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Memo – TAC response 6/27/2022

Review of "Alameda County Altamont Pass Wind Resource Area (APWRA) Technical Advisory Committee (TAC) Bat Fatality Threshold Subcommittee (BFTS) recommendations for bat fatality threshold revisions dated March 7, 2022 and updated April 28, 2022 (Threshold Report)".

The aforementioned Threshold Report recommends replacing the APWRA Program Environmental Impact Report's ("PEIR") bat fatality threshold of 1.67 bats/MW/year for all bats to a species-specific threshold of 0.39 hoary bats/MW/year. In doing so, this revised threshold is designed to provide target reductions in annual hoary bat fatalities by 85% for Golden Hills and 72% for Golden Hills North compared to fatalities observed during the 3-year post-construction monitoring period.

Based on our review of the Threshold Report, we conclude that the proposed hoary bat thresholds are not supported by the best available science and recommend that further consideration and discussion take place prior to their adoption. Here, we summarize what we recognize to be some of the key points from the Threshold Report that should be addressed.

1. **The Threshold Report does not adequately acknowledge the underlying uncertainty in the population size of hoary bats, nor the process by which the population sizes of hoary bats were selected for the modeling efforts by Frick et al. (2017) and Frick and Friedenberg (2021).**

- Continued observations of hoary bat (*Lasiurus cinereus*) fatalities at wind energy facilities across North America are of increasing concern to wildlife biologists, natural resource managers, and wind energy operators alike. Although carcasses can be counted and fatality rates estimated with relative precision, there remains uncertainty over population-level impacts because we do not know the population size of hoary bats. Hoary bats are migratory tree-roosting bats and due to their solitary nature (i.e., this species does not roost communally or hibernate in caves where bats can be counted) and migratory habits that are in large part unknown, we do not have empirical estimates of population size.

- In the absence of data, two recent papers investigating the potential impacts of wind turbine mortality selected hoary bat population sizes based on a process called expert elicitation.

  Using expert elicitation and population projection models, Frick et al. (2017) provided the first attempt to put hoary bat wind turbine mortality into context. In this approach, a small number of bat experts were asked to provide their best estimate of the continental-wide population size of hoary bats. Their estimates ranged from 1 to 10 million individuals, and were used to project population scenarios under varying population growth rates and different levels of wind turbine mortality. From this range of starting population sizes, their modeling effort indicated that the hoary bat would likely go extinct if wind turbine mortality is not reduced considerably (Frick et al. 2017).

In a more recent modeling effort by Friedenberg and Frick (2021), the authors conclude that current levels of wind energy build-out may have already caused substantial population declines in the hoary bats. In their simulations, which relied on a starting population size of 2.25 million hoary bats, the population was projected to experience a 50% decline by 2028 under their lowest-risk scenario of high maximum growth rate and low wind energy build-out. On a more positive note, however, they also showed that risks of further decline and extinction could be meaningfully reduced by rapid implementation of measures to reduce fatalities at wind turbines. The TAC appears to have adopted the population size used in this analysis to establish the hoary bat specific thresholds without explicitly acknowledging that the actual population size of hoary bats is not known.

- An important limitation of these modeling studies is that they cannot provide concrete recommendations for the fatality reduction thresholds that should be achieved in any one project or region to avoid severe population declines or even extinction in the hoary bat. Instead, the modeling efforts by Frick et al. (2017) and (Friedenberg and Frick 2021) provide some illustrative scenarios that indicate that hoary bat mortality needs to be reduced range-wide or in regions where hoary bats sustain the greatest estimated mortality to 1) prevent the species from becoming extinct, and to 2) "buy time" so that tools can be developed to estimate population size and devise new technologies/strategies to reduce wind turbine mortality.

2. **Neither the current threshold framework nor the proposed new thresholds incorporate uncertainty when presenting estimates of fatality (e.g., number of hoary bats/MW/year) or in the comparisons that will be made between estimates of fatality and the adopted thresholds. This practice is not consistent with the best available science.**

- The point estimates obtained from post-construction fatality monitoring efforts are simply that – estimates. It is not possible to know the true number of hoary bats, for example, that are killed at wind turbines at even a single wind energy facility over a given period of time. With a carefully designed fatality monitoring study, however, it is possible to generate an unbiased estimate of fatality that takes into account the sampling process (e.g., in many cases it is not feasible to search all turbines), as well as the search interval, area searched, and other factors such as searcher efficiency and carcass persistence that influence overall detection probability. With any given point estimate (e.g., the number of hoary bats/MW/year), it is standard scientific practice to include a measure of uncertainty that reflect the precision of that estimate. In many cases, the standard error of the estimate is used because it incorporates both the sample size and the variation in the variable of interest, two factors that are known to affect precision. Only if measures of uncertainty are provided with the point estimates, is it possible to make comparisons between fatality rates at different wind energy facilities or among regions. For example, without having a measure of uncertainty it is not possible to determine if an estimated 0.20 hoary bats/MW/year is really different from a threshold of 0.39 hoary bats/MW/year.

3. **A thorough review and analysis of current hoary bat mortality in the APWRA, as well as regional and range-wide estimates of hoary bat mortality, must be done prior to adopting a target threshold for the APWRA.**

   Quotes from the Threshold Report: *"Based upon a review of fatality rates from repowered projects in the APWRA and the MHWRA, the mean bat fatality rate is approximately 3.81 bats/MW with a median of approximately 3.35 (Table 1)."* (Page 3). And *"Based on available data, it appears that the Golden Hills and Golden Hills North facilities have higher than average bat fatality rates when compared to the local area and the larger western region."* (Page 3)

   - Carcasses that are removed before a search takes place have no chance of being detected. Some measure of variability, preferably the standard error of each point estimate, should be provided with for the reported means and medians in Table 1. Without the associated standard errors of the estimates it is not possible to compare one estimate to another or conclude that one is higher or lower than another. Variability also exists around the estimates of species composition for each project. The approach recommended for thresholds does not account for this variability.

   - The Bat Fatality Threshold Subcommittee (BFTS) has recommended a hoary bat fatality threshold, above which, wind-energy operators would be required to reduce mortality. The studies used to calculate the recommended threshold are described in Table 1 of the recommendations. Inputs for the calculation include bat fatality estimates from wind-energy facilities in the APWRA, and proportion of hoary bats found relative to other bat species. The values associated with both inputs can vary substantially between studies, based on differing field and analysis methods. The BFTS proposes use of the best available science and data to measure impacts and determine appropriate measures for reducing bat mortality. Given the BFTS emphasis for use of best available science and data, we recommend the threshold be recalculated using inclusion criteria or adjustments of available estimates.

   - Carcasses that are removed before a search takes place have no chance of being detected. The median reported carcass persistence in the U.S. is 6.1 days; projects in the Pacific region report slightly longer median persistence, approximately 12 days, but are highly variable between projects (AWWI 2020). Two studies with the lowest reported bat fatality rates used by the BFTS, Buena Vista and Diablo Winds, were completed with search intervals ranging from 17 – 90 days. Long search intervals relative to carcass persistence times bias fatality estimates low because many carcasses are removed before searchers have a chance to find them (Smallwood 2017). Estimates from Buena Vista and Diablo Winds are thus not comparable to studies such as Golden Hills, where search intervals were 7 days and searchers had greater chances of having carcasses available to be detected. Site specific estimates of bat carcass persistence also were not measured at Buena Vista or Diablo Winds, thus the actual estimates of bat mortality are highly uncertain. The potential magnitude of not accounting for differences between search interval and carcass persistence is illustrated within the Vasco post-construction monitoring report; estimates of bat fatality rates were twice as high at turbines searched at 7-day intervals compared to 28-day intervals at Vasco (Brown et al. 2013). We recommend that projects with greater than 12 day search intervals, which is the median bat carcass persistence in the Pacific region, be removed from threshold calculations. We also recommend that studies which do not measure site-specific bat carcass persistence rates be removed from threshold calculations.

- Other factors also have a significant influence on fatality estimates, including plot sizes and study duration. All of these factors should be accounted for before determining if fatality rates at Golden Hills are higher than other wind-energy facilities in the APWRA.

- Although the point estimates of all bat and hoary bat fatalities from the Golden Hills facilities are higher than other facilities in the Altamont region, these estimates were calculated from studies using differing field and statistical methods than other facilities in the western region, and differing field methods than other facilities within APWRA. For example, recent studies from Golden Hills were completed using more frequent search intervals than past studies in the APRWA. Past studies in the APWRA and other studies in California were completed using search intervals of 14 – 90 days (AWWI 2020); most bat carcasses do not persist that long, thus estimates from these older studies with long search intervals are biased low. Bat fatality rates at Golden Hills are not high relative to reported bat fatality estimates across the Midwest and the eastern U.S., or in the Mountain Prairie and Southwest U.S. (WEST 2020), which include a greater proportion of studies completed at search intervals of 7 days or less (AWWI 2020).

- The interpretation of the data presented in Table 1 is not consistent with the correct interpretation of confidence intervals, which are provided for the 3-year average hoary bat fatalities/MW/year for Golden Hills and Golden Hills North. The correct interpretation of the 95% confidence interval for Golden Hills is that "We are 95% confident that the true mean number of hoary bat fatalities/MW/Year is between 1.44 and 8.29." The average hoary bat mortality rates for all of the projects listed in the table are found within this confidence interval; therefore, the mean number of hoary bat fatalities for Golden Hills does not differ from the APWRA average.

- A review of region-wide and range-wide hoary bat mortality would put the hoary bat mortality as estimated in the APWRA into greater context. This analysis would also indicate when and where implementation of impact reduction strategies would provide the greatest benefit for the species.

- Available data sources for this analysis include the AWWIC database (REWI) and the Renew database (WEST). This analysis would also help evaluate the seasonal pattern of hoary bat fatalities to ensure that the seasonal timing of impact reduction strategies is also based on the best available science.

4. **There is no available scientific evidence to support the general assertion that achieving these new thresholds for hoary bats in the APWRA will result in meaningful changes in population viability or lower the extinction risk for the hoary bat.**

Quote from the Threshold Report: *"Wind facilities in the Altamont Pass Wind Resource Area have an opportunity to reduce the risk of extinction and change the population trajectory of hoary bats away from their current trend towards 7 severe decline." (Page 6-7)*

- The hoary bat is the most widespread bat in all of North America, with only a tiny portion of its range overlapping the APWRA. Even if the goal were to reduce hoary bat mortality to 0 hoary bats/MW/Year in the APWRA, this would have a negligible impact on population viability or extinction risk.

- As an example and taking an approach similar to what was adopted by Dr. Hayes to scale up the impact of wind energy mortality to the continental scale (as was done in the Threshold Report), it is possible to estimate the fraction of total hoary bat mortality that would occur in the APWRA (even under the worst case scenario as presented in Table 2). The installed capacity in the APWRA is 364.3 MW, which is just 0.238% of the total installed capacity in the U.S. (using the value of 152,707 MW from Table 4). It is not conceivable to believe that reducing hoary bat mortality by 72% or even 85% in a subset of the APWRA will "change the population trajectory of hoary bats". The scale at which wind turbine mortality is happening is so much larger than the APWRA. Thus, a continent-wide solution that is based on the best available science, and implemented in areas that are of greatest risk to long-term population persistence of the hoary bat is what is needed. More than 99.7% of installed capacity is outside of the APWRA, and hoary bat mortality is much higher in the eastern and Midwestern portions of the U.S. compared to the APWRA (AWWI 2020, WEST 2020).

5. **Insufficient evidence has been provided to justify why monitoring for three consecutive years is required to demonstrate the effectiveness of curtailment is required.**

    - The best available science shows curtailment to be highly effective at reducing bat mortality at wind-energy facilities across North America (reviewed in Adams et al. 2021; Whitby et al. 2021). This weight of evidence would suggest that verifying curtailment effectiveness for three consecutive years at Golden Hills North and Golden Hills is not necessary, especially given the high cost of extensive monitoring for a non-listed species. The TAC has not sufficiently demonstrated the need to monitor for three consecutive years, especially since there is no mention of taking variation in estimated hoary fatality into consideration when evaluating the threshold.

6. **If three years of fatality monitoring is required, than alternative methods to intensive monitoring with dog teams should be allowed.**

    The Threshold Report states that "*…use of detection dogs has resulted in a substantial increase in the quality of the fatality estimates produced and facilitates an evaluation of the population-level impacts to bats based on the best available science.*" (Page 1-2)

    There are many factors that influence the quality of fatality estimates, and the use of detection dogs is only one of many possible study design features that could be incorporated to produce better (i.e., unbiased and precise) estimates of hoary bat fatality. The best available science does indicate that the use of detection dog teams to find bat carcasses improves fatality estimating by increasing the proportion of carcasses that are found. However, this does not mean that fatality estimates from human searchers are unreliable, nor does it mean that use of human searchers would not meet the objectives of monitoring in the APWRA. Furthermore, the use of detection dog teams does not "…facilitate(s) the evaluation of the population-level impacts to bats like the hoary bat". The difficulty in evaluating population-level impacts for the hoary bat and the other migratory tree roosting bats is that we lack basic demographic data including estimates of population sizes (see #1 above).

- As an alternative to traditional fatality monitoring using dogs and/or humans to find bat carcasses, measuring acoustic exposure to turbine operations should be considered (Peterson et al. 2021). This method provides a reasonable and cost-effective alternative to the blanket curtailment and monitoring required in the recommendations by the Threshold Report. Peterson et al. (2021) examined the relationships between acoustic bat activity, turbine operations, weather, and carcass data collected at two wind energy facilities in West Virginia over seven years. They found that acoustic bat activity explained nearly 80% of the variation in carcass-based estimates of fatality rates and that patterns in bat activity could be accurately predicted among turbines and year. They conclude that their "…results demonstrate that measuring exposure of acoustic bat activity provides a quantitative basis for designing, evaluating, and adaptively managing curtailment strategies."

7. **If mortality thresholds are used, then consideration of alternative methods other than high wind speed blanket curtailment (i.e., curtailing up to wind speeds of 5.5. m/s or higher) to achieve these new mortality thresholds should be recommended.**

    - Acoustic deterrents have proven effective at reducing hoary bat morality at several sites. For example, Weaver et al. (2020) demonstrated that hoary bat mortality was reduced by 71.4% at wind turbines that were equipped with the NRG Systems acoustic deterrent compared to control wind turbines at wind energy facilities in far south Texas. Acoustic deterrents are thought to be effective by creating a noisy airspace that disrupts bats' ability to effectively echolocate. The sounds produced by these devices cannot be heard by humans and do not harm the bats or other wildlife. There is a cost in acquiring and deploying these devices on turbines, but the benefit to operators is that there is no associated power loss with their use.

    - Smart curtailment strategies that incorporate other variables, such as acoustic bat activity, wind direction, or temperature, in addition to wind speed and time of year, also show promise at reducing bat fatalities while lowering the amount of energy lost compared with blanket curtailment (e.g., Hayes et al. 2019, Peterson et al. 2021). Several such smart curtailment strategies are currently being tested, with funding provided by the US Department of Energy and the Renewable Energy Wildlife Research Fund.

8. **The financial implications of achieving these threshold limits should be taken into consideration, as these projects might not be viable due to the combined costs of blanket curtailment at high wind speeds and fatality monitoring efforts.**

Quotes from the Threshold Report: *"The BFTS recommends the County adopt a revised bat fatality threshold of 0.39 hoary bats/MW because this value provides a balanced approach and meets the goal of adaptive management stated in the PEIR "that impacts are minimized to the greatest extent possible while maximizing energy production".* (Page 7)

"Reducing hoary bat fatalities by 70-80% is possible (Whitby et al. 2021) but may necessitate curtailment during a period longer than 3 months in the fall and/or implementation of higher cut-in speeds (6.0-6.5m/s). Additional information regarding the anticipated effect size of increased cut-in speeds and anticipated energy production loss would further inform this approach, but time is of the essence in reducing risk of hoary bat population decline. Therefore, the BFTS advises the use of the threshold value of 0.40 hoary bats/MW/year based on the median initial population size estimated in Frick et al. (2017)." (Page 7)

"The minimum monitoring time will consist of three sequential fall seasons of the bat-specific mortality monitoring program covering the 3–4 months of the year in which the highest bat mortality has been observed: likely August–November." (Page 8)

- Are these projects financially viable at these increased cut-in speeds and/or with expanded curtailment seasons? The median initial population size in Frick et al. (2017) is not based on empirical data, and it has not been demonstrated that this level of curtailment at 0.238% of the installed wind capacity in the U.S. will have an appreciable effect on slowing decline in hoary bats. Is this level of curtailment consistent with "maximizing energy production"?

- Freidenberg and Frick (2021) assessed the level of reduction needed to prevent population extinction and significant declines under differing scenarios of population size, growth rates, and future wind turbine installation. The largest sources of uncertainty in their analysis were the starting population sizes and growth rates for hoary bats. The authors acknowledge this limitation on page 6 … "Hoary bat population size remains the most important knowledge gap obscuring guidance on overall risk and how much fatality reduction is necessary. We used a range of likely abundance developed by expert elicitation from Frick et al. (2017), but empirical basis for estimating a plausible minimum population size for hoary bats is a top research priority."

- The time period for any mortality minimization efforts should be based on the best available science. According to Figure 1 and Figure 2 and the text in the preceding paragraphs in the Threshold Report, October and November are not the months of highest hoary bat mortality at these sites. It is not clear why the recommend mortality monitoring period includes these months. A recent review of the timing of hoary bat mortality produced by EPRI suggests that most projects show a marked increase in hoary bat mortality during the fall, and the period of time that captured 80% of mortality (using weeks as the unit) for California was estimated from approximately 2nd week in August to mid-Oct (EPRI 2020).

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