Review of "A Review and Critique of Risk Assessments Considered by the U.S. Fish and Wildlife Service Regarding the Collision Risk for Whooping Cranes with NPPD's R-Project"

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(1) is the white paper's take assessment and underlying assumptions based on best available science?; (2) do the final conclusions of the white paper match up with species biology and current scientific understanding of future species growth and threats?; and (3) what are (identify) the limitations and/or deficiencies with the Services' approach and assumptions in their conclusion on Whooping Crane risk to take?

I have completed my review of the document entitled *A Review and Critique of Risk Assessments Considered by the U.S. Fish and Wildlife Service Regarding the Collision Risk for Whooping Cranes with NPPD's R-Project January 30, 2019."* Before addressing the posed questions, I would like to define how I view the specific issue at hand. In my mind, there are two issues: 1) Is it reasonable to expect that the project will result in mortality of one or more Whooping Cranes; and 2) Is it possible to derive reasonable and defensible quantitative estimates of what that mortality may be based upon the scientific literature? Both of these issues must be considered when addressing the three questions posed above for this particular review. Essentially, based on the literature we can expect that there will be Whooping Crane mortality from this project, and it could possibly be high. Developing reasonable, defensible quantitative estimates of the probability of a bird being killed or actual numbers of birds killed, however, is simply not possible with the current data available. Estimates can be derived but the estimates based upon model assumptions is highly variable. Thus, while I consider the final FWS quantitative assessments to be a reasonable approach, I do not put much faith in the accuracy of these estimates. However, I would not put much faith in the estimates of any of the other approaches either for the many reasons outlined in the report and associated attachments. There is simply not enough data in the specific forms (e.g., mortality rates under give weather conditions or mortality rates as they relate to spatial distribution of wetlands and transmission lines) to allow for quantitative predictions with a high level of certainty.

I do believe that USFWS has conducted due diligence and used the best available science in evaluating the strengths and weaknesses of the various approaches used by the different interest groups. I do believe that the greatest weakness is the current lack of understanding of the temporal and spatial mortality risks to cranes posed by the transmission lines. In a temporal sense, the effects of adverse weather events (e.g., high winds, foggy) increase the risk to Whooping Crane mortality. From a spatial context, the juxtaposition of transmission lines to key wetland habitats for foraging and roosting create not only a direct risk but this risk is amplified under adverse weather conditions. I believe that the mortality risk at these select sites is higher than at other points along the transmission lines, thus mortality estimates in many of the studies in the literature and even in FWS (2018c) likely underestimate risk because data were collected across a wide range of weather conditions and spatial context. As correctly noted by FWS (2018c), there is a lack of consensus on how specific distances affect strike probabilities. As

correctly noted in FWS (2018c), it is known that transmission lines cause mortality in cranes, and as noted by Tacha (1979) mortality around specific weather events can be acute, or seasonally be higher because of variation in general weather conditions (Ward 1992) among seasons. I believe that FWS (2018c) minimizes risk to cranes based on Murphy et al. (2009). While the greatest risk to Sandhill Cranes at the Platte was from mass flushing of cranes, 36% of mortality was not related to these events. That is still a significant number, particularly if dealing with an endangered species. While Whooping Cranes do not roost in anywhere near as large as numbers as Sandhill Cranes do at the Platte, Ward and Anderson (1992) noted that mortality was much higher (75 vs 60) in a year with more bird movements as a result of storms and high winds.

Quantification of these spatial and temporal effects are not possible, however, with current data as noted by Dr. Craig Davis in his report. I found Dr. Davis' evaluation of the Gil and Weir report highly valuable, and as he noted, there were inherent weaknesses in their report, but their approach of trying to incorporate spatial and temporal parameters into risk is an approach that has much merit in future endeavors, provided appropriate data can be gathered to support model quantification. The weakness in FWS (2018c) is that it does not include these parameters and assumes that risk is similar across all lengths of the transmission line. Since no data are available to accurately quantify temporal and spatial differences in risk, this weakness is unavoidable.