October 1, 2008

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Re: Critique of Altamont Pass Avian Monitoring Team's "Altamont Pass Wind Resource Area Bird Fatality Study" July 2008

Dear Mr. Houghton:

This letter provides a detailed critique of the Altamont Pass Wind Resource Area ("**APWRA**") Bird Fatality Study that was prepared by the Altamont Pass Avian Monitoring Team ("**Monitoring Team**") and issued in July 2008 ("**Report**").

In general, the Report is deficient in clarity of writing, data-collection methodology, post-processing of data, data analysis, and interpretation of results. The Report was unclear and imprecise and, therefore, little of the science in the Report could be properly evaluated.

The following errors indicate not only a lack of proofreading and technical editing but also a lack of adherence to the conventions of scientific writing:

> incomprehensible sentences (e.g., "Thus, we shoes [sic] the string of turbines as one of our study unites [sic] because searched [sic] were efficiently performed on them."[1]);

> misuse of standard equation script (e.g., Equation 1, Equation 2);

> failure to use consistent terminology in the Report (e.g., survey area, survey radius);

> undefined specialized terms (e.g., backdated, survey area, survey radius, plot, avian group);

> unidentified variables in equations (e.g., *I* in Equation 2);

> undefined acronyms (e.g., NREL in Figure 2);

> incorrect labeling of column headings in tables (e.g., Table ES-3, right-most column);

> incorrect formation of a logic tree (e.g., Figures 5 and 6);

> misunderstanding of the difference between a table and a figure (e.g., Figure 8);

[1] Appendix B, Page B-1, Paragraph 3.

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> misunderstanding of the relationship between precision and number of decimal places reported (e.g., Tables ES-1 through ES-3); and

> failure to provide units with values (e.g., "44 ± 18.6"[2]).

In addition, the methodology was unclear, poor data management practice was used, and key data and limitations of analyses were omitted including:

> failure to disclosure the limitations of the analysis and interpretation of the results.

> failure to use good data management practices;[3]

> failure to present support for use of a statistical model with a dataset;[4]

> misunderstanding of the impact of the data collection methodology on the data analysis; and

> failure to disclose sources of error in the values used in the analysis;

> failure to disclose key aspects of values used in calculations (e.g., the Monitoring Team did not disclose in the Report that the value of scavenger probability used in calculations was the value on the day in the middle of the range of days in the assigned "back-dating" categories);

> failure to clearly describe the methodology by providing conflicting descriptions of processes used (e.g., conflicting descriptions of the record filtering process in Section 3.3, Figure 4 and Table 2);

> failure to present the values used in calculations within the methodology (e.g., values used in calculations in the methods are presented in the results);[5]

> failure to discuss why they did not conduct other potentially more appropriate analyses such as multivariate analyses[6]

These failures reduce the credibility of the analysis. These failures further suggest there may be additional errors in the data collection, data processing, and analysis that are not apparent from the report we reviewed.

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[2] Appendix A, Paragraph 1.
[3] Section 3.4.1. The data management practice described does not use standard numerical notation and therefore increases the potential for errors in the database.
[4] Section 4.4.1.
[5] For example, assignment of body size and avian group to each species was presented in Table 4 of the Results section. In the methodology the calculations described depend on these assignments for the values for scavenger probability and searcher efficiency.
[6] Section 4.4.1 "We did not conduct multivariate or other analyses to determine if the unexplained variance in fatalities was due to random factors or other variables."

The data collection, data processing, and analysis described in the Report indicate a lack of understanding of the scientific method and acceptable standards of scientific work. For example, many unnecessary approximations are made in the post-processing of the data that inflate error in the results. Also, the Monitoring Team did not acknowledge a number of sources of error nor describe how these errors impact the accuracy and uncertainty in the results.[7] In addition, the Monitoring Team designed and used an unconventional methodology instead of standard methodology such as the point count protocol, to collect data on bird use that yielded data with little value for determining the statistical significance of the relationship between the population size of birds in the APWRA and the number of wind turbine–related avian fatalities.

The errors in the data post-processing and analysis as presented in this Report render the results of the Report misleading and I would not recommend that these results be used as a basis for action that depends on these results. The balance of this letter provides a detailed critique of the errors, missing data, and remaining questions in the Report. The critique is arranged in the order in which the issues first appear in the Report. Due to the large number of errors in the Report, this list is not comprehensive.

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Comment 1.

A typographical error occurs in the citation. "…Prepared for Altamont [sic] County Community Development Agency." The Report was prepared for the Alameda County Community Development Agency.

This is the first of many examples of the Monitoring Team's lack of attention to detail that reduces the credibility of the Report.

TABLE OF CONTENTS

Comment 1.

Figures 3-1 through 3-3 in Appendix B are not listed in the Table of Contents.

Comment 2.

Tables C-1 and C-2 of Appendix C are not listed in the Table of Contents.

[7] For example, see Table ES-1 Comment 5.

1 EXECUTIVE SUMMARY

Table ES-1

Comment 1.

Reporting the percentage of American kestrel change in mortality rates and estimated fatality rates as 30.52% implies that the value of the percentage is known to be between 30.515% and 30.525%? Is this the case? If not, the Report is implying an accuracy/precision that it does not have. The professional standard is to report results of calculations with a level of precision based on the resolution of the collected data.

Comment 2.

Failure to acknowledge variation in energy generation over seasons leads to inaccurate estimates of wind turbine-related fatalities in the APWRA.

In the Report, energy is reported as the MW per year.[8] This metric is accurate if the value of MW per year is the amount of energy output each year. However, it would not be accurate if the value of MW per year is a value established by multiplying the rated capacity of turbines by the amount of time in a year and summing operational turbines in the APWRA. This latter value is inaccurate because it assumes each turbine operates at maximum capacity for an entire year, and does not accommodate seasonal variation in wind speed that influences the amount of time that a turbine generates power (e.g., in some months there are more days than in other months when the wind speed is too low for the turbine blades to generate energy) which the Report acknowledges.[9] Therefore, the key data analyzed in this Report, which are the values of "Adjusted fatalities/MW/year" and the "Estimated APWRA – wide average annual fatalities" which is calculated from "Adjusted fatalities/MW/year", have low accuracy which is not discussed in the Report.

The Report is misleading because it does not identify this error and because this error reduces the accuracy of the results.

Comment 3.

The Report fails to acknowledge annual variation in wind speed. If values for the metric MW per year were established by multiplying the rated capacity of turbines by the amount of time in a year and summing operational turbines in the APWRA, as described in Table ES-1, Comment 2, the value would be inaccurate because it would not account for annual variations in wind speed. Annual variation in wind speed will impact the total amount of energy output in a given year.

[8] Table ES-1 "Adjusted fatalities/MW/year".
[9] Section 2, Paragraph 2.

Comment 4.

The problem described in 1 Executive Summary, Comment 2 and 1 Executive Summary, Comment 3 is further exacerbated in the column entitled "Estimated APWRA-wide average annual fatalities." In Section 3.4.4,[9] this estimated value is calculated by multiplying the "Adjusted fatalities/MW/year" with 580 MW, the rated capacity of the 5,400 turbines in the entire APWRA turbine field.[10] However, in Section 2, Paragraph 2, the Report acknowledges that the actual number of turbines available at any one time for operation is estimated to be 4,500 to 5,000, or 83 to 95 percent of 5,400 turbines, yielding a more accurate rated capacity of the entire APWRA turbine field of 480 to 540 MW. The Monitoring Team uses the entire rated capacity of the entire APWRA (580 MW produced by 5,400 turbines) to calculate "Estimated APWRA – wide average annual fatalities" even as they acknowledge that this is an over-estimate of the number of turbines functioning at any one time.

The Report is misleading because it does not identify this error and the reduced accuracy of the results based on this error.

Comment 5.

The results presented in Tables ES-1 and ES-2 assume that the Smallwood and Thelander 2004 & 2005 study ("**Baseline study**") and the study presented in the Report as the Current study ("**Current study**") are comparable. However, a number of differences exist between the Baseline study and the Current study, including, but not limited to:

> Different subsets of turbines were surveyed over different durations. In the Baseline study, "Phase I included 1,526 turbines (NREL group) that were surveyed between March 1998 and September 2002." However, "Phase II included 2,548 turbines (CEC group) that were surveyed between September 2002 and May 2003."[11]

> Different subsets of turbines had different average search intervals between and within studies. In the Current study, search intervals are "44 days between October 2005 and March 2007, and every 37 days between early April 2007 and October 2007."[12] In the Baseline study, Phase I turbines (surveyed between March 1998 and September 2002) had an average search interval of 53 days, and Phase II turbines (surveyed between September 2002 and May 2003) had an average search interval of 90 days.[13]

> The MW values used were the summations of rated MW capacities of different sized groups of turbines which were surveyed for different lengths of time in the two studies. In the Baseline study, the MW values used were the summation of the rated capacities of the turbines surveyed

[10] Section 3.4.4 "That estimate is then multiplied by 580, the rated MW capacity for the entire APWRA turbine field, to provide the average annual APWRA-wide fatality and average monthly APWRA-wide mortality rate".
[11] Section 3.1.1.
[12] Section 3.1.1.
[13] Section 3.1.1.

in different periods of the study (Phase I: 1,526 turbines; Phase II: 2,548 turbines),[14,15] whereas the MW values in the Current study were the rated capacity of the turbines of "A" (2,100 turbines surveyed in 2005 to 2007) and "B" (500 turbines surveyed only in 2007).[14,16]

> The methodology for the post-processing of the wind turbine-related avian fatalities data differed between the Baseline study and the Current study, especially the protocol involved with inferring bird date-of-death (i.e., back-dating wind turbine–related avian fatalities).[17]

> The methodology used to search for carcasses differed between the Baseline and Current study (e.g., the size of the area around a turbine string searched). While the methodology used in the Baseline study was described in detail comparable information was not provided for the Current study, and further differences between the methodologies may exist.

> Values used for searcher detection efficiency differed among the two studies.[18]

In addition, several unanswered questions remain regarding the Current study and the Baseline study.

> Were the strings analyzed in the two studies identical (i.e., were strings in each study composed of the same turbines)?

> How were differences in search effort within each study and among the studies accounted for?

> Were comparable methods used for the Monitoring Team's "backdate" methodology for records in both studies?[19]

> Did both studies use the same methods to identify the species of bird remains?

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[14] Figure [sic] 8, Footnote 1.
[15] Table 1, Footnote 1.
[16] Table 1, Footnote 2.
[17] Appendix B, page B-3, Paragraph 1 "To the number of years used in the mortality estimate, we added three months to every wind turbine string, to represent the time period when fresh carcasses could have accumulated prior to our first search." This manipulation of the data was not mentioned in the Report.
[18] Appendix B, page B-4, Baseline study "Because we did not perform trials to estimate searcher detection and scavenger removal rates, we relied on published estimates from other studies. Orloff and Flannery (1992) estimated searcher detection of 85% of raptor carcasses in APWRA, so we used this value for raptors. For non-raptors, we used the mean between the Johnson et al. (2002) estimate of 38.7% and the Erikson et al. (2003) estimate of 43%, which was 40.85% and rounded to 41%." In the Current study, Table C-1 entitled searcher probability (which one must assume is Searcher detection efficiency) depends on both body size and whether it is a raptor, resulting in the following probabilities: Large raptor 1; medium raptor 1; small raptor 0.75; large non-raptor 0.78; medium non-raptor 0.78; and small non-raptor 0.51.

[19] See Figure 4, Comment 2.

> For the elements of the process that have subjective components, such as species identification and assignment of carcass age, were quality control methods used uniformly across the studies to reduce variation due to subjectivity?

All of these differences can affect whether the data collected in the two studies are similar enough to be used in a comparative analysis. The Report should have discussed how these differences in data were handled when the two studies were compared.

For some of the differences in data between the two studies, the Report describes that approximations were used. The approximations in the Report are less precise than they could be if data presented in the Report were utilized, resulting in unnecessarily large amounts of uncertainty in the analysis (e.g., the number of operable wind turbines in the APWRA).[20] The amount of error introduced because of these approximations, the subsequent reduction in the precision/accuracy of the results, and the limitations in the interpretation of the results are not discussed in the Report. Also, many differences between the two studies are simply ignored (e.g., search methods), resulting in statistical comparisons that have little meaning for the hypotheses being tested. By not making these approximations and omissions clear, the Report misleads the accuracy/precision of the results.

Comment 6.

"CEC group" is not defined. "NREL" is not defined.

Table ES-2

See Table ES-1 Comment 1.

See Table ES-1 Comment 4.

Table ES-3

See Table ES-1 Comment 1.

See Table ES-1 Comment 4.

Comment 1.

The right-most column is incorrectly labeled and the error is not discussed, resulting in misleading results.

Table ES-3 presents a comparison of two sets of turbines, one of which is composed of different ratings and sizes, operating during the same time period. However, the title of the right-most column is "Percent Change in mortality rates and estimated fatalities," implying that all the turbines were changed from one turbine type to another turbine type. However, changing sets of turbines from non-Diablo to Diablo turbines was not discussed in the Report.

[20] Section 2, Paragraph 2.

It is possible that the title was a result of a lack of attention to detail by the Monitoring Team and that the Monitoring Team intended to present the difference in mortality between two sets of turbines as a percent. However, for the meaning of a value reported as a percent difference to be understood, it must be clear which of the two values is the base of the percentage (i.e., when reporting X percent of Y, it needs to be clear what X and Y are). The situation is analogous to not reporting units with a numerical value. For example, in the statement, "I drove 100," it is not clear whether it was 100 miles, feet, or inches, or miles per hour, feet per hour, etc. The same is true when reporting percentages; one must provide the values used to calculate the percent (e.g., Y is a percent of X) to understand what the value means.

For example, if one assumes an Average Annual Mortality Rate ("**AAMR**") for a non-Diablo turbine of 0.9785 and an AAMR for Diablo turbines of 0.1552, the following four percentages could be provided to describe the difference between the values as a percent: 15, 85, 530 or 630. The meaning of these numbers is not clear without context, such as the context provided in the statements below:

> The AAMR of Diablo turbines is 15 percent of the AAMR of non-Diablo turbines;

> The AAMR of Diablo turbines is 85 percent less than the AAMR of non-Diablo turbines;

> The AAMR of non-Diablo turbines is 530 percent more than the AAMR of Diablo turbines; or

> The AAMR of non-Diablo turbines is 630 percent the AAMR of Diablo turbines.

Therefore, proper context must be provided when reporting a percentage value for the meaning of the value to be clear.

The Monitoring Team fails to present the correct context for values reported as "Percent Change in mortality rates and estimated fatalities," rendering the meaning of these values unclear.

Comment 2.

Differences exist in the data collection protocol between Diablo and non-Diablo turbines (e.g., survey area) that may affect direct comparisons of the two groups. The Report should have discussed these differences and their implications for the analysis and results.

The Monitoring Team's failure to discuss these potential sources of error and how they may affect the results misleads the reader regarding the level of accuracy of the results.

Comment 3.

Table ES-3 omits critical data that would reveal the large amount of error in the values in the table. For example, the values in the column entitled "Estimated APWRA-wide average annual fatalities" for non-Diablo and Diablo turbines are extrapolations from data sets of different sizes (i.e., different numbers of each turbine type are surveyed), a point that is not noted or discussed in the table or text. Extrapolations from data sets of different sizes can result in differences in

the uncertainty in extrapolated values. In particular, extrapolation of the number of wind turbine–related avian fatalities from the small set of Diablo turbines clustered in the center of the APWRA to fatalities across the entire APWRA assumes that the center of the APWRA is representative of a wide geographic area over which bird abundance and patterns of use may vary. The error in this extrapolation is higher than in the non-Diablo turbines, which are scattered across the APWRA and are therefore more representative of variation in wind turbine-related avian fatalities across the landscape of the APWRA. This error is not accounted for in the reported upper and lower confidence intervals.

The Report is misleading because it does not discuss the relative levels of accuracy in extrapolated values when comparing extrapolated values.

Comment 4.

The Report does not provide reasoning or evidence to support its assumption that the search effort is best approximated by the rated capacity of the turbines (Table 1).

The Report should discuss why more direct measurements of search effort, such as time spent surveying a turbine string, were not used.

3 METHODS

Figure 2.

Comment 1.

What is an "NREL" turbine? This Report does not define this term. To clearly communicate the results of the study, all terms should be defined.

3.1.1 Current Study

Comment 1.

The methodology for plot selection in Paragraph 1 is not described in sufficient detail. The Report describes plot-selection methodology as follows: "The surveyed turbines were distributed in 84 randomly selected plots stratified by geographic location (north and south monitoring areas) and turbine size (very small at 40 to 65 kilowatt ["**kW**"]; small at 100 to 150 kW; medium at 250 kW or more)."[21]

A number of questions need to be answered to evaluate this work: Where is the map that shows the locations of the 84 selected plots? Why 84 plots? Are the plots of equal size? How were the plots drawn? How did the Monitoring Team select sites with stratified random sampling with two strata (turbine size and geographic location) if more than one turbine size occurs in a string or a plot? Were entire strings surveyed within a selected plot? If a string extended out from a

[21] Section 3.1.1, Paragraph 1.

selected plot to a non-selected plot, were turbines outside the plot surveyed as part of the string? Were these same plots selected for the Baseline study for analysis?

The following question is of particular concern because it deals with the accuracy of the extrapolation to wind-turbine related fatalities for the entire APWRA: how was the stratification over space and by size of turbine of samples accommodated in the analysis? Stratified sampling over-samples small sub-populations of turbines (by location or turbine size), so the data reflect the diversity of turbines rather than composition of the entire population of turbines in the APWRA. To extrapolate from data collected in a stratified sampling manner to the entire population of the APWRA, the over-representation of small populations of turbines in the data that do not represent the actual composition of turbines in the APWRA must be accounted for.

The Monitoring Team fails to discuss the bias in the data, the potential for error in the data due to the biased representation, and steps taken to evaluate and reduce the amount of error in extrapolations of wind turbine-related avian fatalities in the APWRA. These issues further reduce the credibility of the accuracy of the results in the Report.

Comment 2.

Section 3.1.1 states that 2,500 turbines were surveyed.[22] However Appendix A states that the between 2,100 to 2,600 turbines were surveyed.[23,22] This inconsistency needs to be explained.

Comment 3.

The Report states that different search intervals were used in the beginning of the Current study (October 2005 to March 2007) than in the latter part of the Current study (April 2007 to October 2007). However, the Report does not discuss the potential impact of differences in the search intervals within the same study. The Report needs to describe how this irregularity in the data was accounted for in the analysis and discuss the potential limitations of interpreting the results due to this irregularity.

3.1.2 Baseline Study

See Table ES-1, Comment 5.

3.2 Bird Use Monitoring

Comment 1.

The bird use monitoring protocol is a non-standard protocol that has conflicting descriptions in the text.[24] The non-standard aspect of the protocol and the conflicting descriptions lead to questions about whether these data can be used to determine the statistical significance of the

[22] See Section 3.3, Comment 1. It was unclear in the Report if there are different meanings for the terms "searched" or "surveyed", therefore, the term "search" used here may also refer to turbines "surveyed."
[23] Appendix A, Page A-1.
[24] Section 3.2; Section 3.4.6.

relationship between bird presence and wind turbine–related avian fatalities. The value of data to determine the statistical significance of this relationship depends heavily on specific characteristics of the data collected.

The description of a ten-minute observation period in Section 3.2 is inconsistent with the description of survey lengths in Section 3.4.6, where the Report describes the use of a survey period truncated to ten minutes from a longer observation time, the duration of which is not described. Was the observation ten minutes or longer? The Monitoring Team needs to clearly describe the methodology used to collect the bird abundance data.

Comment 2.

Recording the number of birds observed each minute is not standard data collection methodology used in a point count. The Monitoring Team should either use standard protocols (e.g., point counts) that are widely accepted in the scientific community as robust methods of measuring abundance or explain why such methods are not appropriate for this study. If the Monitoring Team uses non-standard protocols, they should describe the protocol in enough detail to allow it to be evaluated and discuss the advantages and limitations of the non-standard protocol.

Comment 3.

The choice of benefits, that the Monitoring Team associated with the bird use data collection protocol, [25] suggests that the Monitoring Team has a poor understanding of the hypotheses that, when tested, would best evaluate the efficacy of mitigation methods to reduce wind turbine–related avian fatalities in the APWRA mandated by CUPs. The Monitoring Team claimed their data had greater accuracy because they recorded each bird they saw during each minute of the ten-minute observation. I assume that "greater accuracy" referred to the higher resolution of time for each recorded observation (one minute versus ten minutes in a point count). However, collection of data in this manner does not provide greater accuracy for statistical analysis to test the hypothesis that the number of wind turbine-related avian fatalities are related to the presence of birds in the APWRA; rather, collection of data in this manner reduces one's ability to use these data to test this hypothesis.

The protocol for conducting an observation using the point count methodology is to record all of the birds and their species observed during a 10-minute period. The point count methodology and its' 10-minute window for observations, are generally accepted by the scientific community as robust methods for collecting data to estimate bird population size. The Monitoring Team recorded birds observed during a shorter time window of 1 minute, and repeated those observations for 10 successive minutes. If a bird stayed in the observer's field of view for 10 minutes, then using this methodology, it would be counted 10 times, once for each minute it was observed; however, using the standard point count methodology this bird would be counted once. Because the Monitoring Team did not record whether individuals counted in successive

[25] Personal communication with Jay Houghton regarding the conference call including the SRC and Monitoring Team on August, 14, 2008.

minutes were of the same individual that had not left the observer's field of view, it is not possible to accurately extrapolate point count data from the Monitoring Team data bird.

Data collected using the Monitoring Team's protocol may provide greater accuracy when testing some hypotheses, but not the hypothesis that the Altamont Pass Wind Resource Area Scientific Review Committee ("**SRC**") asked them to test.[26,27]

The Monitoring Team needs to clarify the hypotheses they are testing and how the manner in which they collect data will result in data appropriate to test these hypotheses.

Comment 4.

Neither Figure 2 nor Figure 3 illustrates turbine strings. Because the smallest unit of area surveyed in the analysis is a string, the Monitoring Team should have included a map denoting the location and the composition of the strings.[28] To evaluate the quality of the analysis in the Report, it is crucial that one understands the data used in the analysis, including the location and length of the strings, the delineation of strings among neighboring turbines, etc.

3.3 Data Quality Control and Filtering

Comment 1.

At least six different terms are used in the Report to refer to areas surveyed or plots in which surveys occurred:

> search area;[29]

> search radius;[30]

> study radius;[31]

> survey area;[32]

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[26] P104 SRC 070808 Meeting Notes, Page 6, Second paragraph: J. Burger describes what "the SRC is trying to get at" is the relationship between abundance and number of fatalities. These documents can be found in the following document, and are referenced here by the letter and number identifier used in the document, such as "P105": http://www.altamontsrc.org/alt_doc/p105_src_7_02_08_call_notes.pdf.
[27] SRC 12/04/06 Meeting Notes, Page 4, Section entitled "SRC Recommendation on Behavior Use and Relative Abundance" in which the SRC states "For now, the SRC recommends that the monitoring team complete a relative abundance study to measure the number of birds of each species in the APWRA. Behavior use studies are not currently recommended by the SRC…."
[28] Section 3.4.1 "The survey effort represents the amount of wind power capacity (the rated MW capacity for each turbine) surveyed each month, summarized across survey strings by month and year".
[29] Appendix A, Paragraph 1, Blade Strike/Turbine Collision Section, Page A-3.
[30] Blade Strike/Turbine Collision Section, Page A-3, and Figure 5 top left-most box.
[31] Figure 5, middle box.
[32] Section 3.3, third bullet.

> fatality monitoring plot;[33] and

> plot.[34]

Several of these terms are not defined, including survey area, search radius, and fatality monitoring plot. Some of these terms appear to be used interchangeably; therefore, it is unclear whether these terms refer to different areas or if the terms are interchangeable. To reduce confusion, the conventions of scientific writing include avoiding the use of multiple terms to refer to the same object or area.

The conventions of scientific writing also require that the writer provide definitions for the specific meaning of general terms used in the text. For example, the Report should identify that the general term "study site" refers to a specific concept such as: the area within fifty meters of a turbine string. For several terms in the Report (e.g., search radius) the specific meaning in the Report is not defined.

The Monitoring Team should use consistent terminology and define the terms they use, including a figure if necessary for clarity.

Comment 2.

"Avian group" is not defined.[35] The Report should define this term and describe the methodology used to assign a bird species to an avian group. The methodology should contain a list or a reference to a list elsewhere in the Report of bird species and their assigned group for all bird species in the Report.

Comment 3.

Conflicting descriptions of the methodology to filter records occur in three locations in the Report.[36] For example, Section 3.3 lists the criteria "inconsistent information" and "consisted of only old bones…" as parts of the filtering process, but these criteria are not included as nodes in the logic tree in Figure 4.

Comment 4.

The Report needs to clarify the methodology by which "back-dating" was used to provide a measure of scavenger removal for fatalities that were wind turbine-related avian mortalities.[37]

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[33] Section 3.2. Paragraph 1.
[34] Section 3.1.1 Paragraph 1 "Each plot included 10 to 60 turbines aligned in 1 to 7 turbine strings."
[35] 2nd Bullet, 1st sub-bullet.
[36] See Section 3.3, Figure 4 and Table 4-2.
[37] Page 3-7, Paragraph 1, "Back-dating … also provided a measure of the probability of scavenger removal for fatalities that were turbine-related".

The following statement renders the methodology used unclear "Carcasses that could not be assigned a back date were used for calculating the total number of fatalities, but not for the scavenger removal estimates."[38]

Comment 5.

Conflicting descriptions of the size of the survey area suggest that remains found outside the regularly surveyed area were included in the analysis. The Report states that the designated survey area was "125 meters [m] from the turbine string."[39] However, the sizes of the survey area listed in both the Current study and the Baseline study are smaller than 125 m:[40] in the Baseline study, the survey area was 50 m from the turbine string,[40] while in the Current study, survey areas were 50 m,[41] 60 m,[42] and 75 m[43] from the turbine string depending on the turbine height. This discrepancy needs to be clarified.

Inclusion of wind turbine–related avian fatalities found outside the survey areas that are opportunistic finds unnecessarily introduces uncertainty and potential bias into the results and thereby reduces their accuracy.

Comment 6.

The Report states that the size of the survey area differs between the Baseline survey and the Current study as well as within the Current study.[44] The Report does not account for such differences in the data in the analysis.

Comment 7.

The term "back-dating" is jargon which should be avoided for clarity.[45]

If it is necessary for clear communication to introduce a term to refer to a unique method, then the term's unique definition should be clearly defined. The meaning of a layperson term in a scientific paper is often unclear; therefore, the conventions of scientific writing discourage the use of terms, such as back-date, that may convey a general idea,[46] without also providing the definition of the terms specific meaning in the document. Adherence to these conventions is essential for clear communication in scientific reports.

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[38] Page 3-7, Paragraph 1.
[39] Section 3.3, 3rd bullet and Box in Figure 4.
[40] Page B-1, Paragraph 4.
[41] Appendix A, Page A-1, Paragraph 1.
[42] Appendix A, Page A-1, Paragraph 1, at "EnXco [sic] Tres Vaqueros site in Contra Costa County".
[43] Appendix A, Page A-1, Paragraph 1, "Survey area at Diablo Winds site".
[44] Section 3.3, Comment 5.
[45] Section 3.3, Page 3-7.
[46] Definition from the Oxford English Dictionary (2nd Edition, 1989) of back-date or backdate: To affix or assign a date earlier than the actual one to (a document, book, event, etc.); to render an enactment, agreement, etc., valid retroactively from a given date.

Figure 4

See Section 3.3, Comment 3.

Comment 1.

The relationships between the logic trees in Figures 4, 5, and 6 are not explained. One must infer how the Monitoring Team uses the logic trees. Are the logic trees used separately from each other or are they nested within each other, and if so how?

Comment 2.

This comment concerns the following path through the logic tree in Figure 4: the fatality record is complete, the fatality is turbine related, the fatality was within 125 m of the turbine, there is no backdate for the fatality, the fatality falls in the survey window. Based on this information, one would follow the path leading to the box labeled: "the death is included in the analysis and not adjusted."

This path through the logic tree indicates that given this information, the death is included in the analysis, and the day-of-death given is the day the bird was found. If a slightly different set of information was used, and "there is no backdate for the death" is instead "back date is possible," the result is the final box "Include in analysis and adjust based on back-date" where the death is included and the day of death is given as a category between 0 and 90 days before the day found (e.g., 0 to 3 days, 4 to 7 days, etc.). Figure 6 indicates that no back-date is given for carcass conditions related to very old carcasses.[47] In short, this means that if the fatality is more than 90 days old, it may be considered to have died the same day it is found, which is incorrect and logically incoherent. Carcasses with other conditions are considered to have died between 0 and 90 days before being found. Therefore, for finds of various conditions, the adjustment for day of death is highly inconsistent, introducing error into the data. The Monitoring Team must provide a justification for this methodology.

Comment 3.

Was any attempt made to look at the relationship between bird use and bird mortality at turbines nearby the location where the birds were observed?

[47] This comment concerns the following path through the logic tree in Figure 6: "carcass"; "no flesh present and no age data available from field photos or notes"; "no back-date"; "Include in Analysis but not adjusted".

3.3.1 Baseline Data Code Conversion

See Table ES-1, Comment 4.

Comment 1.

Section 3.3.1 does not adequately describe how the two data sets were processed in a way that allowed comparable data to be included in a comparative analysis. The Report should explain the reasoning and the benefit of using a different protocol than that of the Baseline study for inclusion of fatalities that are "back-dated" to occur before the start of the surveys.

Figure 5. Process for Assigning Cause of Fatality to Records in the APWRA Fatalities Database

Comment 1.

The purpose of a logic tree (a.k.a. decision tree) is to clearly visualize the data-analysis process so that the validity of the process can be independently evaluated. However, Figures 5 and 6 are incorrectly structured and therefore do not provide clear insight into the process. Rather, these figures add more confusion and prevent independent evaluation of the validity of the analysis process.

The typical format of a logic tree is as follows: a logic tree has nodes, each of which contains a single criterion, and two options lead from the node to other nodes. These two options are (1) meets the criterion in the node and (2) does not meet the criterion in the node. Therefore, there cannot be more than one criterion at a node, and there cannot be more or fewer options leading from node to node than the two options of (1) meets the criterion in the node and (2) does not meet the criterion in the node.

In Figure 5, several boxes have only "yes" options leading from the nodes, without a "no" alternative. The following boxes in Figure 5 only contain a "yes" option: "rarely predated species," "other turbine related cause," and "under powerlines or guy wires." Also, in several instances, the option "and" is provided in addition to "yes" and "no". In addition, several nodes have multiple exclusive criteria at one node (e.g., one box includes the following three criteria: [1] within study radius, [2] multiple causes of death, and [3] uncertain causes of death; a second example is a node that has two criteria: [1] intact and [2] no conflicting information).

Similar issues are found in Figure 6.

This lack of adherence to the accepted logic tree structure leads to confusion. For example, when multiple criteria are present at a node, where do you go if one of the criteria is met and the other is not? Can you have multiple uncertain causes of death? What does one do if the criterion is not met, but the node does not offer a "no" option?

Comment 2.

The Monitoring Team have not defined “multiple causes of death,” “uncertain causes of death,” or “conflicting information” in the text or in the appendices. Also, the Report does not define output terms in Figure 5 including “other,” “other turbine related causes,” “unknown,” or “undefined,” nor does the Report describe whether these data are handled differently or similarly in the analysis and the reasoning behind their decision. “Other” is described in Appendix A and includes causes such as fence collisions and auto collisions, but “other turbine related causes” is not defined.[48] It is left to infer what the Monitoring Team means by these terms.

3.4 Data Analysis

3.4.1 Survey effort

Comment 1.

The areas of bird observation (Figure 2) overlap considerably, especially in the southern half, where wind turbines were clustered. How was this overlap accounted for during bird-use surveys?

Comment 2.

The range for the time of day of the surveys for bird use is quite large, and spans the active period of many different species of birds. The division of the surveys within the day and the rotation of times of day of use relative to seasonal activity of species of birds may impact the number of observations of different species of birds. How frequently were data collected? Was every point surveyed every month? How was potential bias accounted for or avoided?

Comment 3.

The Monitoring Team fails to utilize parsimony which is essential to the management of databases.

The accepted definition of a decimal is base ten; however, the Report states the Monitoring Team represented months as decimals which essentially gives a non-standard definition of base twelve to decimal fractions. Using a decimal fraction (a fraction of ten) to represent a fraction of twelve is not a sound database management practice, because it requires an additional error control step to prevent base twelve data from being manipulated as base ten data. If an extra error control is not introduced, a high potential exists that error will be incorporated into the database when data are entered or manipulated by different users. For example, if one needed to add one month to a subset of records because there was an error in the original data entry resulting in a subset of records being off by one month, one would add 0.01 to each record and queried the year of each adjusted record, the addition of 0.01 to December 2000 (2000.12) would result in the value “2000.13”, which without the extra error control step will not be

[48] Appendix A, Subheading “Other”.

automatically converted to a number representing January 2001 (2001.01). Without an error control step, the year 2000.13 would be parsed out as 2000 rather than 2001, resulting in a record that is at least one year off.

A much better database practice is to use separate columns for year and month, both of which may be identified with numbers. This format is compatible across a wide number of database and analysis platforms.

That the Monitoring Team considered this step to be good database management indicates that the Monitoring Team lacks an understanding of basic error control in database management. Therefore, the entire database should be examined for other such mistakes and errors.

Comment 4.

The Report needs to explain why rated MW capacity is a good measure of survey effort. Paragraph 1 equates the two: "Rated MW capacity was summed by string and month as an index of survey effort, and to standardize fatality observations by survey effort." A more direct measure of survey effort would be the number of times the string was surveyed over a period of time that would take into account different time intervals between surveys. Also, the amount of time that was spent surveying a turbine would more directly measure survey effort (e.g., each wind tower was searched in eight to ten minutes in the Baseline study).[49]

Figure 6. Process for Back-Dating Records in the APWRA Fatalities Database

See Figure 5, Comment 1. As with Figure 5, the structure of the logic tree in Figure 6 is incorrect leading to confusion. See Comments 1 to 4 below.

Comment 1 (Box labeled "Fresh flesh, no invertebrate scavengers (maggots), and/or eyes fluid filled").

This box has two arrows leading out of it, one to "Back date 0 – 3 days" and the other to "Back date 4 – 7 days". Which arrow is chosen? Which "back date" is assigned? What is the intermediate criterion used to determine whether it is "Back date 0 – 3 days" or "Back date 4 – 7 days." The same problems occur with box beneath this one labeled "Flesh is "Gooey"."

Comment 2 (Box "No flesh present and no age date available from field, photos, or notes").

Carcasses that have these qualities go through a line with "No backdate" written on it leading to a box that states "included in analysis but not adjusted." Therefore, if the carcass has deteriorated such that it may be greater than ninety days old, the record is included in the study with a death date of the day it was found, whereas carcasses found with conditions estimated to be less than or equal to ninety days old are included with adjusted date of death earlier than ninety days earlier. This procedure introduces large errors into the data.

[49] Appendix B, Page B-2, Paragraph 3.

Comment 3.

The logic tree is misleading because it suggests that a range of days dead is assigned to a record and used in calculations. However, the Monitoring Team used R_{ib} for the day *i* that is the middle of the range to calculate "Average annual mortality rate (Adjusted fatalities/MW/year)" and "Estimated APWRA – wide average annual fatalities".[50] The sizes of the ranges increase the older the fatality (range of 3 days for a death 0–3 days prior to being found; 60 days for a death over one month prior to being found). Feather piles that are not brittle or decayed are assigned to a category with the largest range of 90 days.[51] The error resulting from using the mid-point value of a range of 3 days is much smaller than for the oldest "day since death" category, and much smaller than that for feather piles that are not brittle or decayed. Table X, Y and Z were created as part of the critique of the Report. Using the values in Table C-2, Table X below was created to illustrate the scavenger removal probability for a range of values of days within each category of "days dead".

Table X. Probability of Removal by Scavengers (R_{ib})

"Back-date" Categories (days)	Small Birds (R_{ib})				Medium/Large Birds (R_{ib})			
	Low	Middle[a]	High	Difference Between High and Low	Low	Middle[a]	High	Difference Between High and Low
0 to 3	0.979	0.909	0.852	0.127	1.000	1.000	1.000	0.000
4 to 7	0.805	0.746	0.695	0.110	1.000	0.994	0.986	0.014
8 to 30	0.666	0.449	0.319	0.347	0.982	0.949	0.930	0.052
31 to 90	0.310	0.160	0.107	0.203	0.929	0.899	0.879	0.050
0 to 90	0.979	0.241	0.107	0.872	1.000	0.912	0.879	0.121

[a] If there are an even number of days in the range, the average R_{ib} of the middle two days was used.

The amount of uncertainty the Monitoring Team does not acknowledge when only using the probability for the day in the middle of the range of days in the "Back-date" category without accounting for the extremes of the range, can be illustrated by looking at the standard deviation of the "Estimated APWRA – wide average annual fatalities" around the middle of range value for a hypothetical small raptors fatality in the 8 to 30 days "Back-date" category. If one assumes that 2.034 MW were searched in a month and that 580 MW is an accurate representation of energy production in the entire APWRA wind turbine field, then the "Estimated APWRA – wide average annual fatalities" calculated using the day in the middle of the range would be 397. Using the low and high number of days in the range results in estimates of 589 and 282 fatalities, for a more accurate estimate of fatalities of 307 $\pm$ 155 (mean $\pm$ standard deviation). This is an extraordinarily large amount of uncertainty which, when not acknowledged, misleads the reader about the number of wind turbine-related fatalities in the APWRA.

[50] Fn. 44 – P107 SRC Comments on August 2008 Fatality Monitoring Report M21, Page 1, Fifth bullet point.
[51] Figure 6, following the path in Figure 6 from "Feather pile", "Feathers brittle or decayed" and choosing the option "no" leads to "Back-date 0 to 90 days".

The Monitoring Team should accurately present the uncertainty in their estimates to not mislead the reader about the number of wind turbine-related fatalities in the APWRA.

Comment 4.

Table X illustrates that the difference in probability of removal by scavengers between low and high number of days in the "Back-date" categories is highest for feather piles that are not brittle or decayed from small birds which are assigned the category 0 to 90 days. If it is the case that feather piles comprise the majority of finds for a focal species, such as burrowing owl, then large amounts of error would be introduced using this method, since the difference in the probability of removal by scavengers changes by 0.872 over the range of days dead in the category.

Since burrowing owls are a focal species, and the wind turbine-related mortality of burrowing owl is of particular concern, the Monitoring Team should have discussed the high level of uncertainty in the values for burrowing owls of "Average annual mortality rate (Adjusted fatalities/MW/year)" and "Estimated APWRA – wide average annual fatalities" introduced with this methodology.

3.4.2 Unadjusted (Documented) Fatality Data

Comment 1.

The Monitoring Team used calculations to create metrics from the raw data, and those values were then used in the analysis. Therefore, the results of the analysis depend on whether the manipulations to the raw data were appropriate and accurate. However, the metrics described in Section 3.4.2 do not account for many variables that influence the accuracy of the measure. The Monitoring Team should discuss the error and provide evidence that the calculated metrics are the most appropriate data to analyze.

The calculation described in the following sentence results in values which do not account for differences among strings in numbers of turbines, turbine models, or MW capacity of turbines in a string: "The mean number and standard deviation of fatalities were then calculated for the number of strings surveyed."[52]

In addition, the Monitoring Team does not describe if and how these data are used in the analyses.

Comment 2.

In Section 3.4.2, the Monitoring Team fails to discuss the importance of site-specific searcher detection efficiency measures or scavenger removal efficiency measures. The SRC and Monitoring Team have acknowledged the values of these variables are critical to developing accurate estimates of wind turbine-related avian fatalities.[53] The importance of these values is reflected by the fact that the SRC and Monitoring Team are working to develop a study to obtain

[52] Section 3.4.2, Paragraph 1.
[53] SRC 7-2-08 Notes, Pages 1-2.

study-specific searcher efficiency and scavenger removal rates for the express purpose of reducing the error in the prediction of estimates of wind turbine-related avian fatalities, in order to "provide a statistically valid measure of bird mortality."[54]

However, this Report uses non-study-specific rates without discussing the errors introduced into the data, and hence the limitations on the interpretation and use of the results. Also, the Monitoring Team and SRC agree that searcher efficiency and scavenger removal rates are confounded, and study-specific experiments are required to tease them apart.

3.4.3 Adjusted Mortality and Detection Probability

Equation 1

Comment 1.

There many problems with Equation 1, which indicate a lack of understanding of which calculations were used and/or a lack of understanding of how the equations work. There are many errors in the equations, including:

> incorrect use of mathematical equation script conventions;

> omission of an explicit description of the dependence of variables on other variables (e.g., *R* is dependent on both time and bird groups, reflecting the likelihood the bird is scavenged); and

> omission of look-up tables of values of variables (e.g., values of *R* dependent on bird group).

I have re-written Equation 1 below such that it accurately incorporates standard mathematical equation script conventions.[55]

Adjusted mortality ("M_a") can be estimated using the following equation:

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[54] SRC 7-2-08 Notes, Pages 1-2, and P98_Data Quality Assurance and Control Methods Review (6-30-08).

[55] Section 3.4.3, Page 3-9

Adjusted mortality can be estimated using the following equation:

$$Mortality_{adjusted} = M_u / R \, x P \qquad \text{(Equation 1)}$$

Where M_u is the unadjusted mortality expressed as either the documented number of fatalities per wind turbine per year or the number of fatalities per MW or rated capacity per year (Smallwood 2007). R is an estimate of the carcass removal rate, as measured by the proportion of carcasses remaining since the last fatality search (estimated by scavenger removal trials) and P is a measure of search efficiency, representing the proportion of carcasses found by the searchers during a survey as estimated by searcher detection trials.

$$M_a = \frac{M_u}{R_{bi} P_b} \quad \text{(Equation 1)}$$

where M_u is the unadjusted mortality, R_{bi} is the estimated carcass removal rate for a given bird group *b* found at day *i*, and P_b is the searcher efficiency for a given bird group *b*; '*b*' includes all possible combinations of bird group (raptor, non-raptor) and body size (small, medium, and large).

Comment 2.

The Monitoring Team fails to explicitly define the values used in Equation 1. The reader must search the entire Report to find these values. Table Y was created to illustrate the values that one must assume are being used to calculate M_a. These values were obtained from multiple places in the text.

Table Y. Species-specific Choice of *P* and *R* for Bird Category *b*

b		Searcher	Percent Scavenged at
Body Size	**Bird Group**	**Detection (P_b)**	**Time *i* (R_{bi})**
Large	Raptor	100	B_i
Large	Non-raptor	80	B_i
Medium	Raptor	79	B_i
Medium	Non-raptor	78	B_i
Small	Raptor	75	D_i
Small	Non-raptor	51	D_i

B_i = scavenger rate for large/medium birds at day *i*, accessed in Table-C-2 column "Medium/Large Birds"

D_i = scavenger rate for small birds at day *i*, accessed in Table C-2 column "Small Birds"

Comment 3.

The Monitoring Team fails to clarify which of the following values were the dependent variables in the ANOVA statistical models: the documented number of fatalities per wind turbine per year,[56] the number of fatalities per MW, [57] or the number of fatalities per rated capacity per year.[57] The confusion generated becomes apparent when further clarification is not provided in the descriptions of calculations in Sections 3.4.4 and 3.4.5.

[56] Section 3.4.2, Paragraph 2.
[57] Section 3.4.3 "Where Mu is the unadjusted mortality expressed as either the documented number of fatalities per wind turbine per year or the number of fatalities per MW or rated capacity per year (Smallwood 2007)."

Section 3.4.3.1 Searcher Efficiency (*P*)

Comment 1.

It is unclear which values are used in the calculations because values described in Section 3.4.3.1 conflict with those provided in Table C-1. In Section 3.4.3.1, the Report states the searcher detection efficiency for large non-raptor birds is 80%, while Table C-1 states for the same birds the searcher detection probability is 0.78 (i.e., 78%). Similarly, Section 3.4.3.1 states the searcher detection efficiency for medium sized raptors is 79%, while Table C-1 states the searcher detection probability is 1.00 (i.e., 100%).

Comment 2.

Because of the errors in the Report, re-written text of Equation 1 in Equation 1 Comment 1 and Table Y in Equation 1 Comment 2 are only examples of correct text; however, due to the lack of clarity of the formatting and structure in the Report, the re-written text may not reflect the Report authors' intent.[58] This emphasizes the importance of adherence to standards that clearly communicate the work performed.

Comment 3.

When using scavenger removal probabilities from Smallwood 2007,[59] the Monitoring Team fails to acknowledge the limitations of Smallwood's methodology. The limitations influence the accuracy of the probabilities, which heavily influence the predicted number of wind turbine-related avian fatalities in the APWRA. Failure to discuss these limitations misleads the reader about the accuracy of the predicted number of wind turbine-related avian fatalities in the APWRA. At minimum the Monitoring Team should discuss the limitations of the study reported in Smallwood (2007).

3.4.3.2 Scavenger Carcass Removal Rate Estimate (Rc)

Comment 1.

The Monitoring Team fails to adequately provide evidence or reasoning for their claim that the calculation of *Rc* that they present provides a more representative measure of the probability of scavenger removal.[60] In fact, the SRC expressly discouraged the use of time since death to calculate *Rc* because of "the estimates of days since death were too large and are subject to bias".[61]

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[58] Equation 1, Comment 1.
[59] Smallwood, K. S. (2007) Estimating Wind Turbine–Caused Bird Mortality. Journal of Wildlife Management: Vol. 71, No. 8, pp. 2781–2791. SCR Ref # R51.
[60] Section 3.4.3.2, Paragraph 1 "In this study, time since death was used to calculate $\mathbf{R_c}$ since it provided a more representative (record-specific) measure of the probability for scavenger removal".
[61] P105, SRC 7-2-08 Notes, Page 2 "The monitoring team said they planned to use estimates of days since death to adjust mortality for scavenger removal. Smallwood disagreed with this approach, arguing

Comment 2.

The Monitoring Team did not discuss alternative methods of calculating *Rc,* the pros and cons of each and why their method should be considered the preferred method.[60]

Comment 3.

The Monitoring Team assigns finds of bird remains to back-date categories, which are a range of days; however, the Monitoring Team selects the day that is the mid-point of this range to determine the probability of scavenger removal for a record in a category. Only after the Report was published, did the Monitoring Team explain that probability of scavenger removal for each record was derived from a value for a day in the mid-point of the range, rather than utilizing the range of days of death in the back-date category.[25] Nowhere in the Report was the use of a single value from the middle of the range of day of death for scavenger probability described. The use of this value introduces a large amount of error in the value of scavenger removal probability, estimate of average annual wind turbine-related fatalities, and estimate of the annual number of wind turbine-related fatalities in the APWRA.

The statement in Section 3.4.3.2 egregiously misleads the reader about the accuracy of the analysis suggesting that the results in the Report have a higher degree of accuracy than they have.[60]

Equation 2

Comment 1.

It is unclear why Equation 2 is included in the Report. Equation 2 utilizes the undefined variables *c, I, x*, and *R*; therefore, the purpose of Equation 2 cannot be determined from the Report. The Monitoring Team's failure to understand standard mathematical equation script conventions is demonstrated by their use of undefined variables, and this leads to confusion about the Monitoring Team's intent.

Comment 2.

The reader is unable to determine which values are used in the equations because the table in the Report entitled "Table C-1" uses different terms in the title ("Searcher probability"), column heading ("Searcher Efficiency"), and in the equation description ("Searcher Detection"). These values conflict with those presented in the text.

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that the error ranges around the monitoring team's estimates of days since death were too large and are subject to bias. Many estimates of days since death range 0-90 days, and that range is routinely applied to certain types of evidence such as feather piles. Smallwood referenced his recent report (P101) as evidence of bias in estimating days since death. If the approach is taken, the monitoring team would need to carry the error term from this adjustment through the calculation of mortality, but since the error term is so large, Smallwood advocated against taking this approach."

Equation 3

Comment 1.

Equation 3 erroneously suggests that carcass removal rate is only dependent on the days-since-death of a wind turbine-related avian fatality, but this rate is also dependent on the bird group, which affects the likelihood of a species to be predated (i.e., carcass removal rate (*R*) depends on both bird category (*b*) and estimated time since death (*i*)).

Equation 3[62] could be more accurately re-written using $R_{i,b}$ as follows:

$$R_{i,b} = a + c \ln(i + 1) \qquad \text{(Equation 3)}$$

where *b* is the bird category, *i* is the estimated time since death, and *a* and *c* are constants derived from fitting the logarithmic model to empirical data gathered during multiple scavenger removal trials.

Appendix C

Table C-1. Searcher Probability

See Equation 1, Comment 2, Table Y.

See 3.4.3.1, Comment 1.

See Equation 2, Comment 2.

Table C-2. Scavenger Probability

See Figure 6, Comment 4.

3.4.4 APWRA-Wide Fatality

See Table ES-1 Comment 3.

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[62] Section 3.4.3.2,

> Where $\mathbf{R_i}$ is the percent of carcasses remaining on the **i**th day since the estimated time of death as described by the following logarithmic model (Smallwood 2007):
>
> $$R_i = a + b\ln(i+1) \qquad \text{(Equation 3)}$$
>
> and **a** and **b** are derived from fitting the logarithmic model to empirical data gathered during multiple scavenger removal trials, and **i** is the record specific estimated time since death. For the

4 Results

4.1 Survey Effort

Table 1. Survey Effort of Study Comparisons

See Table ES-1, Comment 4.

Comment 1.

Several mistakes and omissions occur in Table 1.

> the first column is not labeled

> four colors of shading are used without explanation

> two new undefined terms are used: “Grand Comparison” and “Core Comparison”

> there is an inappropriate use of columns/rows potentially resulting from the inaccurate joining of Diablo Comparison with the other two tables “Grand Comparison” and “Core Comparison”

> the precision of MW searched is different for Grand Comparison and Diablo Comparison and is not explained

Figure 8. Megawatts Searched per Month in Baseline and Current Studies

Comment 1.

Several mistakes and omissions occur in Figure 8:

> Figure 8 is actually a table, not a figure;

> one column is unlabeled;

> one row has missing values;

> there are at least eight colors of shading, the purpose of which is unexplained; also, there are both null values and zero values, but the difference between a null and zero value is not explained;

> undefined terms are included that are not used elsewhere in the document including “study group,” “A,” and “B”; and

> values are reported to one, two, or three decimal places, suggesting different levels of precision among months, however this is not possible if the data are collected to the same resolution.

4.2 Fatality Record Filtering Summary

Table 2. Step Down Record Filter

Comment 1.

Because the criteria are phrased as questions, it is entirely unclear whether the record is included or excluded if it meets or does not meet the criteria. For example, for "Days Dead less than 90?" it is not clear if the record is included or excluded if the bird is dead less than 90 days. The appropriate way to phrase this would be to list criteria as statements (e.g., "Bird is dead less than 90 days") and describe whether the record is included if the criteria are met or not met. Table Z below was created to illustrate this point.

Table Z. Replacement for Table 2 and Table 3 in Report

	Criteria not met (no. records excluded from analysis)		Criteria met (no. records included in analysis)	
Criteria	**Baseline[a]**	**Current[b]**	**Baseline[a]**	**Current[b]**
Records are complete	224	183	989	1839
The fatality occurred less than 90 days before found	178	115	1035	1907
The fatality is turbine related	23	32	1190	1990
The fatality is within 125 m of the turbine	8	16	1205	2006
All criteria listed above	433	346	780	1676

[a]Total of 1,213 records in Baseline study

[b]Total of 2,022 records in Current study

Comment 2.

A detailed examination of Table 2 and Table 3 indicate the Monitoring Team has either mis-represented the number of records which meet/do not meet the filtering criteria or has unnecessarily utilized a step-wise approach to determining records incorporated rather than utilizing only records which meet a number of criteria.

Examination of the data presented in Table 2 and Table 3 indicates that none of the records fail to meet more than one criterion. For example, none of the records that fail to meet the criterion "Records are complete" also fail to meet the criterion "The fatality occurred less than 90 days before found". This pattern is possible, but extremely improbable given the nature of the filtering criteria. For example, it is extremely likely that one would have an incomplete record that was also assigned a day-of-death more than 90 days before found. Additional discussion of the records and criteria are required to explain this potential inconsistency.

In the case that the Monitoring Team has mis-represented the data, and there are records which fail to meet more than one criterion, then the order in which the criteria are used to eliminate records influences the number of records which will be reported as excluded at each step. The

Monitoring Team fails to clarify this critical detail. Also, it would be unnecessary to have both Table 2 and Table 3; the relevant data can be succinctly summarized in a table such as Table Z, which I created to illustrate this possibility.

In the unlikely case that the pattern of data is accurate, a step-wise approach is unnecessary because all the criteria would be mutually exclusive and only the data that meet all five of the criteria would be included in the analysis. However, the Monitoring Team describes a step-wise approach for record filtering in Section 3.3., Figure 4 and Table 2. The Monitoring Team needs to clarify this inconsistency.

In order to clarify this situation, the Monitoring Team needs to clearly present the number of records which meet/do not meet each criterion, discuss the influence of the order in which criteria are used to eliminate records and the resulting records eliminated at each step in the decision process. The Monitoring Team should also describe why records were eliminated in a step-wise fashion rather than only including records which meet a number of criteria.

Comment 3.

The Monitoring Team fails to succinctly present the methodology used in the studies so that it can be evaluated. For example, the data in Table 2 and Table 3 are more concisely presented in Table Z, which aids the inspection of the data which may shed light on errors in the methodology. For example, one can see that out of 1,213 records in the Baseline study only 23 finds were assigned a cause of fatality other than related to wind turbines. This may seem unlikely given that all birds are included in these records, and therefore provides a basis for a discussion of the evidence used to attribute a bird fatality to wind turbines. However, the Report presents the same data in two tables that have repeated values, making such patterns less clear.

4.3 Unadjusted Fatalities

Table 4. Unadjusted Fatalities (Raw Finds) for Baseline and Current Study

Comment 1.

There are two rows in which the species name is followed by the text “(continued)”. For example, there is a row for “red-tailed hawks” and “red-tailed hawks (continued)”, and the same for golden eagles. Each row has the same value of unadjusted fatalities. No explanation is provided.

Comment 2.

Incorrect terminology: the label “Species” is provided for four-letter bird codes, which is incorrect. Species names (genus and species names) often do not correspond well to the four-letter bird codes that are derived from common names, especially in the case of changing scientific names. The accepted reference to species in the scientific community is only by scientific name (genus and species) for such reasons.

4.4 Adjusted APWRA-Wide Fatalities

4.4.1. Baseline-Current Study Comparison

Comment 1.

In Paragraph 1, the Monitoring Team wrote “two study periods were statistically different,” a meaningless statement in statistics, unlike the following phrase “the two study periods were statistically significantly different”. This incorrect usage of basic technical terminology demonstrates a lack of professional competence.

Comment 2.

The Report Monitoring Team did not describe why an Analysis of Variance (“**ANOVA**”) is an appropriate choice for analysis of the data.

The ANOVA test is a statistical test used to describe with a measured level of confidence whether the pattern you observe has occurred randomly. The results of the test are valid only if the data meet certain assumptions that include, but are not limited to, normal distribution of dependent variables and equal variance. Problems can also occur with unbalanced sample sizes, small sample sizes, and other factors. If the data do not meet the assumptions, then it is inappropriate to use the ANOVA test, and the “results” of an ANOVA test should be discarded and ignored.

The Monitoring Team does not discuss whether or not the data meet the assumptions of an ANOVA. There are tests one can conduct to determine whether or not the data violate ANOVA assumptions, however, the Monitoring Team does not discuss performing such tests or, if performed, the results of such tests.

A cursory examination of the data indicates it is likely that the data violate the ANOVA assumptions due to zero values (not finding any birds at a turbine). In the case that the data violate ANOVA assumptions, tools such as transformation can be used in some cases to make the data appropriate for ANOVA; this was not discussed in the Report. If the ANOVA used to test a hypothesis was used inappropriately, then the results of the analysis may be considered of little value in testing the hypothesis. In the case that ANOVA is not appropriate, alternative tests can be used to correctly analyze the data.

In addition, for statistically insignificant results, the report did not evaluate the power of the ANOVA test to detect specified changes. The test result could be insignificant simply because of inadequate sample size. Without an adequate power, one cannot conclude that there is no change.

Comment 3.

The Monitoring Team does not explain why they did not conduct multi-variate analyses. Without a proper multi-variable analysis, one could not be sure about the effect of study period alone.

The effect of the study period could be masked by other important factors that were different between the baseline and current periods.

Comment 4.

The Monitoring Team presents results for the arithmetic mean monthly fatalities,[63] however, they do not describe how mean monthly fatalities were calculated. Given that the interval between the study periods was often greater than a month, how were these monthly values calculated?

4.4.3 Diablo Turbine Comparison

Table 5. Comparison of Mortality Rates and Estimated Fatalities for the Baseline and Current Study Periods

and

Table 6. Comparison of Mortality Rates and Estimated Fatalities at Core Turbines for the Baseline and Current Study Periods

Comment 1.

Which data were used in the ANOVA?

Comment 2.

The criteria used to evaluate the body size of a bird for the bird-group categorization were not included in the methods, nor were the assignments of body sizes to each bird species that were used in calculations included in the methodology. The reader must search the Report to determine the values of searcher detection and scavenger probability utilized for each species by looking in the text, a table in the results and tables in the Appendices. The lack of a clear presentation of data further obfuscates the methodology utilized by the Monitoring Team.

Comment 3.

If the categorization of body size used in the Report is that which is described indirectly in Appendix A in the bullet "Species", then the Report should make this clear in the methodology section when the dependence of variables on body size is described.

[63] Section 4.4.1, Paragraph 1 "… the arithmetic mean monthly fatalities increased between the Baseline and Current periods...".

4.5 Bird Use

Figure 12a. Monthly Avian Use and Mortality for Burrowing Owls During the Current Study

Comment 1.

The bird observation data for December, January, and February 2006, which are provided for American kestrel, red-tailed hawk, and golden eagle, are not provided for burrowing owls. Why?

Figure 12b. Regression of Avian Use and Mortality for Burrowing Owls During the Current Study

Comment 1.

A linear regression produces an equation for a regression line that models the relationship between X and Y variables. The fit of the data to the regression line influences the accuracy of predictions that can be made using the equation.

The plot of the regression for the burrowing owl (Figure 12b) shows values clustered at the left and a single value on the far right. For these data, the slope of the regression line, and hence the statistical significance of the regression and the R^2 values, is heavily influenced by the value of a single data point. Standard statistical analysis requires discussion of the dependence of the results of the regression on a single data point, verification of the accuracy of this data point, and, depending on the objective of the analysis, follow-up with further statistical tests. In addition, the Monitoring Team did not report the root mean square error ("**RMSE**"), which describes the accuracy of predictions made from the regression line. To accurately describe the results, the Monitoring Team needs to describe this dependence of the slope of the regression line on a single value and report the limitations in accuracy of predictions from this model.

5 DISCUSSION

Comment 1.

Section 5 fails to discuss the uncertainty in the data, the limitations of the analysis, and the limitations in interpretation and extrapolation of the results in the Report.

Comment 2.

The Monitoring Team states: "These results clearly show that, to date, avian mortality has not been reduced for the for target raptor species at the APWRA."

This statement is misleading. The statement suggests that the results show with a high degree of certainty that avian mortality has not been reduced for target raptor species at the APWRA; however, the results presented do not include a discussion of the uncertainty and error in the data and the results. When incorporating the large amount of uncertainty and error in the data

and analysis, the results are highly uncertain, and it is unlikely such conclusions could be reached with such certainty.

Comment 3.

The Monitoring Team states: “Conversely, the Diablo comparisons revealed a marked reduction in the average annual mortality and fatalities of all target species and species groups for that set of turbines relative to the remainder of the study area.”

This statement is misleading. The statement suggests that the turbine model is related to the difference in average annual mortality and fatality of all target species; however, the Monitoring Team has not excluded the hypothesis that this difference is due to a unique spatial pattern of avian fatalities at the Diablo turbines, that differs from the rest of the APWRA.

Comment 4.

The Monitoring Team fails to discuss the results of the analyses for “Estimated APWRA – wide average annual fatalities” in the discussion.

Comment 5.

The Monitoring Team mentions total fatalities, yet they fail to disclose in the methodology or the results a measure or analysis of “total fatalities”.

6 References

Comment 1.

The following inconsistencies and typographic errors are noted, and indicate that this Report would likely not be published in a scientific peer-reviewed journal without extensive additional editing.

There is a typo in the title of the citation of Johnson et al. (2002): “Collision mortalit7y [sic] of local…”

Inconsistent use within the References of full title or abbreviated title “California Energy Commission” or “CEC” in references, the former used in Orloff and Flannery (1992; 1996) and Smallwood and Thelander (2004) and the latter used in Smallwood and Spiegel (2005a; 2005b; 2005c).

Appendix A: Current Study Field Methods

Comment 1.

The units are not provided “44 $\pm$ 18.6” in Paragraph 1.

Comment 2.

At what point in time was the cross-referencing described on Page A-1, Paragraph 2, conducted? Accurate cross-referencing depends on the amount of data available at the time the cross-referencing was conducted. Different data would be available for accurate cross-referencing in the field, the day the survey was finished, or before/after the subsequent survey. The Report needs to provide these details to allow for an evaluation of the quality control in the cross-referencing process.

Comment 3.

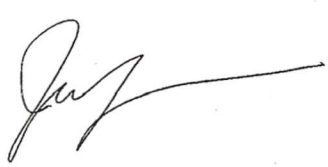
A-1. Numbering methodology in "Incident number". How many searchers were searching at a time? If there was more than one, then there would be multiple finds numbered "1" for the current day.

This concludes comments on the Report.

***Limitations*:** This critique is based on the July 2008 version of the Altamont Pass Avian Monitoring Team Report entitled "Altamont Pass Wind Resource Area Bird Fatality Study" and the conclusions and recommendations herein are therefore applicable only to that version. The comments and recommendations in this critique have been made solely based on the July 2008 version of document entitled "Altamont Pass Wind Resource Area Bird Fatality Study", and URS has not reviewed: raw data; analyzed data; or any other details of the studies or analyses not included in the Report. In preparation of the critique, URS has used background and other information (herein referenced by footnotes) furnished to URS by Altamont Winds Inc. and/or obtained via the website: www.altamontsrc.org. URS has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information.

Sincerely,

URS CORPORATION



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