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Memo

To:	Constance L. Cassler, Ph.D. Supervisory Fish and Wildlife Biologist U.S. Fish and Wildlife Service 1339 20th Street Vero Beach, Florida 32960	From:	Bruce K. Johnson, Ph.D. Principal, Senior Scientist Stantec Consulting Services, Inc. 300 Primera Blvd., Suite 300 Lake Mary, Florida 32746
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Reference: Core Scientific Issues related to Panther-Vehicle Mortality (PVM) Analyses

This memorandum briefly summarizes a number of serious scientific issues and concerns related to the technical basis for the estimation of future panther-vehicle mortalities (PVM) as analyzed by the Service during their intra-agency section 7 consultation for the Eastern Collier Multiple Species Habitat Conservation Plan (ECMSHCP) and associated Incidental Take Permits (ITPs). I am providing you this summary memorandum pursuant to your recent request. A more comprehensive analysis of the concerns relating to the Service's PVM analysis is contained in the technical analysis prepared by Megan Higgs, Ph.D., which was submitted to the Service on November 11, 2020. See "Statistical review of Future Roadkill Estimation Method (FREM) used by US FWS South Florida Ecological Field Office staff" (November 10, 2020). This memo does not address equally serious concerns with the theories of PVM causation and attribution stated in the Draft Biological Opinion, which will be addressed under separate cover.[1]

The paramount scientific issues outlined in this memo relate to uncertainties surrounding the development, validation and use of the "Future Roadkill Estimation Method" (FREM), a simplistic algebraic equation that the Service utilizes as a deterministic model for predicting future PVM based upon estimates of future roadway traffic levels. The model employs only three variables: 5-year (aggregate) PVM data; 5-year (mean) traffic volume data (by road segment) within the regional transportation network; and projected 5-year (mean) traffic volume data (by road segment) within the regional transportation network. The FREM provides the core underpinning for the Service's projections of future PVM levels (a projected population sink), and it is therefore directly tied to Florida panther population viability analysis (PVA) results.

Despite the central importance of the FREM model to the Service's projection of future PVM, no detailed documentation has been provided to the Eastern Collier Property Owners (ECPO; applicants) regarding critical scientific and statistical aspects of the FREM model development, validation, and appropriate use (or misuse) for PVM projections. The only documentation provided to ECPO to date is a half-page narrative description of the equation and a summary of two sample predictions that were offered as validation of the FREM equation (USFWS 2020), which provide no suitable basis for the applicants to assess the objectivity or appropriateness of the PVM methodology.

The Service's *Information Quality Guidelines and Peer Review* (USFWS 2012) states, "The FWS definition of objectivity includes whether the disseminated information is presented accurately, clearly, and completely, and in an unbiased manner. To achieve this end, FWS will subject information to review by persons qualified to judge objectivity (as defined by the type of information and the circumstances in which it will be used). Such

[1] The Applicants do not agree that future PVM caused by third parties on external roadways is controlled by or can be attributed to the Applicants or their requested ITPs. Nonetheless, the Applicants do agree that PVM provides important context for understanding the status and viability of the Florida panther, and agree that the BO should consider not only past and present PVM but also projected future PVM levels to the extent such future PVM levels can be predicted with reasonable certainty based on proper scientific methods.

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a "peer review" will be conducted before decision making, unless legal deadlines or other constraints prevent such a timely review. In such cases, the peer review may have to be post hoc. To the extent they are understood, we will explicitly state assumptions, limitations or biases related to the information." Other than stating the central (and unsupported) assumption that PVM projections are related in a linear relationship to traffic volumes, the Service has not provided any information relevant to the FREM model that "is presented accurately, clearly, and completely, and in an unbiased manner," especially regarding limitations or biases that could affect its analytical value.

The critical issues that the Service must thoroughly document and substantiate in a peer review in order to justify the use of the FREM include:

- clearly describing and documenting the detailed methodology that was used to derive the FREM equation itself (e.g., datasets used; selection of data intervals- annual or multi-year; linear or multiple regression analyses; raw data transformations; etc.) with "sufficient transparency about data and methods that a qualified member of the public could undertake an independent reanalysis" (USFWS 2012);
- indicating whether all available regional PVM and traffic volume data were utilized for FREM model development; or if portions of datasets were used for model development, how the data subsets were selected in a scientifically unbiased, representative manner;
- documenting in detail how the derived FREM equation was validated in terms of its accuracy and precision for PVM projections;
    - specifically, were the data used to derive the FREM equation (model training data) also used to validate the equation?
    - which datasets (i.e., road segments and time periods independent of those used for model development) were used to validate the FREM equation's predictive capability?
    - the FREM states mathematically, and the Service has stated in writing, that PVM on a given road segment increases as a linear function of changes in traffic volume; where are the statistical analyses to substantiate these linear relationships for the 91 road segments included in the PVM calculations, which are essential to justify the use of the FREM ?
    - was the FREM validated against rolling 5-year time periods for each road segment, in order to provide error statistics associated with temporal/stochastic variability in PVM projections by road segment (i.e., variability simply through selection of a given 5-year interval)?
    - was the FREM validated for each road segment against rolling 5-year periods to retrospectively evaluate FREM PVM projections versus actual PVM recorded for that road segment and those 5-year time periods (and if so, what were the error statistics)?
- assessing the predictive accuracy and precision of the FREM approach in a statistically robust manner that confirms or refutes its appropriateness for PVM projections used for individual road segments and overall projected PVM, as related to Florida panther analyses and regulatory decision-making.

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It is important to note that without extensive, rigorous testing of retrospective data and generation of error statistics, the FREM remains a purely deterministic model. That is, given the same inputs, it will calculate exactly the same projected PVM numbers every time without any error estimates. In terms of ecological modeling and statistics principles, the lack of rigorous FREM validation and generation of error estimates is not a defensible position for the Service to maintain.

In addition to the core issues surrounding the FREM equation development, validation, and use for PVM projections, the Service has cited Charry and Jones (2009) as support for a linear relationship between wildlife-vehicle mortality and traffic volume. Specifically, the Service stated, "Thus, we predict future annual mortality rates for each road segment in the Action Area will increase as a linear function of traffic volume consistent to that observed by Charry and Jones (2009)." This statement implies that Charry and Jones (2009) observed a linear relationship between wildlife-vehicle mortality and traffic volume, presumably providing some support for the FREM approach, but the paper does not quantify such a relationship and therefore should not be cited in support (or refutation) of the FREM.

As a matter of record, the Charry and Jones (2009) study was not a peer-reviewed publication; it was a conference paper presented at a 2009 International Conference on Ecology and Transportation (ICOET) meeting. The primary focus of the paper involved a literature review of 32 studies to semi-quantitatively define "levels of impacts" to wildlife species associated with traffic volume thresholds. Despite being characterized by the Service as a "meta-analysis" (implying pooled statistical analyses), it is simply a literature review compilation of wildlife-vehicle mortalities across multiple taxa (amphibians, reptiles, birds, small mammals, ungulates, and mammalian carnivores) from studies throughout the United States, Canada, and Europe. The paper has no direct applicability to the Florida panther or PVM, and it categorically does not characterize a linear mathematical relationship between traffic volumes and PVM. The Service should remove the citation due to its lack of relevance to the PVM analysis and its lack of scientific peer review.

REFERENCES CITED

Charry, B., and J. Jones. 2009. Traffic volume as a primary road characteristic impacting wildlife: A tool for land use and transportation planning. In *Proceedings of the 2009 International Conference on Ecology and Transportation,* ed. P. J. Wagner, D. Nelson, and E. Murray, 159–171. Raleigh: Center for Transportation and the Environment, North Carolina State University.

[USFWS] US Fish and Wildlife Service. 2012. Information Quality Guidelines and Peer Review. https://www.fws.gov/informationquality/topics/InformationQualityGuidelinesrevised6_6_12.pdf

[USFWS] US Fish and Wildlife Service. 2020. Email from Constance Cassler to Bruce Johnson, July 8, 2020.

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