	806.4	98.8-1,524.0
All bats	19.690	11.486–28.989	5,860.9	3,418.9-8,628.9

[a] CI = confidence interval.

10. Is there empirical evidence of greater collision risk of turbines sited closer to particular landscape features or types of vegetation cover?

At Wolfe Island I estimated the highest fatality rates of bats at wind turbines located along the periphery of the wind project, nearer the lakeshore, and near patches of forest and within or near drainage features (Figure 9). The lowest fatality rates were at wind turbines located farther from forest patches interior to the Wolfe Island project.

Figure 9. *Highest fatality rates of bats among wind turbines at Wolfe Island, Ontario, 2009-2011.*

Wind turbines located within 900 m of Wolfe Island's lakeshore averaged 37.3 bat fatalities/MW/year. Wind turbines located within 200 m of extensive woodlands interior to the project averaged 35.9 bat fatalities/MW/year. Wind turbines located within 200 m of large forest patches and within 900 m of lakeshore averaged 41.1 bat fatalities/MW/year, and those located within both 200 m of small woodlands and 900 m of lakeshore averaged 50.4 bat fatalities/MW/year, or 2.33 times higher than fatality rates in at interior turbines farther from forest patches. The evidence clearly indicates that wind turbines located farther from forested areas and interior to a wind project are safer to bats.

11. Does the layout of the proposed Project minimize potential bat collision mortality?

Based on what was learned from the spatial pattern of fatalities/MW/year at Wolfe Island, of the proposed wind turbine sites, only 8% would pose no obvious siting hazards, 38% would pose at one siting hazard, 28.7% would pose two siting hazards, and 25.3% would pose 3 obvious siting hazards (Table 5, Figure 10). The linear arrangement of wind turbines within a narrow north-south band would position most of the wind turbines at the Project's edge, which the pattern of fatalities at Wolfe Island indicates would increase fatality rates. I will add that my experience with fatality monitoring is consistent with the pattern at Wolfe Island. Many of the proposed turbine sites are also within 200 m of forest patches and bodies of water, situations known to increase bat collision risk. Much of the Project's collision risk to bats could be reduced through careful micro-siting to minimize edge and nearness to water and woods.

Table 5. Determinations of whether each proposed turbine site (WTG = wind turbine generator) is within 200 m of a forest patch, 200 m of a wetland, and composing the Project's edge or interior, as well as the number of hazardous settings based on what was learned from Wolfe Island.

WTG	Near forest patch?	Near stream, marsh, pond?	Position in project	Number of hazards
1	No	Yes	Edge	2
2	No	Yes	Edge	2
3	No	No	Edge	1
4	Yes	Yes	Edge	3
5	No	Yes	Edge	2

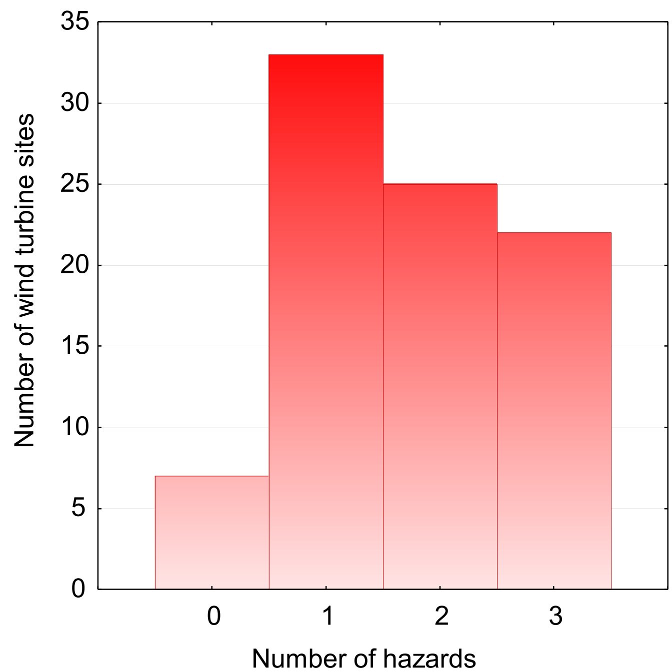
WTG	Near forest patch?	Near stream, marsh, pond?	Position in project	Number of hazards
6	No	No	Edge	1
7	No	Yes	Interior	1
8	Yes	Yes	Interior	2
9	No	No	Interior	0
10	No	No	Interior	0
11	No	No	Interior	0
12	No	No	Edge	1
13	Yes	No	Edge	2
14	No	No	Edge	1
15	No	Yes	Edge	2
16	No	No	Edge	1
17	No	Yes	Edge	2
18	Yes	Yes	Edge	3
19	No	Yes	Edge	2
20	Yes	No	Edge	2
21	Yes	No	Edge	2
22	Yes	Yes	Edge	3
23	Yes	Yes	Edge	3
24	No	Yes	Edge	2
25	No	No	Edge	1
26	No	Yes	Interior	1

WTG	Near forest patch?	Near stream, marsh, pond?	Position in project	Number of hazards
27	No	Yes	Interior	1
28	No	Yes	Edge	2
29	No	Yes	Interior	1
30	No	No	Interior	0
31	No	Yes	Edge	2
32	No	Yes	Interior	1
33	No	No	Edge	1
34	No	No	Edge	1
35	No	No	Edge	1
36	No	Yes	Edge	2
37	No	No	Interior	0
38	Yes	Yes	Edge	3
39	No	No	Edge	1
40	No	No	Edge	1
41	Yes	Yes	Edge	3
42	Yes	No	Edge	2
43	Yes	No	Edge	2
44	Yes	Yes	Edge	3
45	Yes	Yes	Edge	3
46	Yes	Yes	Edge	3
47	Yes	Yes	Edge	3

WTG	Near forest patch?	Near stream, marsh, pond?	Position in project	Number of hazards
48	No	No	Interior	0
49	No	No	Edge	1
50	No	No	Edge	1
51	No	Yes	Interior	1
52	No	No	Edge	1
53	Yes	No	Edge	2
54	Yes	Yes	Edge	3
55	Yes	Yes	Interior	2
56	Yes	No	Interior	1
57	Yes	Yes	Edge	3
58	No	No	Edge	1
59	Yes	Yes	Edge	3
60	No	Yes	Edge	2
61	Yes	Yes	Edge	3
62	Yes	Yes	Interior	2
63	Yes	No	Edge	2
64	Yes	Yes	Edge	3
65	Yes	Yes	Interior	2
66	Yes	Yes	Edge	3
67	No	Yes	Interior	1
68	Yes	No	Interior	1

WTG	Near forest patch?	Near stream, marsh, pond?	Position in project	Number of hazards
69	Yes	Yes	Edge	3
70	Yes	Yes	Edge	3
71	Yes	Yes	Edge	3
72	No	Yes	Interior	1
73	No	No	Edge	1
74	No	No	Edge	1
75	No	No	Interior	0
76	No	No	Edge	1
77	Yes	Yes	Edge	3
78	Yes	No	Edge	2
79	No	No	Edge	1
80	Yes	Yes	Edge	3
81	Yes	Yes	Edge	3
82	No	Yes	Edge	2
83	No	No	Edge	1
84	No	No	Edge	1
85	No	No	Edge	1
86	No	Yes	Edge	2
87	Yes	No	Interior	1

Figure 10. Number of proposed wind turbine sites by the number of siting hazards inferred from the spatial pattern of bat fatalities/MW/year at Wolfe Island.



12. Were the Project's contributions to cumulative impacts appropriately analyzed?

The impacts of other wind energy projects to bats were discussed in the context of predicting this Project's impacts based on fatality rates estimated at other projects. Firelands Wind made no attempt to assess cumulative impacts. A useful starting point for assessing cumulative impacts would be the USA-wide fatality estimates caused by wind energy (Smallwood 2020). As of 2014, I estimated 2.22 (95% CI: 1.77–2.72) million bat fatalities in the USA's lower 48 states. I also provided some species-specific estimates and regional estimates. A cumulative impacts analysis should also be informed by the effects of habitat loss, insecticide use and white-nose syndrome.

13. Was sufficient effort made to analyze the Project's risks to bats?

Consistent with the Precautionary Principle in risk assessment, an analyst faced with potential impacts to rare or precious resources in the face of high uncertainty should err on the side of caution (National Research Council 1986). For example, without evidence of absence of a particular species, the appropriate finding is assumed presence whenever presence is remotely plausible. If the site is within a species geographic range, and if it also includes habitat that is plausibly suitable for either breeding, foraging, refuge, stop-over, staging, or dispersal or migration movement, then the site should be assumed to provide habitat value for that species. In the case of this Project, if there is habitat for the species, then the appropriate conclusion would be there would be a risk of collision should the Project be built.

Instead of erring on the side of caution, however, Firelands Wind's reports of preconstruction surveys speculated that the Project would not adversely affect bats and particular species of bat. Even though an Indiana bat was found on the Project site, and even though it was documented to have traversed multiple types of vegetation cover over a large area within only 4 days of tracking, Baer et al. (2017b) asserted that because most of the bat's movements were located outside the Project boundary it was therefore at low risk from the Project. But what about the rest of this bat's life? Erring on the side of caution, or simply exercising common sense, it should be expected that the captured bat uses an even larger area than was indicated by the 4 days of tracking data. It should also be expected that this Indiana bat is not alone. Bats live with other bats, so if one catches a bat, then one should assume other Indiana bats also reside in the Project Area. Treating the bat as a fluke was unrealistic and inconsistent with the Precautional Principle.

Furthermore, there is the issue of attraction of bats to operative wind turbines – a phenomenon reported prior to the preconstruction studies. In my own studies using a thermal-imaging camera to watch bats flying among wind turbines, I have recorded video many times of bats flying from operative wind turbine to operative wind turbine and very deliberately visiting the turbines. I quantified attraction in a before-after, control-impact experimental design in which the turbines of one project were shutdown halfway through my study while the turbines of another project continued operating (Smallwood and Bell 2020a). Over seven years of observing bats with my thermal-imaging camera, I also many times observed bats that I assumed to be Myotine bats (based on size and behavior) to alter their flight paths low over the ground and suddenly ascend to the sweeping blades of an overhead wind turbine. I saw one of these Myotine bats collide with a turbine blade. Erring on the side of caution, it would be reasonable to assume that Indiana bats express this same attraction toward operative wind turbines. An Indiana bat living on the Project's boundary would likely be at risk of collision – perhaps not as high a risk as a bat living amid the wind turbines – but it only takes one instant for a sweeping blade to end the curious bat's years of safety at the Project's periphery.

14. Is the proposed mitigation adequate?

According to Apex (2018) and the Emerson Creek Wind Facility- Technical Assistance Letter from US Fish and Wildlife Service to Apex (dated 30 January 2020), the mitigation for potential bat impacts is the following:

• "Avoid tree removal to extent possible and within 150 feet of northern long-eared bat roosts from June 1 to August 1.

• Curtail all turbines at wind speeds up to 6.9 m/s during spring (Mar 15-May 15) and fall (Aug 1 – Oct 31) migration from 30 minutes before sunset to 30 minutes after sunrise. Curtail turbines at wind speeds up to 6.9 m/s within 2.5 miles of IBAT roost trees during summer (May 16 – Jul 31).

• Conduct post-construction monitoring in accordance with ODNR guidelines."

One shortfall of the curtailment strategy is that it does not cover the period of seasonal peak bat activity, as indicated by the acoustic bat surveys performed a decade ago. Tetra Tech

(2012) reported one peak in bat activity between about 18 and 24 July 2011, and Ritzert et al. (2011) reported another peak between about 23 July to 12 August 2010. Not only is the interannual consistency of peak bat activity periods uncertain, but the peaks that have been documented in the Project Area largely fall outside the dates of the curtailment schedule.

Another shortfall is the single cut-in speed and its universal implementation within specific dates, when a more effective approach has been devised and reported (Hayes et al. 2019). By using real-time acoustic detection of bats combined with wind speed data, the approach of Hayes et al. (2019) achieved much greater fatality reductions than any previous operational curtailment approach. For example, assuming the fatality reduction achieved at Wolfe Island in 2011 would have been found significant with larger sample sizes, its fatality reduction was only 54% with cut-in speeds of 4.5 and 5.5 m/s. Hayes et al. (2019) summarized fatality reductions of 34% to 93% with most between 50% and 60% using various increases in cut-in speeds. Curtailment decisions in the Hayes ta l. (2019) study did not even initiate until wind speeds reached 7.9 m/s, and only when a threshold level of bat activity was detected. The Hayes et al. approach should replace the measure proposed by Apex (2018).

A third shortfall of the curtailment measure is its implementation without compensatory mitigation for the bat fatalities that would not be prevented. Even if the Hayes' et al. (2019) approach was implemented at the Project and bat mortality was reduced by the 84.5% achieved by Hayes et al., this level of reduction applied to the predicted collision mortality of 15,588 (95% CI: 13,401-19,524) per year based on the unmitigated Wolfe Creek project or the 5,861 (95% CI: 3,418.9-8,628.9) per year based on my USA-wide estimate would still leave a mean annual mortality of 908 to 2,416 bats. Even with the best available curtailment strategy, compensatory mitigation would be warranted.

The proposed post-construction monitoring would be grossly deficient because the ODNR guidelines are outdated and proven to generate inaccurate fatality estimates. Human searchers should be replaced by scent-detection dogs and their trained handlers (Smallwood et al. 2020). Dogs should search turbines no less often than weekly. Instead of performing separate carcass detection trials to quantify searcher detection rates and carcass persistence rates, randomized placements of fresh carcasses representing the full range of species likely to collide with wind turbines should be integrated into routine fatality monitoring for the purpose of quantifying an overall carcass detection rate (Smallwood et al. 2018). These changes would eliminate most of the biases in fatality estimation, and generate much more accurate estimates.

I additionally recommend that all of the wind turbines undergo fatality monitoring, and that the monitoring continue for at least three years. The fatality search radius also needs to be lengthened over the radius recommended in the ODNR guidelines. A subset of turbines should be searched to much greater distances from the turbine in order to quantify the proportion of fatalities missed within the standard search radius.

15. What is your opinion of the high degree of certainty that both Chris Leftwich and Rhett Good testified he has in the results of the mist-net studies and acoustic detection surveys in the Project Area?

It is unclear to me what Mr. Leftwich and Mr. Good mean by scientific certainty in mist-net and acoustic detection survey results. The bats that were captured in mist nets were certainly captured in mist nets. The bat calls detected at a met tower were certainly calls of bats, although the number that could not be identified to species was obviously large but not clearly reported. Regardless, it is the *interpretation* of results where scientific uncertainty needs to be managed. Left uncertain were the bats not captured, whether and to what degree net stations varied in capture rates, which species were missed (see my Figures 1 and 2), and whether the mist-netting protocol unknowingly introduces biases and in what form those biases take. Left uncertain is whether mist net captures inform of likely wind turbine collision rates; after all, the capture results did not correlate significantly with results of the acoustic detection surveys, nor were mist nets placed anywhere near the heights above ground where bats will encounter operative wind turbine rotors. There is plenty of uncertainty in the meaning of preconstruction study results.

16. Do you agree that Firelands Wind was obligated to follow the OPSB rules, the guidelines of the U.S. Fish and Wildlife Service, and the guidelines of the Ohio Department of Natural Resources in evaluating the Project's potential impacts on bats?

The rules were in place to ensure minimum standards were met toward collecting the types of data the Board felt were needed in support of impact analysis. Survey protocols are typically formulated for rare or precious resources for which high uncertainty exists in how to detect them, enumerate them, and assess patterns in their behaviors and spatial distributions. The Board imposed no rules on the analysis itself, other than any description of impacts the guidance document might have provided or implied. A survey protocol is not intended to limit one's analysis of the data collected, nor does it restrict the use of other data and information provided from other studies. In my own work, I have often exceeded minimum protocol standards to design and implement sampling and field methods that I needed to assess potential or actual impacts. For example, to develop integrated carcass detection trials, I added an entire field method to the existing protocol that my contract required me to follow, thereby enabling me to analyze the results of one method against the other (Brown et al. 2016). Had I been tasked with setting mist nets in the Project Area, I would have sought to place acoustic detectors near the mist nets to learn which species were not captured, and I would used a thermal-imaging camera to watch the net sets to quantify how many bats escaped capture and whether bats learned of the net hazard. But I also would have analyzed the capture data for indicators of biases and limitations (see my earlier testimony, where I did perform some of that type of analysis). The impacts that need to be analyzed cannot be so analyzed by sticking solely to protocols on data collection. Analysis is more than data collection.

17. Do you agree with Chris Leftwich's and Rhett Good's testimony that ODNR and USFWS were adequately consulted when preparing preconstruction studies and reports?

I cannot speak for the agencies on whether the consultation was adequate, but I can say that such studies ought to be shared with the public in a timely fashion. The USFWS (2011) guidance on wind energy and Indiana bat identifies the development of adaptive management as one of its four principle objectives. A first step in adaptive management is the identification and inclusion of all stake-holders and the comprehensive assembly and sharing of relevant information. Preconstruction studies qualify as relevant information – information that needed to be circulated to stake-holders early enough for meaningful participation. In this way, experts among the stakeholders can flag deficiencies in proposed study designs or study reports so that the deficiencies can be rectified. I am less concerned over whether resource agencies were consulted to their satisfaction than I am over whether scientific methods were adequate for assessing potential impacts to public trust resources.

18. Do you concur with Rhett Good's testimony that "Currently there is no established link between the rates of bat captured or rates of bat calls recorded and the level of bat mortality?"

Yes. But I will also point out that this conclusion is counter to that of Ritzert et al. (2011), of whom Mr. Good was a co-author. In that report, the authors claimed that there was such an established link in Kunz et al. (2007). Scientists should change their opinions upon the accumulation of additional evidence, so there is nothing unscientific in Mr. Good's revised opinion. I point it out merely as an example of how some assumptions that led to the formulation of survey protocols in 2010 and 2011 have since been invalidated.

I also agree with Good's testimony that comparing fatality rates among existing wind projects is the best method of predicant collision fatality impacts. However, I reiterate my earlier testimony that fatality estimates from existing wind projects should not be compared as reported. Field methods varied too greatly. Further adjustments are needed to reduce the effects of known biases associated with various field methods.

Finally, I do not believe that science has exhausted all possibilities for using acoustic detection surveys or other types of survey to link bat detection rates to bat fatality rates. I am currently analyzing my own thermal-imaging data in the hope of identifying useful patterns of bat flights associated with combinations of terrain and wind. If strong patterns emerge, then I will try to model those patterns for the purpose of turbine micro-siting. Acoustic detectors might yet be deployed in manners that are more predictive. Certainly, real-time implementation of acoustic detectors mounted on wind turbines contributed to substantial reductions of bat collision fatalities via a "smart" curtailment algorithm (Hayes et al. 2019).

19. Do you agree with Rhett Good's testimony that "To date no evidence exists that bat mortality is higher in the Midwest or Eastern U.S. at projects with more forest…?"

No. See Smallwood (2020) for evidence contrary to his opinion. Among wind projects monitored for fatalities with search intervals <10 days among wind turbines ≥0.66 MW in rated capacity, Smallwood (2020) found a 61.5-fold range of variation in estimated fatality rates among regions of the USA, with the highest fatality rates in the High Plains states and the second highest in Appalachia and northeastern USA.

20. Do you agree with Rhett Good's testimony that "Mortalities of all of these species [Indiana bat, northern long-eared bat, little brown bat, tri-colored bat] have been documented at wind-energy facilities, although typically in much lower numbers than eastern red, hoary bat, and silver-haired bat?"

I agree that an uncritical review of existing reports indicate that Good is correct, but I do not necessarily agree with him. I am suspicious of the effects of a bias that has been built into fatality monitoring. I described this bias earlier in my testimony, but I'll summarize it briefly here. Larger bats are much easier for human searchers to find. These same bats are used in carcass detection trials, which inaccurately represent the detection probabilities of smaller bat species. Small bats that are found are then adjusted by detection probabilities that are too large, resulting in underestimation of small bat fatalities. Adding to the underestimation is the higher likelihood that small-bodied bats would not be found by searchers in the first place.

That smaller-bodied bats are more readily missed by human searches is evident in the mean difference in fatality estimates between search intervals <10 days and those >10 days. For example, mean fatality estimates based on search intervals <10 days were 10 times greater for tri-colored bat and 22 times greater for little brown bat (Smallwood 2020). When my colleagues and I tested scent-detection dogs against human searchers, both teams following the same field methods other than the human team not wagging tails, the dogs detected 4 bat species as fatalities and the human team detected one species (Smallwood et al. 2020). It could be that Myotine bats are indeed killed by wind turbines less often than the migratory tree-roosting bats, but it could also be true that wind turbines kill many more Myotine bats than we yet realize.

21. Do you agree with Rhett Good's testimony that "Minimization measures proposed for the project will require USFWS review and approval, and will significantly reduce bat mortality."

Not without qualification. The efficacy of fatality minimization measures is in the details of their implementation. A poor implementation can easily result in no fatality reduction at all. To be believable, the minimization measures must be described in detail. To be convincing, they need to be implemented with the tenets of experimental design in mind (Sinclair and DeGeorge 2016).

22. Do you hold the opinions expressed in this testimony to a reasonable degree of scientific certainty?

Yes.

23. Does this conclude your testimony?

Yes, it does. However, I reserve the right to submit supplemental testimony as new information subsequently becomes available or in response to positions taken by other parties.

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CERTIFICATE OF SERVICE

On September 21, 2020, I served a copy of this filing by electronic mail on the following persons:

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Jack A. Van Kley

EXHIBIT A

EXHIBIT A

Kenneth Shawn Smallwood
Curriculum Vitae

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Ecologist

Expertise

- Finding solutions to controversial problems related to wildlife interactions with human industry, infrastructure, and activities;
- Wildlife monitoring and field study using GPS, thermal imaging, behavior surveys;
- Using systems analysis and experimental design principles to identify meaningful ecological patterns that inform 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

- 486 professional publications, including:
- 88 peer reviewed publications
- 24 in non-reviewed proceedings
- 372 reports, declarations, posters and book reviews
- 8 in mass media outlets
- 87 public presentations of research results

Editing for scientific journals: Guest Editor, *Wildlife Society Bulletin*, 2012-2013, of 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.

Member, Alameda County Scientific Review Committee (SRC), August 2006 to April 2011. The five-member committee investigated causes of bird and bat collisions in the Altamont Pass Wind Resource Area, and recommended mitigation and monitoring measures. The SRC reviewed the science underlying the Alameda County Avian Protection Program, and advised the County on how to reduce wildlife fatalities.

Consulting Ecologist, 2004-2007, California Energy Commission (CEC). Provided consulting services as needed to the CEC on renewable energy impacts, monitoring and research, and produced several reports. Also collaborated with Lawrence-Livermore National Lab on research to understand and reduce wind turbine impacts on wildlife.

Consulting Ecologist, 1999-2013, U.S. Navy. Performed endangered species surveys, hazardous waste site monitoring, and habitat restoration for the endangered San Joaquin kangaroo rat, California tiger salamander, California red-legged frog, California clapper rail, western burrowing owl, salt marsh harvest mouse, and other species at Naval Air Station Lemoore; Naval Weapons Station, Seal Beach, Detachment Concord; Naval Security Group Activity, Skaggs Island; National Radio Transmitter Facility, Dixon; and, Naval Outlying Landing Field Imperial Beach.

Part-time Lecturer, 1998-2005, California State University, Sacramento. Instructed Mammalogy, Behavioral Ecology, and Ornithology Lab, Contemporary Environmental Issues, Natural Resources Conservation.

Senior Ecologist, 1999-2005, BioResource Consultants. Designed and implemented research and monitoring studies related to avian fatalities at wind turbines, avian electrocutions on electric distribution poles across California, and avian fatalities at transmission lines.

Chairman, Conservation Affairs Committee, The Wildlife Society--Western Section, 1999-2001. 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, 1995-2000, Institute for Sustainable Development. Headed ISD’s program on integrated resources management. 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. Worked with Shu Geng and Mingua Zhang on several studies related to wildlife interactions with agriculture and patterns of fertilizer and pesticide residues in groundwater across a large landscape.

Lead Scientist, 1996-1999, National Endangered Species Network. Informed academic scientists and environmental activists about emerging issues regarding the Endangered Species Act and other environmental laws. Testified at public hearings on endangered species issues.

Ecologist, 1997-1998, Western Foundation of Vertebrate Zoology. 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, 1994-1995, EIP Associates, Sacramento, California. Provided consulting services in environmental planning, and quantitative assessment of land units for their conservation and restoration opportunities basedon ecological resource requirements of 29 special-status species. Developed ecological indicators for prioritizing areas within Yolo County to receive mitigation funds for habitat easements and restoration.

Post-Graduate Researcher, 1990-1994, Department of Agronomy and Range Science*, U.C. Davis*. Under Dr. Shu Geng's mentorship, 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. Managed and analyzed a data base of energy use in California agriculture. Assisted with landscape (GIS) study of groundwater contamination across Tulare County, California.

Work experience in graduate school: Co-taught Conservation Biology with Dr. Christine Schonewald, 1991 & 1993, UC Davis Graduate Group in Ecology; Reader for Dr. Richard Coss's course on Psychobiology in 1990, UC Davis Department of Psychology; Research Assistant to Dr. Walter E. Howard, 1988-1990, UC Davis Department of Wildlife and Fisheries Biology, testing durable baits for pocket gopher management in forest clearcuts; Research Assistant to Dr. Terrell P. Salmon, 1987-1988, UC Wildlife Extension, Department of Wildlife and Fisheries Biology, developing 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 to Dr. E. Lee Fitzhugh, 1985-1987, UC Cooperative Extension, Department of Wildlife and Fisheries Biology, developing and implementing statewide mountain lion track count for long-term monitoring.

Fulbright Research Fellow, Indonesia, 1988. Tested use of new sampling methods for numerical monitoring of Sumatran tiger and six other species of endemic felids, and evaluated methods used by other researchers.

Projects

<u>Repowering wind energy projects</u> through careful siting of new wind turbines using map-based collision hazard models to minimize impacts to volant wildlife. Funded by wind companies (principally NextEra Renewable Energy, Inc.), California Energy Commission and East Bay Regional Park District, I have collaborated with a GIS analyst and managed a crew of five field biologists performing golden eagle behavior surveys 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. Focused behavior surveys began May 2012 and continue. Collision hazard models have been prepared for seven wind projects, three of which were built. Planning for additional repowering projects is underway.

<u>Test avian safety of new mixer-ejector wind turbine (MEWT)</u>. Designed and implemented a before-after, control-impact experimental design to test the avian safety of a new, shrouded wind turbine developed by Ogin Inc. (formerly known as 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 Ogin, I managed a crew of seven field biologists who performed periodic fatality searches and behavior surveys, carcass detection trials, nocturnal behavior surveys using a thermal camera, and spatial analyses with the collaboration of a GIS analyst. Field work began 1 April 2012 and ended 30 March 2015 without Ogin installing its MEWTs, but we still achieved multiple important scientific advances.

Reduce avian mortality due to wind turbines at Altamont Pass. Studied wildlife impacts caused by 5,400 wind turbines at the world's most notorious wind resource area. Studied how impacts are perceived by monitoring and how they are affected by terrain, wind patterns, food resources, range management practices, wind turbine operations, seasonal patterns, population cycles, infrastructure management such as electric distribution, animal behavior and social interactions.

Reduce avian mortality on electric distribution poles. Directed research toward reducing bird electrocutions on electric distribution poles, 2000-2007. Oversaw 5 founds of fatality searches at 10,000 poles from Orange County to Glenn County, California, and produced two large reports.

Cook *et al*. v. Rockwell International *et al*., No. 90-K-181 (D. Colorado). 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. Provided expert reports based on four site visits and an extensive document review of burrowing animals. Conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. 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. After appeals the award was increased to two billion dollars.

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

Expert testimony and declarations on proposed residential and commercial developments, gas-fired power plants, wind, solar and geothermal projects, water transfers and water transfer delivery systems, endangered species recovery plans, Habitat Conservation Plans and Natural Communities Conservation Programs. Testified before multiple government agencies, Tribunals, Boards of Supervisors and City Councils, and participated with press conferences and depositions. Prepared expert witness reports and court declarations, which are summarized under Reports (below).

Protocol-level surveys for special-status species. Used California Department of Fish and Wildlife and US Fish and Wildlife Service protocols to search for California red-legged frog, California tiger salamander, arroyo southwestern toad, blunt-nosed leopard lizard, western pond turtle, giant kangaroo rat, San Joaquin kangaroo rat, San Joaquin kit fox, western burrowing owl, Swainson's hawk, Valley elderberry longhorn beetle and other special-status species.

Conservation of San Joaquin kangaroo rat. Performed research to identify factors responsible for the decline of this endangered species at Lemoore Naval Air Station, 2000-2013, and implemented habitat enhancements designed to reverse the trend and expand the population.

Impact of West Nile Virus on yellow-billed magpies. Funded by Sacramento-Yolo Mosquito and Vector Control District, 2005-2008, compared survey results pre- and post-West Nile Virus epidemic for multiple bird species in the Sacramento Valley, particularly on yellow-billed magpie and American crow due to susceptibility 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. 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. Monitored 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 sites. Also used GPS to monitor the response of fossorial animals to yellow star-thistle eradication and natural grassland restoration efforts at Bear Valley in Colusa County and at the decommissioned Mather Air Force Base in Sacramento County.

Mercury effects on Red-legged Frog. 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. Also measured habitat variables in streams.

Opposition to proposed No Surprises rule. 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." Submitted 188 signatures of scientists and environmental professionals concerned about No Surprises rule US Fish and Wildlife Service, National Marine Fisheries Service, all US Senators.

Natomas Basin Habitat Conservation Plan alternative. 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.

Assessments of agricultural production system and environmental technology transfer to China. Twice visited 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.

Yolo County Habitat Conservation Plan. Conducted landscape ecology study of Yolo County to spatially prioritize allocation of mitigation efforts to improve ecosystem functionality within the County from the perspective of 29 special-status species of wildlife and plants. Used a hierarchically structured indicators approach to apply principles of landscape and ecosystem ecology, conservation biology, and local values in rating land units. Derived GIS maps to help guide the conservation area design, and then developed implementation strategies.

Mountain lion track count. Developed and conducted a 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. Track survey transect was established on dusty, dirt roads within randomly selected quadrats.

Sumatran tiger and other felids. Upon award of Fulbright Research Fellowship, I designed and initiated track counts for seven species of wild cats in Sumatra, including Sumatran tiger, fishing cat, and golden cat. Spent four months on Sumatra and Java in 1988, and learned Bahasa Indonesia, the official Indonesian language.

Wildlife in agriculture. Beginning as post-graduate research, I 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 since 1989 with a hiatus of 1996-2004. The data are analyzed using GIS and methods from landscape ecology, and the results 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. 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 clear-cuts. Developed gopher sampling methods and tested various poison baits and baiting regimes in the largest-ever field study of pocket gopher management in forest plantations, involving 68 research plots in 55 clear-cuts among 6 National Forests in northern California.

Risk assessment of exotic species in North America. 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.

Peer Reviewed Publications

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Smallwood, K. S., D. A. Bell, and S. Standish. 2020. Dogs detect larger wind energy impacts on bats and birds. Journal of Wildlife Management 84:852-864. DOI: 10.1002/jwmg.21863.

Smallwood, K. S., and D. A. Bell. 2020. Relating bat passage rates to wind turbine fatalities. Diversity 12(84); doi:10.3390/d12020084.

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Smallwood, K. S. and M. L. Morrison. 2018. Nest-site selection in a high-density colony of burrowing owls. Journal of Raptor Research 52:454-470.

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Smallwood, K. S. 2015. Habitat fragmentation and corridors. Pages 84-101 in M. L. Morrison and H. A. Mathewson, Eds., Wildlife habitat conservation: concepts, challenges, and solutions. John Hopkins University Press, Baltimore, Maryland, USA.

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Morrison, M. L., K. S. Smallwood, and L. S. Hall. 2002. Creating habitat through plant relocation: Lessons from Valley elderberry longhorn beetle mitigation. Ecological Restoration 21: 95-100.

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Comments on Environmental Documents

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

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- Notes on Proposed Study Options for Trail Impacts on Northern Spotted Owl (2017; 4 pp);
- San Gorgonio Crossings EIR (2017; 22 pp);
- Replies to responses on Jupiter Project IS and MND (2017; 12 pp);
- MacArthur Transit Village Project Modified 2016 CEQA Analysis (2017; 12 pp);
- Central SoMa Plan DEIR (2017; 14 pp);
- Colony Commerce Center Specific Plan DEIR (2016; 16 pp);
- Fairway Trails Improvements MND (2016; 13 pp);
- Review of Avian-Solar Science Plan (2016; 28 pp);
- Replies to responses on Initial Study for Pyramid Asphalt (2016; 5 pp);
- Initial Study for Pyramid Asphalt (2016; 4 pp);
- Agua Mansa Distribution Warehouse Project Initial Study (2016; 14 pp);
- Santa Anita Warehouse IS and MND (2016; 12 pp);
- CapRock Distribution Center III DEIR (2016: 12 pp);
- Orange Show Logistics Center Initial Study and MND (2016; 9 pp);
- City of Palmdale Oasis Medical Village Project IS and MND (2016; 7 pp);
- Comments on proposed rule for incidental eagle take (2016, 49 pp);
- Grapevine Specific and Community Plan FEIR (2016; 25 pp);
- Grapevine Specific and Community Plan DEIR (2016; 15 pp);
- Clinton County Zoning Ordinance for Wind Turbine siting (2016);
- Hallmark at Shenandoah Warehouse Project Initial Study (2016; 6 pp);
- Tri-City Industrial Complex Initial Study (2016; 5 pp);
- Hidden Canyon Industrial Park Plot Plan 16-PP-02 (2016; 12 pp);
- Kimball Business Park DEIR (2016; 10 pp);
- Jupiter Project IS and MND (2016; 9 pp);
- Revised Draft Giant Garter Snake Recovery Plan of 2015 (2016, 18 pp);
- Palo Verde Mesa Solar Project Draft Environmental Impact Report (2016; 27 pp);
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- Supplementary Reply Witness Statement Amherst Island Wind Farm, Ontario (2015, 38 pp);
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- Replies to comments 24 Specific Plan Agua Caliente Band of Cahuilla Indians FEIS (2015, 6 pp);

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- West Valley Logistics Center Specific Plan DEIR (2015, 10 pp);
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- Bay Delta Conservation Plan EIR/EIS (2014, 21 pp);
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- Addison and Rising Tree Wind Energy Project FEIR (2014, 12 pp);
- Alta East Wind Energy Project FEIS (2013, 23 pp);
- Blythe Solar Power Project Staff Assessment, California Energy Commission (2013, 16 pp);
- Clearwater and Yakima Solar Projects DEIR (2013, 9 pp);
- Cuyama Solar Project DEIR (2014, 19 pp);
- Draft Desert Renewable Energy Conservation Plan (DRECP) EIR/EIS (2015, 49 pp);
- Kingbird Solar Photovoltaic Project EIR (2013, 19 pp);
- Lucerne Valley Solar Project Initial Study & Mitigated Negative Declaration (2013, 12 pp);
- Palen Solar Electric Generating System Final Staff Assessment of California Energy Commission, (2014, 20 pp);
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- Rising Tree Wind Energy Project DEIR (2014, 32 pp);
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- Soitec Solar Development Project Draft PEIR (2014, 18 pp);
- Comment on the Biological Opinion (08ESMF-00-2012-F-0387) of Oakland Zoo expansion on Alameda whipsnake and California red-legged frog (2014; 3 pp);
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- 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);
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- 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 & Save Our Scenic Area (2010; 6 pp);
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- 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);
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- Response to testimony of experts at the East Altamont Energy Center evidentiary hearing on biological resources (2002: 9 pp);
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- 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).

Comments on other Environmental Review Documents:

- Proposed Regulation for California Fish and Game Code Section 3503.5 (2015: 12 pp);
- Statement of Overriding Considerations related to extending Altamont Winds, Inc.'s Conditional Use Permit PLN2014-00028 (2015; 8 pp);
- 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.

Posters at Professional Meetings

Leyvas, E. and K. S. Smallwood. 2015. Rehabilitating injured animals to offset and rectify wind project impacts. Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 9-12 March 2015.

Smallwood, K. S., J. Mount, S. Standish, E. Leyvas, D. Bell, E. Walther, B. Karas. 2015. Integrated detection trials to improve the accuracy of fatality rate estimates at wind projects. Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 9-12 March 2015.

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

Dog detections of bat and bird fatalities at wind farms in the Altamont Pass Wind Resource Area. East Bay Regional Park District 2019 Stewardship Seminar, Oakland, California, 13 November 2019.

Repowering the Altamont Pass. Altamont Symposium, The Wildlife Society – Western Section, 5 February 2017.

Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area, 1999-2007. Altamont Symposium, The Wildlife Society – Western Section, 5 February 2017.

Conservation and recovery of burrowing owls in Santa Clara Valley. Santa Clara Valley Habitat Agency, Newark, California, 3 February 2017.

Mitigation of Raptor Fatalities in the Altamont Pass Wind Resource Area. Raptor Research Foundation Meeting, Sacramento, California, 6 November 2015.

From burrows to behavior: Research and management for burrowing owls in a diverse landscape. California Burrowing Owl Consortium meeting, 24 October 2015, San Jose, California.

The Challenges of repowering. Keynote presentation at Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 10 March 2015.

Research Highlights Altamont Pass 2011-2015. Scientific Review Committee, Oakland, California, 8 July 2015.

Siting wind turbines to minimize raptor collisions: Altamont Pass Wind Resource Area. US Fish and Wildlife Service Golden Eagle Working Group, Sacramento, California, 8 January 2015.

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, Berlin, Germany, March 2015.
- 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.

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

Memberships in Professional Societies

The Wildlife Society
Raptor Research Foundation

Honors and Awards

Fulbright Research Fellowship to Indonesia, 1987
J.G. Boswell Full Academic Scholarship, 1981 college of choice
Certificate of Appreciation, The Wildlife Society—Western Section, 2000, 2001

EXHIBIT B

National Park Service

Bats

NPS.gov / Home / Benefits of Bats

Benefits of Bats

Sure, it's interesting that bats navigate by echolocation and that they're nocturnal. But do they really matter? The short answer is "Yes!" These flying mammals bring many benefits to their ecosystems. More than **45 unique species of bats** live in national parks, and different species provide different benefits. Some pollinate plants, others eat insects, many serve as prey to other animals, and they all inspire scientific discoveries.

This lesser long-nosed bat is covered with pollen. This species of bat lives in the desert and sips the nectar of cacti and agave flowers.

NPS photo

Supporting Cave Communities

Caves are complex and unique ecosystems that provide homes for a diversity of creatures from insects to amphibians and fish as well as mammals like wood rats and bats. Many of these creatures can only survive within the cave, and they rely on nutrients carried into the cave by water or other animals. Bats benefit caves by providing important nutrients in their guano (better fertilizer than cow manure!) that support the growth of communities of cave organisms.

Insect Control

Bats that eat insects are called "insectivorous." They feast on insects each night, adding up to more than $3.7 billion worth of pest control each year in the U.S. When bats are around to eat insects, there are fewer insect pests causing damage to crops, and farmers don't have to invest as much in pesticides. Imagine a teenage boy eating 200 quarter-pound burgers -- that's how much a bat eats in insects in one night!

Pollinators

Several species of bats in tropical and subtropical areas of the Americas eat nectar. Many types of plants in these regions rely on bats for pollination and seed dispersal, such as the blue agave. In some southwestern parks, long-nose and long-tongue bats are perfectly adapted to pollinate these plants, and they provide extensive value to the agricultural industry. So next time you sweeten your coffee with agave nectar, remember to thank a bat.

Seed Dispersal

Fruit-eating bats play important roles in distributing seeds to maintain plants and forests. These species of bats, often called "flying foxes" because of their larger body size and big eyes, live in tropical and subtropical areas of the Old World (Africa, Asia and Australia). Fruit-eating bats are also found in some Pacific islands, Latin America, and the Caribbean and live in national parks in Guam, American Samoa, and the Virgin Islands!

Prey

Just as some bats rely on thousands of insects each night for survival, other animals in the ecosystem rely on bats for their calories. Hawks, falcons, and owls eat bats, and mammals like weasels, ringtail cats, and raccoons sometimes attack bats while they roost.

Inspiration

Some of bats' unique features like membrane wings and **echolocation** have inspired technological advances in engineering. Drones that have thin and flexible bat-like wings are are in the works as well as tiny, more efficient sonar systems for navigation. The wingsuits used by basejumpers take more than a few cues from bats' aerodynamic bodies.

Last updated: August 17, 2020

EXHIBIT C

GOV. DEWINE PROCLAIMS OCT. 24-31 AS 'BAT WEEK'

Gov. DeWine Proclaims Oct. 24-31 as 'Bat Week'

COLUMBUS, Ohio – Bats are important to both Ohio's economy and ecosystems, which is why Gov. Mike DeWine has proclaimed Oct. 24-31 as Bat Week to highlight the need for bat conservation.

"Bats contribute substantially to our economy by protecting our forests and agriculture from crop-damaging insects and pests," said Mary Mertz, director of the Ohio Department of Natural Resources (ODNR). "It is critical that we continue efforts to promote the health of bat populations here in Ohio and across the nation."

Unfortunately, bat populations in Ohio are declining because of a combination of threats from disease, land development, and contamination from pesticides. Studies have shown that the loss of bats could cost the nation's agricultural industry more than $3.7 billion per year because of the pest-control benefits they provide. With almost 14 million acres of agricultural land in Ohio, bats have an important role in our state.

ODNR is encouraging Ohioans to help celebrate Bat Week by doing something positive for these important winged mammals. People can help by building artificial bat roosts, planting native vegetation to attract insect prey for bats, or educating people on how important bats are.

"Bats are amazing creatures that are vital to the health of our natural world and economy," said ODNR Division of Wildlife Chief Kendra Wecker. "The recent decline of many species of bat populations due to White-nose Syndrome and other factors highlight the need for public and private partnerships to work together to restore bat populations."

At least 10 species of bats are commonly found in Ohio. Two species — Indiana bats and northern long-eared bats — are federally listed. The remaining species are all protected under state law.

Bat Week is an international, annual celebration designed to raise awareness about the need for bat conservation. The Bat Week proclamation was backed by the Ohio Bat Working group and the Ohio Wildlife Rehabilitators Association. For more information and ideas on how to get involved in bat cons