EXHIBIT A

Technical Comment on
Scientific Basis to Establish Policy Regulating Communications Towers to Protect Migratory Birds: Response to Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions with Communications Towers, WT Docket No. 03-187, Federal Communications Commissions Notice of Inquiry
and
Reply to Comments Filed With Federal Communications Commission on WT Docket No. 03-187, Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions With Communication Towers

Prepared for:

CTIA – The Wireless Association
National Association of Broadcasters
PCIA – The Wireless Infrastructure Association

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Technical Comment on *Scientific Basis to Establish Policy Regulating Communications Towers to Protect Migratory Birds: Response to Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions with Communications Towers, WT Docket No. 03-187, Federal Communications Commissions Notice of Inquiry (Longcore, et al. 2005)*[1] and *Reply to Comments Filed With Federal Communications Commission on WT Docket No. 03-187, Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions With Communication Towers (Longcore and Rich 2005)*[2]

I. Executive Summary

The statistical analyses used in the Longcore *et al.* Report (2005) (hereinafter referred to as Longcore or Longcore Report) are flawed, and do not provide an accurate representation of nationwide avian mortality related to communications towers. Accordingly, their findings should not be used as a viable estimator of avian mortality and risk to bird populations, particularly with respect to per species mortality–the foundation for their biological significance argument.

The majority of stakeholders associated with this issue advocate more research because they recognize there must be scientifically valid research conducted and properly reported before specific design recommendations could be incorporated into federal policy. The Longcore Report does not in any capacity diminish this need. Some specific points discussed in more detail below include:

- The biological significance of avian mortality should be related to the likelihood of affects to populations, not effects to individual birds. Currently, available data are not sufficient to allow an accurate estimate of the numbers of individual birds killed at towers on a species-by-species basis, and are not sufficient to extrapolate to population-level effects. To accurately estimate mortality on a species-by species basis, an unbiased random sample of a large number of towers, located in a wide variety of conditions and locations, would be needed. Longcore uses data from Shire *et al.* (2000) (hereinafter Shire) to estimate the number of individual birds of each species killed at towers, and assumes that the data are representative of avian mortality at communications towers. This is a poor assumption. Indeed, even Shire concedes that the data they present were collected in an uncoordinated manner, and there was bias in the towers studied because only towers with bird mortality were studied.[3] Further, the data presented in Shire and used by Longcore are not random, unbiased samples. For example, the average reported height of towers in the Shire Report was 1,124 feet above ground level.[4] Consequently,

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[1] Travis Longcore, Catherine Rich, and Sidney A. Gauthreaux, *Scientific Basis to Establish Policy Regulating Communications Towers to Protect Migratory Birds: Response to Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions with Communications Towers, WT Docket No. 03-187, Federal Communications Commission Notice of Inquiry,* filed on Feb. 14, 2005 (Longcore Report).

[2] Travis Longcore and Catherine Rich, *Reply Comments to Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions With Communication Towers WT Docket No. 03-187, Federal Communications Commission Notice of Inquiry,* filed on March. 14, 2005 (Longcore and Rich).

[3] *See* Shire Report, at 19.

[4] *See id.* at 5.

these data should not be used to estimate bird mortality on a species-by-species basis because they are not a good, representative sample as discussed in the analysis below.

- Longcore uses information from 26 tower sites located in 14 states and extrapolates the results to all towers in the United States.[5] Twelve (46%) of these towers were studied for a time period of only one year or less,[6] indicating the results are highly variable and not necessarily representative. Bird migration is highly variable from year to year, as is mortality at a specific tower; therefore, extrapolating with such data is misleading. Birds also do not migrate uniformly across the continent; therefore, Longcore's analyses should have been conducted within a regional context. Birds also migrate at different heights within a region based on species preference, topography, and weather. In summary, there is a high level of uncertainty with the extrapolation presented in the Longcore Report.

- Nineteen studies, that is, 73% of the studies were from sites with towers equal to or greater than 1,000 feet in height.[7] The majority of communications towers, however, are not tall towers. Sprint, for example, has more than 5,600 towers, 85% of which are less than 200 feet tall (99% of them are less than 300 feet tall).[8] Similarly, 67% of Cingular's towers are less than 200 feet tall and 85% are less than 300 feet tall.[9] Therefore, developing a mortality estimate using the data in Longcore is misleading and again highly uncertain. Moreover, all but one of the towers cited in Longcore are over 600 feet tall. Extrapolating this data set to towers less than 600 feet tall is unsound statistical practice because one cannot with a reasonable degree of certainty extrapolate beyond the limits of the data analyzed (*i.e.,* use tall towers to predict short tower effects). Lastly, it does not appear logical or legitimate to make rules affecting communications towers, many of which are less than 300 feet in height, based on studies of towers over 600 feet high.

- Longcore used a logistic regression[10] to evaluate the effect of tower height on bird mortality using a data set of 26 towers ranging in height from 197 feet to 1,994 feet (mean height of 1,102 feet). A regression is a statistical method used to explore cause-and-effect relationships between two variables (*e.g.,* tower height and incidence of avian mortality), when one of the variables (the predictor variable) is continuous. The logistic regression is used when the predictor variable is not continuous, but categorical (*e.g.,* the data fall into two or more categories; yes or no, or greater than 250 or less than 250). Longcore converted a continuous variable (mean annual mortality) to a categorical variable.[11] This is an arbitrary, *post hoc* classification that, at best, marginally fits the logistic (logit) regression model. Logit is typically used to only analyze dependent variables with a binary outcome (*e.g.,* dead or alive, success vs. failure). Longcore states

[5] *See id.* at 12.
[6] *See id.* Table 4, at 32.
[7] *See id.* at 32.
[8] *See In Re Effects of Communications Towers on Migratory Birds*, Comments of Sprint, filed on Nov. 12, 2003, WT Docket No. 03-187, *Notice of Inquiry*, 18 FCC Rcd 16938 (2003).
[9] *See Data Regarding Cingular Wireless' Registered and Non-Registered Structures dated March 22, 2005*, provided by Robert Sutherland, Cingular Wireless to John Lortie, Woodlot Alternatives (May 2005).
[10] A logistic regression is a special form of regression where the *Y* variable is categorical rather than continuous.
[11] *See* Longcore Report, at 12.

that converting a continuous variable (mean annual mortality) into a nominal variable (their mortality classes), *"…reduces the effect of different study methodologies, search inefficiencies, and scavenger removal.* [12] This statement, however, is not supported by any statistical theory or reference to studies in the scientific literature. In fact, converting the data does not offset differences in studies with widely different field methodologies.

Even if one accepts the logistic regression at face value, the R^2 value of 0.27 is very low and suggests only a causal relationship between tower height and mortality rates.[13] It is not the strong relationship suggested by Longcore.[14] A more appropriate test of the data set used by Longcore would be a simple regression of mortality (dependent variable) vs. tower height (independent variable). This regression, however, is not statistically significant (R^2=0.104; F=2.708; p=0.113).

- Longcore and Rich (2005) emphasize the importance of using good science to evaluate effects of avian collision, yet they fail to follow accepted scientific practices in their data analysis and presentation of findings as discussed in detail below. In their report, they claim that the telecommunications industry selectively interprets science[15]. The same claim can be made against Longcore and Rich. They chastise Cingular Wireless for citing an unpublished opinion from Dr. Kerlinger,[16] yet they do the same thing repeatedly in their comments[17] when they refer to an unpublished work by Gauthreaux and Besler (2005), Longcore *et al.* (2005), and Nicholson (pers. comm. 2004). The Longcore Report cites new information that will be published in a forthcoming book on the effects of artificial night lighting on migratory birds. Despite repeated requests, information contained in the forthcoming book was not made available to us, and to the best of our knowledge has not completed the peer review process. Therefore, we are unable to comment on some important aspects (*i.e.,* the underlying data) of the Longcore Report.

- Contrary to the assertions of Longcore and Rich,[18] the authors of the Woodlot Alternatives, Inc. 2003 Report provided credentials in brief in the introduction of that report: "*Technical comments were prepared by Woodlot's professional staff, including Principal Biologist Steve Pelletier, who has particular expertise in evaluating wildlife impacts and developing avoidance and mitigation measures for projects ranging from wind power developments to commuter rail lines. Woodlot President and Certified Wildlife Biologist John Lortie is an avian expert with special expertise in migratory bird studies. Senior Avian Ecologist Robert Roy is considered to be one of the top ornithologists in northern New England. Mr. Roy has led avian species evaluations at multiple projects and recently designed and conducted migratory bird surveys and avian*

[12] *Id.*
[13] *Id.*
[14] R^2 is the coefficient of determination, which describes the proportion of variation in the Y variable (mortality class) with the X variable (tower height). The proportion varies between 0 and 1.0, with larger values (*i.e.,* approaching 1.0) indicating that the data more closely follow the regression line and you have a good relationship, and conversely lower values indicate a poor relationship.
[15] *See* Longcore and Rich, at 3.
[16] *See* Longcore and Rich, at 3.
[17] *See* Longcore and Rich, at 4, 12. *See also* Longcore Report, at 21, 23, 32.
[18] *See* Longcore and Rich, at 5.

impact evaluations for a Federal Energy Regulatory Commission (FERC) wind power project in northern New England, utilizing both standard bird survey field protocols and radar surveys. Dr. Peter Vickery, a Woodlot Associate and one of the foremost bird experts in the country, also assisted in the preparation of this document. Dr. Vickery is an avian ecologist and president of Ecological Research, a non-profit organization in Richmond, Maine. He received his PhD from the University of Maine and is an adjunct professor at the University of Massachusetts."

Woodlot is regarded as one of the top avian risk assessment firms in the United States and has more than a dozen ongoing studies of avian migration in the eastern United States. These studies utilize advanced radar systems and other equipment to monitor bird and bat migration. Collectively, the authors of the Woodlot (2003) report have more than 50 years experience with migratory birds. Longcore and Rich's attempts to discredit Woodlot, as well as Avatar, EDM International, Inc., and Pandion Systems, Inc.[19], cast serious doubt on whether Longcore and Rich's comments are truly unbiased and scientific.

- Longcore and Rich claim there is evidence to enact policy that would substantially reduce bird deaths at towers *without interfering with the expansion of telecommunication services or the maintenance of air traffic safety* (emphasis added).[20] We are unaware of Longcore and Rich's expertise in the telecommunications industry or in air traffic safety, which allows them to make these assertions. Spurious claims such as these undermine the overall credibility of Longcore and Rich's other opinions.

[19] *See* Longcore and Rich, at 6.
[20] *See* Longcore and Rich, at 4.

II. Specific Comments

Existing Studies Utilized by Longcore Are Inadequate and Often Inappropriate for Estimating Avian Attrition and Biological Significance of Bird Mortality at Communications Towers.

Longcore uses data from Shire to estimate the number of individual birds of each bird species killed at towers and assumes that the data are representative of avian mortality caused by towers. Shire examined 149 documents with information on bird mortality at communications towers, and performed a detailed analysis on 47 of the documents (or studies) because these documents (less than 32 % of the total studies) were the only ones containing numbers of birds killed per species. Only 14 of the studies occurred west of the Mississippi River, and of those, most were within a few hundred miles of the river. From a practical standpoint, these studies occurred in the eastern half of the United States. Shire is unclear specifically how many of these studies reported the details of height, lighting, and guy-wires, but stated that *"many gave none of these"* details.[21]

In using information reported in Shire, Longcore assumes that the data are representative, which clearly is not the case. Shire stated that the data was: (1) collected in an uncoordinated manner, and (2) specific towers were studied because bird mortality was observed.[22] The data presented in Shire and used by Longcore are not random or unbiased samples, and accordingly, should not be used to develop relationships for which they were not intended.

One of the important biases in the Shire Report is the average reported height of towers, which was 1,124 feet above ground level.[23] As previously mentioned, most of the studies did not report tower height, so this finding is biased and these data are not representative of the actual population of communications towers.[24] Because of this inaccurate portrayal of the tower environment, the data contained in the Shire Report should not be used to estimate bird mortality on a species-by-species basis.

Longcore also uses data reported in Shire to represent yearly estimates of total numbers of each species killed.[25] Many of the numbers, however, represent multiple years of data. For example, it appears that the number of avian mortalities are totals for multiple years and should not be used as yearly estimates. Thus, the numbers are biased high and are over-estimates of annual mortality.

There is no current, accurate estimate of avian mortality on a per annum, per species basis resulting from collision with communications towers. The available data are insufficient to allow an accurate estimate of the numbers of avian mortalities at towers on a species-by-species basis. Moreover, such data are not sufficient to extrapolate to population-level effects. To accurately estimate mortality on a species-by-species basis, an unbiased random sample of a large number of towers, located in a wide variety of conditions and locations, would be needed.

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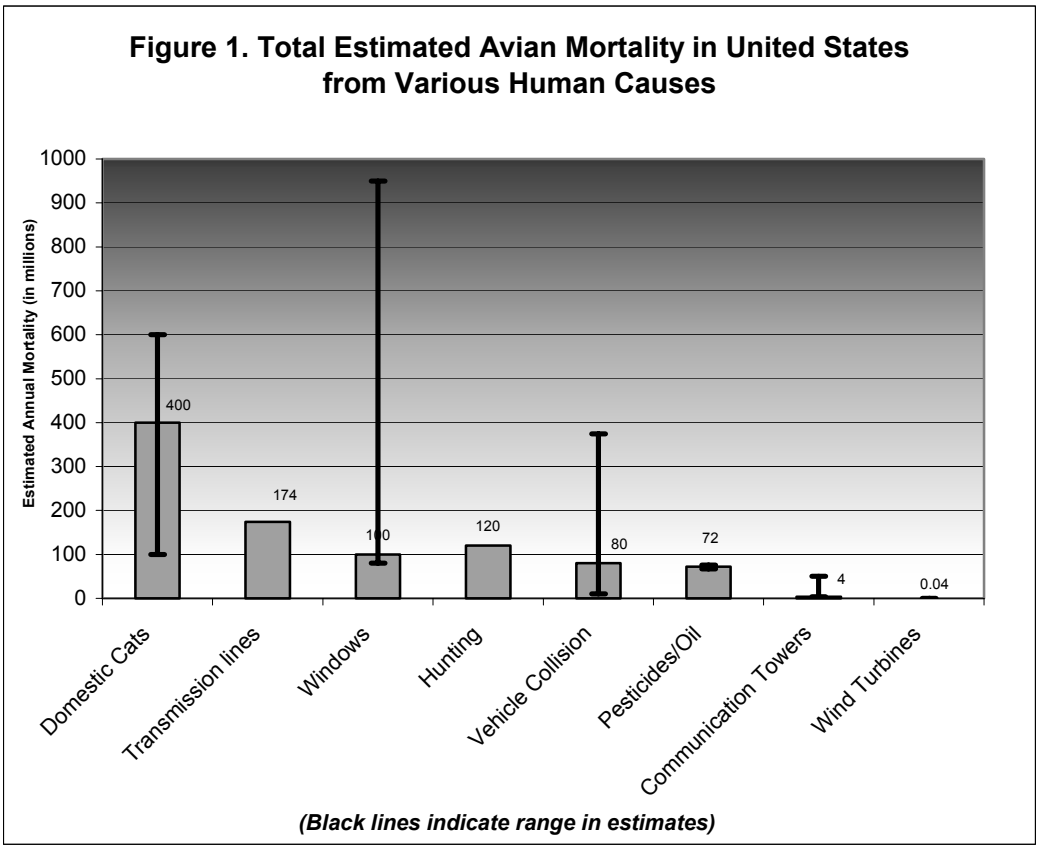
[21] *See* Shire Report, at 5.
[22] *See* Shire Report, at 19.
[23] *See id.*
[24] As explained previously, 99% of Sprint's towers and 85% of Cingular's towers are less than 300 feet tall. *See infra* p. 2.
[25] Longcore Report, Table 1, at 5.

Also critical to this assessment is data on the percent of individual birds that collide with a tower out of the total number of birds passing through an area. If mortality data are not prorated using the number of birds passing through an area, then it is not possible to estimate whether taller towers have a higher incidence of collision, and to what degree. Additionally, it will not be possible to develop a correlation between tower height and incidence of collision.

Another way to evaluate the effects of avian collisions with communications towers is to compare estimated levels of mortality with estimated total populations of birds. Manville (2004) summarizes several authors who have developed or reviewed total United States breeding bird populations, which are placed at about 10 billion birds in the spring and 20 billion in the fall. Manville (2004) and Woodlot (2003) present similar summary data on total annual estimated human-caused avian mortality.[26] Figure 1 below is from Woodlot 2003 Report and illustrates that communications towers account for a small percentage of overall mortality (estimated to be 0.42 percent of human-caused mortality and only 0.05 percent of total bird populations, Woodlot).[27]



[26] *See* Manville 2004 Report. *See also* Woodlot 2003 Report.
[27] *See* Woodlot 2003 Report, at 14.

Irrespective of the estimate or methodology used, there is a high level of uncertainty about the total numbers of birds killed per year and whether there could be a biologically significant effect. Existing information does not indicate that there is a biologically significant effect. Avatar also reaches the same conclusion and states, *"There are no studies to date that demonstrate an unambiguous relationship between avian collisions with communication towers and population decline of migratory bird species."*[28]

Based on its Biased Sample, an Insufficient Sample Size, Faulty Experimental Design, and Uncertainty in its Analysis, Longcore Fails to Demonstrate a Relationship Between Tower Height and Avian Attrition

Statistical analyses are often used to compare data sets and infer relationships between two variables, in this case tower height and avian mortality. Statistics should help explain natural variation and detect differences from those expected to occur at random. There are a number of requirements in experimental design and implementation that must be met to achieve statistical certainty (as explained below), which is nothing more than the likelihood or probability that one's hypothesis is correct.[29]

It is necessary to obtain a random sample when designing an experiment or a sampling event that will involve statistical analysis. If the sampling is not random, there is bias, and the samples are not deemed representative of the true population. This is a fundamental assumption of statistical analysis and probability.

Another important design consideration is the expected variability in the sample population. This will determine how many samples are needed to be truly representative. For example, in an entirely homogenous population (*i.e.,* each individual is a perfect clone of all others), a sample size of only one is needed to represent a typical individual. This is rarely (never) the case. All populations have some variation. If all communications towers are considered the population of interest, variation can be viewed in terms of structure design (height, guy-wires, *etc.*), location, and mode of operation. There is a large amount of variation among communications towers. Therefore, it is necessary to sample a large number of towers to represent the typical "individual" tower. If done correctly, relationships between the typical tower and avian collisions can be described. Sampling can also occur on towers of similar design (*e.g.,* all guyed towers greater than 1000 feet tall). This type of sampling is termed stratified sampling, and it enables the researcher to focus in on one or more features of interest.

It is important to describe the uncertainty[30] one has with the results obtained from a sampling event. Namely, how well does the sample represent the true population? If there is a high degree of certainty, then the relationship between the variables (*e.g.,* tower height and mortality) is well understood and can be predicted numerically. The converse is also true; if there is much

[28] *See In Re Effects of Communications Towers On Migratory Birds*, Avatar Environmental, LLC, Report Regarding Migratory Bird Collisions with Communications Towers, WT Docket No. 03-187, Section 5.1, 5-2 (rel. Dec. 22, 2004).

[29] A good treatment of this issue is provided by Bart *et al.* (2004) in an article titled, *Goals and Strategies for Estimating Trends in Landbird Abundance.*

[30] Uncertainty has two components – incomplete knowledge and natural variability.

uncertainty, the relationships are poorly understood, and any numerical prediction should be viewed as uncertain. As noted previously, in a homogenous population, very few samples are needed to describe a relationship. In a heterogeneous population, however, many samples are needed to describe a relationship. There are several methods that can be used to estimate a sample size needed to represent the typical "individual." These methods use the expected variability in the sample population to estimate the number of samples needed.

Regression is used to analyze relationships between a predictor variable (*e.g.,* tower height) and a response variable (*e.g.,* avian mortality). In effect, regressions are used to see if there is a cause and effect relationship. The strength of a regression (*i.e.,* how certain the prediction is accurate) is subject to the discussion presented above and is related to sample size, experimental design, natural variability, and incomplete knowledge. The coefficient of determination R^2 is a numeric tool used to describe the strength of a relationship predicted by a regression.[31] R^2 describes the proportion of variation in the Y variable (mortality class) with the X variable (tower height). The proportion varies between 0 and 1.0, with larger values (*i.e.,* approaching 1.0) indicating that the data more closely follow the regression line and one has a good relationship, and conversely lower values indicate a poor relationship.

The statistical analysis used by Longcore to describe the relationship between tower height and avian mortality is flawed for several reasons as explained below:

- First, Longcore entitles this section of the report "*Long-term studies show effect of tower height on bird mortality*." Only seven of the studies included in Table 4 are actually long-term studies. Twelve of the 26 studies (46%) were one year or less in duration, and 19 of the 26 (73%) studies were 5 or less years in duration. It is a mischaracterization to infer that these data are representative of long-term studies. More important, fewer data add to the uncertainty. There is a lot of variability in this population of towers, and the small sample size will not allow extrapolations to be made without substantial uncertainty.

- Non-random sample – The towers included in Table 4 are not a random sample. Longcore <u>specifically</u> states <u>that</u> "*the towers analyzed were studied because they killed birds and*" were "*not selected randomly*."[32] This is a biased sample and not representative; therefore, the data should not be used in an extrapolation.

- The towers in Table 4 are not representative samples,[33] and mortality levels at these towers should not be used to extrapolate mortality levels to other towers. As previously mentioned, 99% of Sprint's towers and 85% of Cingular's towers are less than 300 feet tall. If a biased sample is used to extrapolate results to the larger population (in this case all communications towers), then the extrapolation will be biased and should not be relied upon.

[31] This term describes the amount of variability in the response variable that is accounted for in the regression.
[32] Longcore Report, at 13, 32.
[33] A sample is a subset of a population of interest. In this case, the towers in Table 4 should be representative of all communications towers, which they clearly are not.

- Longcore used logistic regression to evaluate the effect of tower height on bird mortality. Longcore reclassified the variable "annual mortality," a total count of all dead birds at each tower, into two mortality classes – Class "0" = <250 birds/year and Class "1" = >250 birds/year.[34] This is an arbitrary, *post hoc* classification that, at best, marginally fits the logistic (logit) regression model, which is typically used to analyze dependent variables with a binary outcome (*e.g.,* dead or alive, success vs. failure). Longcore states that converting a continuous variable (mean annual mortality) into a nominal variable (their mortality classes) *"…reduces the effect of different study methodologies, search inefficiencies, and scavenger removal."*[35] This statement, however, is not supported by any statistical theory or reference to studies in the scientific literature. In fact, converting the data does not offset differences in studies with widely different field methodologies and does not correct for the biases discussed above.

- Assuming arguendo that one can accept the logistic regression at face value, the R^2 value of 0.27 is very low and only suggests a causal relationship between tower height and mortality rates.[36] It is not the strong relationship suggested by the authors. R^2 is the coefficient of determination, which describes the proportion of variation in the Y variable (mortality class) with the X variable (tower height). The proportion varies between 0 and 1.0, with larger values (*i.e.,* approaching 1.0) indicating that the data more closely follow the regression line and one has a good relationship. Conversely, lower values, such as the 0.27 reported in Longcore, indicate a poor relationship.

- Longcore used the logistic regression relationship to conclude that only 5 percent of the time would towers less than 160 feet tall cause more than 250 casualties per year.[37] One can expect this conclusion to be very uncertain because the regression (*i.e.,* the relationship between the two variables tower height and mortality) was weak and indicated a poor relationship. This is most likely due to the fact that 25 of 26 towers were greater than 600 feet in height, and most were short-term studies.

  It is not clear why the 197-foot tower was included in the analysis, or how it made its way into the data set. A footnote in Table 4 of the Longcore report indicates that the data from the 197-foot tower was from a personal communication, not a published report, between C.P. Nicholson and G. Winegrad. This is unusual as the text immediately above the table states, *"To allow transparency and reproducibility…these data were obtained from and full citations are found in, the Woodlot Report and a report from the National Wind Coordinating Committee."*[38] Yet the data from the 197-foot tower are not available and are from a personal communication.

- A more appropriate test of the data set used by Longcore would be a simple regression of mortality (dependent variable) vs. tower height (independent variable). However, this simple regression, as shown below, is not statistically significant (R^2=0.104; F=2.708;

[34] *See* Longcore Report, Figure 2, at 12.
[35] *See* Longcore Report, at 12.
[36] *See id.*
[37] *See id*. at 13.
[38] *See* Longcore Report, at 32.

p=0.113) (see Figure 1). This is not surprising because of the variability of the data contained in Table 4, which was used to develop the simple regression. This analysis provides further evidence that Longcore's analysis was flawed.

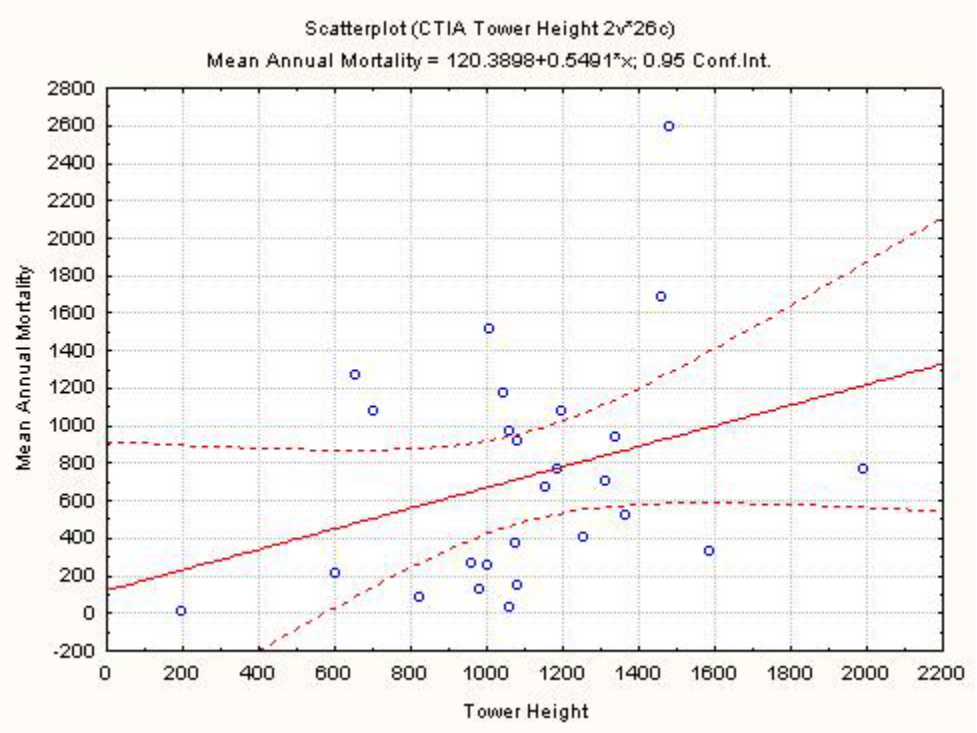


Figure 1. Scatterplot (each dot represents a tower of a certain height and the corresponding mean annual mortality) and 95% confidence limits (dashed lines give an indication of how much uncertainty there is in the estimate of the true mean. The narrower the interval between the solid and dashed lines, the more precise the estimate) for regression of tower height and mortality. (R^2=0.104; F=2.708; p=0.113).

Longcore and Rich in Table 1 report that 59% of towers are in the 200 to 499 foot height class, and these towers account for 41% of avian mortality.[39] This statement is misleading because the data base Longcore and Rich rely on is incomplete. They used only towers included in the FCC tower registration database, when in fact the majority of towers under 200 feet in height are not registered and hence are not reflected in the numbers in the database. In Cingular's case, this is fully 50% of their towers. Almost all Sprint towers below 200 feet in height are not in the FCC's database. American Tower owns or operates over 12,000 towers, of which only 4,600 are subject to the FCC's tower lighting requirements.[40] More importantly, mortality estimates are mere assumptions postulated by Longcore and Rich.[41] The multiplication factors used to extrapolate the relative number of birds killed in the three tower height strata were obtained from observations at a single tower in Florida that was reduced in height from over 1,000 feet to about 300 feet. However, the tower profile (size of base, guy wires) remained that of a 1,000-foot

[39] *See* Longcore and Rich, at 12.
[40] *See In the Matter of American Tower Corporation Request for Waiver of 47 C.F.R. § 17.4,* Letter from Dennis P. Corbett, Counsel to American Tower Corporation to Marlene H. Dortch, Secretary, Federal Communications Commission, 3 (filed May 19, 2005).
[41] *See* Longcore and Rich, at 11.

tower. Therefore, no conclusion should be drawn about a "typical" 300 foot tower from this study, much less to extrapolate the data for all towers nationwide.

The Michigan Tower Study Remains Preliminary and Lacks a Significant Sample Size.

In this section of the Longcore Report, comparisons are made between the Shire data and preliminary results of an ongoing study of bird mortality at telecommunications towers in Michigan being performed by J. Gehring. Gehring (2004) reports *interim* results for a study in progress concerning bird mortality at communications towers in Michigan in a report dated January 31, 2005. The study is intended to investigate the following hypotheses:

1) Communications towers supported by guy wires will provide a higher risk to birds than towers lacking guy wires (un-guyed, self supporting).
2) Communications towers approximately 305 meters (1,000') above ground level (AGL) will kill more birds than towers 116-146 meters (380'- 480') AGL.

Gehring's interim report presents the results of studies conducted in the fall of 2003 and the spring and fall of 2004, which focused primarily on the potential effects of guy systems (guyed or un-guyed) and tower height. Studies proposed for 2005 and 2006 will include the effects of tower lighting on bird mortality.

Overview of Study Design

In 2003, Gehring counted avian mortality at 6 towers in Michigan; three were guyed and three were un-guyed, and all were 116-146 meters tall. In the spring of 2004, 11 guyed and 9 un-guyed towers in the 116 to 146 meter range were surveyed, along with three towers larger than 305 meters in height that were presumably guyed. In the fall of 2004, Gehring surveyed 12 guyed and 9 un-guyed towers that were 116 to 146 meters tall and three that were larger than 305 meters.

During surveys, observers walked along transects to count dead birds at each tower site. In addition, Gehring tested each surveyor to determine how many birds they missed on a test transect containing 10 dead birds (*i.e.,* detection rate). Tests were also conducted to determine scavenger rates.

Gehring analyzed the data collected in 2003 using a Mann-Whitney U-test, which is a non-parametric test[42] that is analogous to the parametric t-test used to compare two means. In 2004, Gehring employed a Kruskal-Wallis test, which is a non-parametric test that is analogous to the parametric analysis of variance, used to compare multiple means. Raw data (*i.e.,* not adjusted for observer detection rates or scavenger removal rates) were used when testing for significant differences among tower types. Data collected in 2005 and 2006, however, will be adjusted using estimates of detection and scavenger rates.

Gehring estimated observer detection rates for each observer by placing 10 carcasses along a sample transect. She then calculated mean observer detection rates "*using methods developed by*

[42] Non-parametric statistical analyses do not depend on the data being drawn from a defined random variable with known probability distribution (Gotelli and Ellison 2004).

W. Erickson (West, Inc.)", but she does not specify what these methods are, other than to say that she used "*bootstrapping*"[43]. A similar approach was employed to estimate carcass removal rates.

Observations Concerning Results, Discussion, and Management Implications

Gehring's interim report provides an overview of the interim results of what is apparently a longer-term study. As such, the results and interpretation of the data should be considered preliminary in nature. Gehring, however, reaches the conclusion that taller, guyed towers result in greater mortality than shorter, un-guyed towers, and makes management recommendations based on these conclusions. However, the data collected to date do not unequivocally support the statements and conclusions made in the Gehring interim report.

The basic premise of the research is that higher numbers of bird carcasses at a tower relates directly to the characteristics of the tower. Gehring, for example, hypothesizes that more birds die at taller towers, and she believes that the data collected in 2003 and 2004 support this hypothesis. It is just as likely, however, that the number of dead birds observed at an individual tower is a function of the number of birds passing by and the weather at the time of passage. Assume, for example, that short and tall towers kill the same percentage of birds passing by under a given set of weather parameters. If this is true, then the number of dead birds that are observed would be a function of how many are flying by (*i.e.,* more birds flying by would theoretically result in more dead birds on the ground). In this regard, it may not be prudent to conclude that observing more dead birds on the ground at any particular site is directly due to the characteristics of the tower. It may be primarily related, instead, to the number of birds passing by.

Gehring recognizes and acknowledges that comparisons of bird mortality may be confounded by what she terms migration intensity, and proposes to measure passage rates using radar in 2005 and 2006. Recognition and acknowledgement of this fact by the principal investigator is indicative that researchers, and policymakers, should not rely solely on the results of the 2003-2004 data for reaching conclusions or making management recommendations regarding the effects of tower height and guying systems on bird mortality.

The sample sizes resulting from this study in 2003 and 2004 are relatively small. In 2003, for example, a total of only six towers (116-146 meters AGL) were sampled (3 guyed and 3 un-guyed). This is too small a number (n=3 for each category) for the mean and standard error, as reported in Table 1, to be meaningful. Gehring instead should have reported the exact counts of dead birds at each tower. Furthermore, no dead birds were observed at the un-guyed towers, resulting in a Mann-Whitney U value of 0. Under these circumstances, it would be more appropriate, due to the small sample sizes and the lack of any recordable data at the un-guyed towers, to simply present the raw data. It is misleading to conclude that there is a statistically significant difference between guyed and un-guyed towers based on these data.

[43] Bootstrapping is a randomized procedure where the observations in a dataset are re-sampled with replacements from the original dataset, and then the re-sampled data set is used to re-calculate the test statistic of interest (Gotelli and Ellison 2004).

Additional towers were included in the 2004 study, particularly for towers in the 116-146 meter AGL category, making the mean values somewhat more reliable. Nonetheless, it is more appropriate, with such small sample sizes, to report all raw data for each tower. Three towers larger than 305 meters AGL were studied in both the spring and fall of 2004, but one tower was excluded after the data were collected in the spring for a variety of reasons, including the fact that the tower had an obsolete guying system and it was difficult to search for carcasses. Very low mortality rates, however, were observed at this tower, and removing it from the analysis is an unusual *post hoc* treatment of the data set. To avoid the appearance of bias, it is more appropriate to statistically analyze the raw data with and without the tower and present the results of both analyses.

Based on the results of the Kruskal-Wallis analysis of the spring and fall 2004 data, Gehring reports that the number of birds killed at the three categories of towers (*i.e.,* 116-146 meters AGL [with and without guy wires] and guyed towers greater than 305 meters AGL) is statistically different. Although this may be a reasonable conclusion, it would be useful to know the exact number of birds killed at each tower rather than just the totals and means, as reported in Tables 2 and 3. It is possible, for example, that results at a small number of towers skewed the results of the Kruskal-Wallis test. In addition, with such a small sample of towers >305 meters AGL, one should be cautious in concluding that taller towers result in increased mortality.

In estimating observer detection rates, Gehring placed 10 birds along a sample transect at each location and had observers conduct a normal search of the area. Gehring selected carcasses *"…representing a range in size and colors, but predominantly Brown-headed Cowbirds (Molothrus ater) painted to simulate the fall plumage of migrating songbirds."*[44] This implies that different birds were used throughout the tests. It is also inevitable that the birds were placed in habitats with varying amounts of ground cover, and the study should have accounted for the habitat characteristics in the area that the birds were placed. Furthermore, the birds ideally should have been placed in randomly selected locations, and it is not clear if the researchers followed such an approach. The greatest concern with this portion of the study, however, is with the small number of birds used to measure detection rates. With a sample of 10 birds, for example, a single bird represents a 10 percent swing in the detection rate. A more robust approach is to randomly place on the order of 100 carcasses and to measure covariates such as bird size and habitat type. It is very likely that there is a wide range of detection rates between observers, and using the mean rate may artificially increase (or decrease) the mortality estimate.

In general, the Gehring study should be considered a pilot study designed primarily to begin establishing protocols for a more advanced analysis of a wider range of towers. It does not provide a viable and legally sufficient basis for the FCC to change its marking and lighting requirements *at this time*. The statistical analysis of the data resulting from such a study is also

[44] Gehring 2004 Summary, at 4.

likely to be relatively sophisticated, and it would be prudent to prepare a detailed plan for how the data will be treated prior to conducting the study. A power analysis[45] for all proposed statistical tests should be included in such a study plan. Finally, Gehring proposes to include radar observations of passage rates, but it is unclear how this information will be used in the final analysis of the data, which is another reason for an *a priori* study plan for the proposed study.

Materials Cited by Longcore on the Impact of Tower Lighting on Avian Attrition Are Uncertain, Incomplete, and Unavailable; Thus, the Longcore Analysis Cannot Be Reviewed, Much Less Utilized for Decision-Making and Sound Policy Judgments.

Woodlot was unable to review information repeatedly cited in the Longcore Report that may be critical to the interpretation of the effects of lighting on migrating birds. We requested copies of the Gauthreaux and Besler (2005) article and also a copy of the draft book titled, *Ecological Consequences of Artificial Night Lighting* (C. Rich and T. Longcore [editors]). We spoke with the publisher, Island Press, who stated that the chapters of the book are still in draft form and undergoing review; hence, they were unable to release a copy of the article or the book, even in draft form.

Some statements in the Longcore Report regarding the use of statistics in analyzing data are problematic. For example, Longcore states, "*Anecdotal observations are data.*" (We agree with this.) *"Although they may not be accompanied by precise quantification, precision is not necessary when effects are large."* (We also agree with this, when "large" is properly defined ahead of time.) *"For example, the dataset for the Orlando tower described by Dr. Taylor was well over 100 birds per year before the change to strobe lighting, then well under 100 birds per year following the change to strobe lighting. Even without knowing the exact number of years of observation before or after the change in light type, or the exact number of birds beyond those classes (i.e., over 100 birds/under 100 birds per year), one can conclude with a high degree of statistical certainty that the magnitude of mortality was significantly different."*[46] Woodlot disagrees and notes that this type of statement is contradictory to established scientific practice regarding use of ecological statistics (Gotelli and Ellison 2004). The term "high degree" is subjective and not defined, and therefore is misleading. Furthermore, there is either statistical certainty, which is defined numerically, or there is not. Certainty should be described numerically using measures of error and variability, and should be transparent.

There are a number of requirements in experimental design and implementation that must be met to achieve statistical certainty, which is nothing more than the likelihood or probability that one's hypothesis is correct[47]. The hypothesis in this case is that different types of lights have different attraction properties to birds. One of the primary reasons statistical analyses are used to compare

[45] Statistical power analysis is a technique that allows one to estimate how large a sample is needed to enable statistical judgments that are accurate and reliable, and how likely a statistical test will be to detect effects of a given size in a particular situation. "*Performing power analysis and sample size estimation is an important aspect of experimental design, because without these calculations, sample size may be too high or too low. If sample size is too low, the experiment will lack the precision to provide reliable answers to the questions it is investigating. If sample size is too large, time and resources will be wasted, often for minimal gain.*" http://www.statsoft.com/textbook/stpowan.html#power_doe3.

[46] Longcore Report, at 26.

[47] A good treatment of this issue is provided by Bart et al. (2004) in an article entitled "Goals and Strategies for Estimating Trends in Landbird Abundance."

data sets and infer relationships is to unbiasedly explain natural variation and detect differences from those expected to occur at random. Using the above example, one would need to explicitly state what *"well over 100 birds per year"*[48] truly is, and then ensure that the data collection processes are random and sufficiently precise. The expected degree of certainty is arrived at before data collection by estimating the expected variability in the data and then determining the number of random samples needed to account for that variability. For instance, with highly variable data, more samples are needed for an accurate estimate. The converse is true when there is little or no variability. This is important because the need for scientifically sound, defensible data for designing and operating communications towers has been a primary objective of the Communication Tower Working Group (Manville 2005). This is one of the reasons certain investigations are ongoing, such as the Gehring study.

III. Conclusions

The statistical analyses used in the Longcore Report are flawed and do not provide an accurate representation of nationwide avian mortality related to communications towers. Longcore's findings should not be used to estimate risk to bird populations. Scientifically valid research work should be conducted and must be properly reported before specific design recommendations are incorporated into or amend Federal policy on the build-out and deployment of our nation's communications infrastructure, specifically broadcast and wireless towers.

The majority of communications towers are much smaller in height than those used by Longcore to estimate avian mortality. Developing a mortality estimate using the data in Longcore is misleading and highly uncertain. It is not logical or legitimate to create rules affecting wireless towers, most of which are less than 300 feet in height, based on studies of towers over 600 feet high.

The Longcore Report cites new information that will be published in a forthcoming book on the effects of artificial night lighting on migratory birds. New information contained in the forthcoming book was not available to us, and to the best of our knowledge has not completed the peer review process. The FCC should not rely on unpublished studies, which are not available for independent review, as a scientifically valid basis for changing its substantive rules governing communications towers.

[48] Longcore Report, at 26.

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