COVER SHEET

TITLE: The effects of inter-personal factors on bird and bat mortality searcher efficiency.

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ABSTRACT

The effects of inter-personal factors on bird and bat mortality searcher efficiency.

Employee efficiency and performance are essential to the success of a project. These inter-personal factors have been investigated in specific settings but have not been explored in the scientific research assistants. This study looks at the effects of amount of sleep, mood, and energy level on the searcher efficiencies of bird and bat mortality searchers at wind farms. The inter-personal data was gathered by surveys—sleep to the nearest half hour and both mood and energy level on a scale of 1 (low) to 7 (high). Searcher efficiency—percent of marked carcasses found—was calculated (1) by searcher per field season, and (2) by day. These variables were analyzed with linear regression. No significant relationships were found (critical $R^2 \geq 0.95$). This could be due to the low variability in the data because of study mechanics. Future studies should allow better quantification of the factors being examined through the surveys.

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The effects of inter-personal factors on bird and bat mortality searcher efficiency.

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Introduction:

Employee efficiency and job performance are essential to the success of a project and its members. Efficiency can vary on a daily basis for a single employee and between separate individuals due to inter-personal factors (i.e. aspects of life, not directly related to work, but affect the employee's mental or physical state and thus have the potential to affect job performance). Many inter-personal factors have been proven to affect employee efficiency. Sleep deprivation leads to inconsistent task performance. (Oken et al., 1895) Social stress is correlated to a decrease in social memory performance. (Takahashi et al., 128) Positive moods have a direct relationship with job performance. (Tsai et al., 1578) Although these inter-personal factors have been investigated in specific settings, they have not been explored in the setting of scientific research. Research studies need to be as consistent as possible to reduce extraneous effects and thus variation in the data collected.

One very important study in progress is the effect of wind farms on bird and bat mortality at UW-Madison. Such a study holds such great importance because although renewable energy sources must be explored, they must not do more damage to the environment (including their organisms) than good. This study is heavily dependent on the efficiency of the researcher's ability to accurately and effectively locate bird and bat carcasses in the search area around the generators.

This factor is so important that most studies on bird and bat mortality at anthropogenic structures have spent the additional resources necessary to correct for searcher efficiency in order to produce a more accurate estimate of total mortality. (Sterže and Pogačnik, 624) As a result of these studies, it has been discovered that searcher efficiency is controlled by environmental factors of the study such as cover type or carcass size. (Smallwood, 2783-4) While this information is important and useful, there are more factors contributing to a searcher's efficiency than just the variation in physical aspects of the study. Human factors of the searcher's life are likely to affect his work performance (in this case searcher efficiency), as it has been demonstrated to do in other types of work.

As a result, the effects of inter-personal factors on searching efficiency must be determined to reduce the about of uncertainty in the data before any conclusions can be drawn about the study's intended purpose. The effects of inter-personal factors (mainly sleep, mood, and energy level) on searcher efficiency of bird and bat mortality will be determined.

Methods:

The information on the inter-personal factors examined was gathered through the use of surveys. The searchers filled out a survey on each day that they went out into the field. These surveys asked the searcher to specify the number of hours of sleep they received the night prior to the search (to the nearest half hour), rank their mood from 1 (poor) to 7 (great), and quantify their energy level from 1 (low) to 7 (high). Both a pre-searching and post-searching rank of mood and energy level were collected in the survey but only the pre-searching values were used in analysis because these values were more consistently collected. The critical value to determine significance in all statistical analysis was and R^2 value ≥ 0.95.

The correlation between sleep and the other inter-personal factors was analyzed because sleep was thought to be related to level and mood. Linear regression was used to determine if this hypothesis was valid. The sleep data from each survey was analyzed with the energy level and mood from the same survey. If a correlation was found, the only inter-personal factor that was further analyzed would have been sleep. If no correlation was found, all inter-personal factors would have been further analyzed.

Searcher efficiency data was determined by the methods used in Grodsky 2010. Searcher efficiencies for bird and bat mortality were calculated and analyzed separately because in Grodsky 2010 there was a significant difference between the searcher efficiencies when the carcass set out was a bird versus a bat. There was low variation in the raw data due to ≤ two carcasses being set out each time searcher efficiency was tested. In order to compensate for this low variation searcher efficiency was calculated in two different ways: (1) by searcher per field season and (2) by day.

To calculate searcher efficiency by searcher per field season the number of recovered carcasses for a field season (fall or spring) by a searcher was divided by the total number of carcasses laid out for that searcher in that field season. Sleep, mood, and energy variables analyzed with the searcher efficiency by searcher per field season were calculated by averaging the survey values over the searching seasons by searcher. The variation searcher efficiency by searcher per field season was evaluated during analysis of the data sets.

To calculate searcher efficiency by day the number of marked carcasses recovered for the entire day was divided by the number of marked carcasses laid out that day (across all searchers). The inter-personal factor data analyzed (via linear regression) with daily searcher efficiency was calculated by averaging the survey data for each day. This type of searcher efficiency and inter-personal factors were also analyzed with linear regression over time. This analysis was done separately for each field season.

Results:

No correlation was found between sleep and the other inter-personal factors (i.e. all R^2 values were less than 0.95). Sleep and energy level had an R^2 value of 0.0145. Sleep and mood had an R^2 value of 0.0709. (Figure 1)

Moderate variation was found in searcher efficiency when analyzed according to searcher per field season. (Figure 2) No correlations were found between searcher efficiency, when examined as searcher per field season, and any of the inter-personal factors (i.e. all R^2 values were less than 0.95). Bird searcher efficiency and sleep had an R^2 value of 0.0003. Bird searcher efficiency and energy level had an R^2 value of 0.0041. Bird searcher efficiency and mood had an R^2 value of 0.0009. Bat searcher efficiency and sleep had an R^2 value of 0.0556. Bat searcher efficiency and energy level had an R^2 value of 0.027. Bat searcher efficiency and mood had an R^2 value of 0.0156. (Figure 3)

Poor variation was found in the by day searcher efficiency depicted by the majority of the data points having a value of 0 or 1 for searcher efficiency in all six graphs of figure 4. No correlations were found between the by day searcher efficiency and any of the inter-personal factors (i.e. all R^2 values were less than 0.95). Bird searcher efficiency and sleep had an R^2 value of 0.0012. Bird searcher efficiency and energy level had an R^2 value of 0.0041. Bird searcher efficiency and mood had an R^2 value of 0.006. Bat searcher efficiency and sleep had an R^2 value of 0.0263. Bat searcher efficiency and energy level had an R^2 value of $1x10^{-7}$. Bat searcher efficiency and mood had an R^2 value of 0.0008. (Figure 4)

No correlations were found between time and bat searcher efficiency, bird searcher efficiency, sleep, energy level, or mood in either field season (i.e. all R^2 values were less than 0.95). Sleep and Spring 2009 bat searcher efficiency had an R^2 value of 0.5008. Sleep and Spring 2009 bird searcher efficiency had an R^2 value of 0.0871. Sleep and Spring 2009 sleep had an R^2 value of 0.0003. Sleep and Spring 2009 energy level had an R^2 value of 0.0742. Sleep and Spring 2009 mood had an R^2 value of 0.0668. Sleep and Fall 2009 bat searcher efficiency had an R^2 value of 0.0592. Sleep and Fall 2009 bird searcher efficiency had an R^2 value of 0.0013.

Sleep and Fall 2009 sleep had an R^2 value of 0.1379. Sleep and Fall 2009 energy level had an R^2 value of 0.0017. Sleep and Fall 2009 mood had an R^2 value of 0.1379. (Figure 5)

Discussion:

The method of evaluating searcher efficiency resulted in low variability in the raw data, and in order to analyze any correlation between inter-personal factors or time, the data had to be averaged in two different ways to create variation. The first approach of averaging searcher efficiency (by searcher by field season) was successful in introducing a moderate amount of variation into the data (Figure 2). This is most likely due to the larger number of raw observations that were averaged to reach the twelve averaged data points (average: 6.6; range: 2-13 raw observations per averaged data point). The second approach of averaging searcher efficiency (by day) was not successful in introducing enough variation into the data (Figure 4). This is most likely due to the relatively small number of raw observations that were averaged to reach the sixty-one averaged data points (average: 1.4; range: 1-4 raw observations per averaged data point). Because this approach was also the one used to test the correlations of searcher efficiencies over time, the low variation could explain why no correlation was found. The by day searcher efficiency could create enough variation in the data to test a correlation with inter-personal factors with linear regression if more raw observations were taken on each individual day.

No correlations were found in the entire scope of this study. There may be a number of reasons for this. There simply may not be any correlation between searcher efficiency and the inter-personal factors examined here. However the more likely causes are due to the design and mechanics of the study. First of all, there was inconsistent reporting on the surveys which resulted in many incomplete raw observations (i.e. there would be recorded searcher efficiency for a searcher on a given day, but the survey data would be missing and vice versa). This large number of incomplete raw observations resulted in a low sample size (n=61), which was most likely not large enough to reveal an underlying relationship (if it existed) because the number of observations was not large enough to put the stochasticity in the data into perspective.

Another reason, no correlations were found between searcher efficiency and these inter-personal factors (specifically energy level and mood) could be due to the layout of the survey. The survey used a ranking scale from 1 to 7. There was a very distinct difference between the average and slightly above average values (i.e. 4, 5, and 6) and the extreme and below average values in the survey data. For example out of eighty-one surveys, there were one "2", nine "3"s, sixteen "4"s, twenty-eight "5"s, twenty-five "6"s, and two "7"s reported for energy level and one "2", five "3"s, twenty-three "4"s, thirty-three "5"s, fifteen "6"s, and four "7"s reported for mood. This pattern in energy level and mood is most likely due to the searchers picking a value around or slightly above average out of a desire to finish the survey quickly without much thought to the differentiation between the levels of a good mood (5-7), an average mood (4), and the levels of a poor mood (1-3). The scale was either not fine tuned enough to detect differences between daily energy levels and moods—if indeed the searchers are consistently between values of "4" and "6"—or the more likely possibility is that it was too easy for the searchers to simply circle a number without accurately assessing their energy level and mood.

This pattern also extended to sleep but to a lesser extent: out of eighty-one surveys, there were one "4", two "4.5"s, five "5"s, fourteen "5.5"s, twenty "6"s, eleven "6.5"s, eighteen "7"s, six "7.5"s, and four "8"s. The pattern in sleep could also be due to filling out the survey quickly and picking a moderately above average value, but it also could be a reflection on the average amount of sleep the searchers were consistently getting. Another factor that could have contributed to this pattern in the sleep survey data was that one of the searchers often worked the night shift at another job before coming to search for carcasses. On his surveys he consistently filled out a "0" as the amount of hours of sleep he got the night before. The intention of the survey was to define "night" as the amount of time the searcher spent sleeping in the last twenty-four hours not necessarily the hours between dusk and dawn. As a result, data was collected from this searcher on how many hours he slept during the field seasons on days he came to search for carcasses. He was only able to give an average amount of "6" hours per night which then replaced all of his "0" values for sleep in his surveys. There were also two surveys where he had indicated "8" hours of sleep). This misunderstanding, greatly increased the incidence of "6" hours of sleep in the survey data.

Even with this unexpected complication, the pattern was still less distinct in the sleep survey data. This could be due to the greater number of choices the searchers had to consider when completing the survey due to the appropriate values increasing in half-hours instead of full hours. Another reason the pattern was less distinct in the sleep data is that searchers had to write in their response, rather than just circling a number, which might have caused more thought on the part of the searcher before choosing a response. Amount of sleep was also conceivably easier for the searcher to quantify than mood and energy level, which are more abstract notions themselves.

If this study is to be continued or attempted again, some changes should be made to the surveys. First, there should be more incentives and assurances that each searcher fills out a survey for every day that they search. This can take many different forms from as simple as a small treat upon completion to as severe as a moderator who is responsible for the surveys and does not let the searchers go out to search (or go home) until the surveys are completed. Second, the method of quantifying mood and energy level need to be changed. One idea is to increase the number of questions on the survey so that multiple questions could be compiled to achieve an aggregate assessment of energy level or mood. Another idea is to allow greater variation into the data by having a greater number of options to choose from and to make those choices less abstract. For example, the mood portion of the survey could have ten or fifteen faces all showing different emotions so the searcher could more easily identify their mood as one on the survey rather than just picking a subjective number. The energy level portion of the survey could have ten to fifteen pictures of activities each requiring a different level of energy (ex. napping, sitting, walking, mountain biking, etc.). Before these surveys were used, each picture (face or activity) would be assigned a value on a continuum so the data could be converted to a form more conducive to being graphed and analyzed.

Another change that should be made if the study is continued or repeated is to increase the variation in raw searcher efficiency values by setting out more carcasses each time a searcher is tested. A different approach may be to place only one carcass out but then find a way to better analyze the binomial searcher efficiency data with the multinomial inter-personal factor data. Also, to avoid the confusion that occurred surrounding the definition of "night" regarding sleep on the survey, this portion of the survey should be more clearly worded to ensure searchers know it refers to the past twenty-four hours and not just the hours between dusk and dawn. With these changes, the future studies have a much greater change of detecting relationships between searcher efficiency and inter-personal factors.

Conclusion:

While this study was not able to reveal correlations between searcher efficiency and inter-personal factors, it did yield some very crucial insight into how future studies should be designed. It would have been extremely difficult to predict the problems encountered here unless the study had actually been attempted because the majority of these problems were due hidden flaws in the mechanics of the study that were not obvious outright. It has laid the ground work for future studies that will be able to better evaluate the desired relationships.

Appendix

Figure 1: Energy Level and Mood vs. Sleep

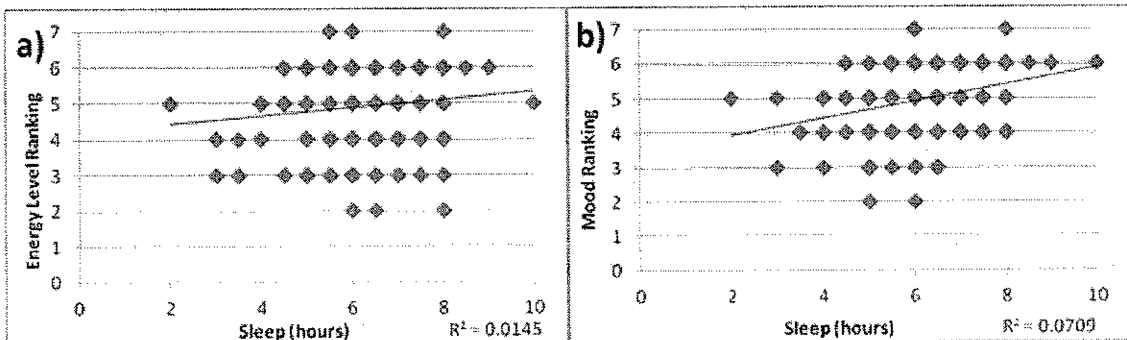

Figure 1: Graphed above are the energy level and mood for bird and bat mortality at a wind farm in Southeastern Wisconsin. Interpersonal factor data (sleep, energy level, and mood) was gathered by daily surveys before searching—sleep to the nearest ½ hour, ranking of energy level and mood on a scale from 1(low) to 7 (high). The two graphs above show a) energy level versus sleep the previous night and b) mood ranking versus sleep the previous night

Figure 2: Variation of By Searcher per Field Season Searcher Efficiency

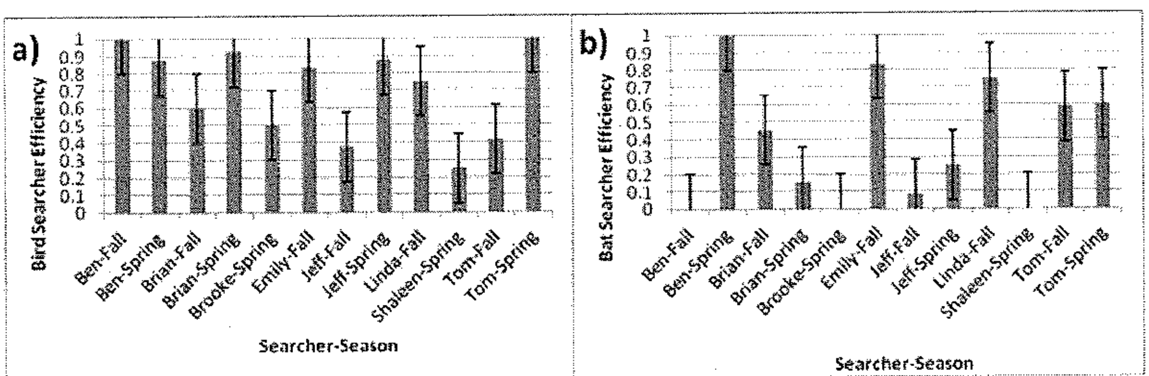

Figure 2: Graphed above are the searcher efficiencies for bird and bat mortality a wind farm in Southeastern Wisconsin. These searcher efficiencies are averages for each searcher per field season (spring and fall of 2009). Bird and bat searcher efficiencies were calculated separately. The two graphs above show a) average bird searcher efficiency by searcher per season and b) average bat searcher efficiency by searcher per season.

Figure 3: Correlations of By Searcher per Field Season Searcher Efficiency

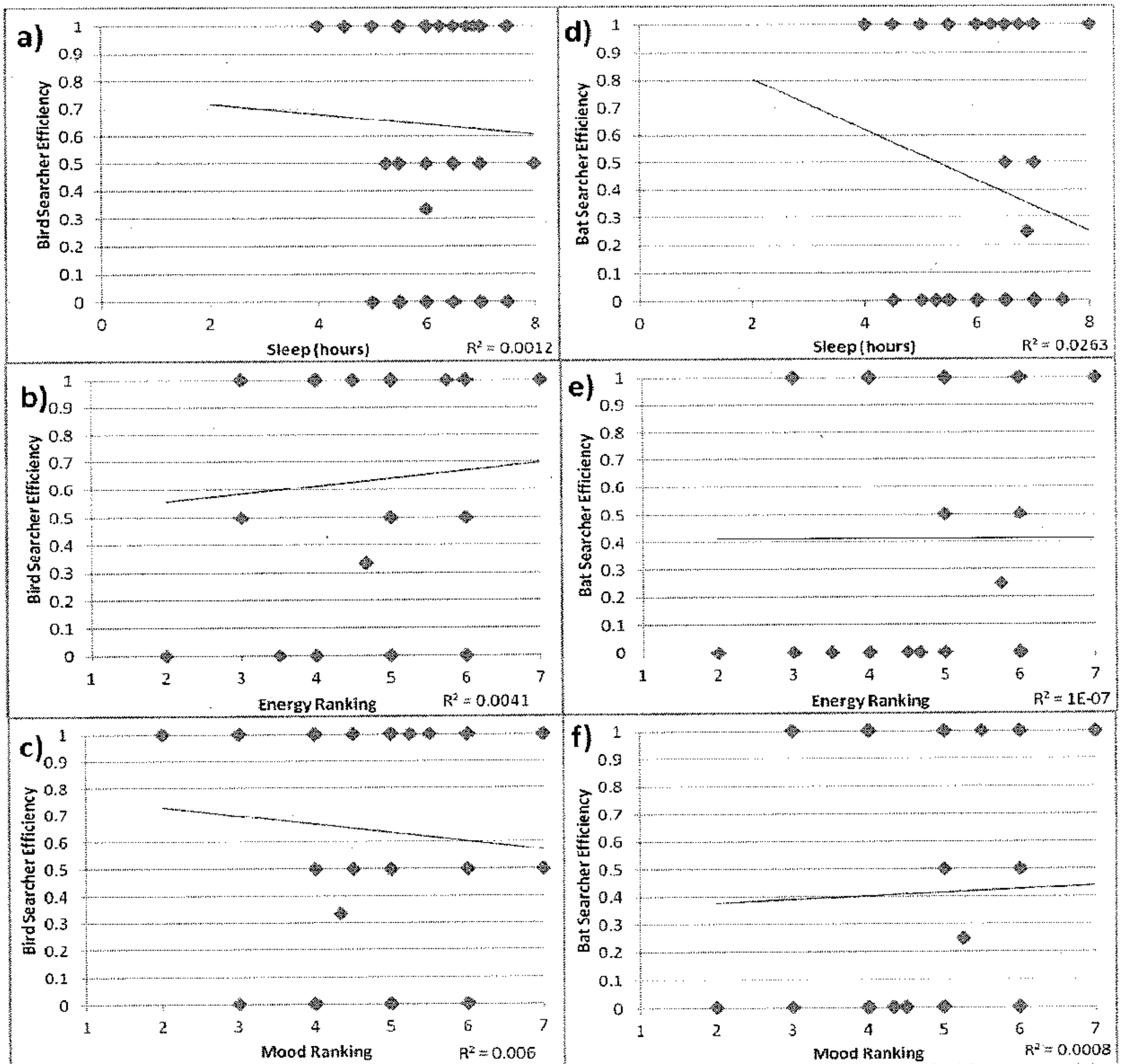

Figure 4: Graphed above are the searcher efficiencies for bird and bat mortality a wind farm in Southeastern Wisconsin. These searcher efficiencies are averages for each day during both field seasons (spring and fall of 2009). Bird and bat searcher efficiencies were calculated separately. Inter-personal factor data (sleep, energy level, and mood) was gathered by daily surveys before searching—sleep to the nearest ½ hour, ranking of energy level and mood on a scale from 1(low) to 7 (high). The survey data was then averaged by day. The six graphs above show a) bird searcher efficiency versus hours of sleep prior to searching b) bird searcher efficiency versus energy level ranking c) bird searcher efficiency versus mood ranking d) bat searcher efficiency versus hours of sleep prior to searching e) bat searcher efficiency versus energy level ranking and f) bat searcher efficiency versus mood ranking.

Figure 4: Correlations of By Day Searcher Efficiency

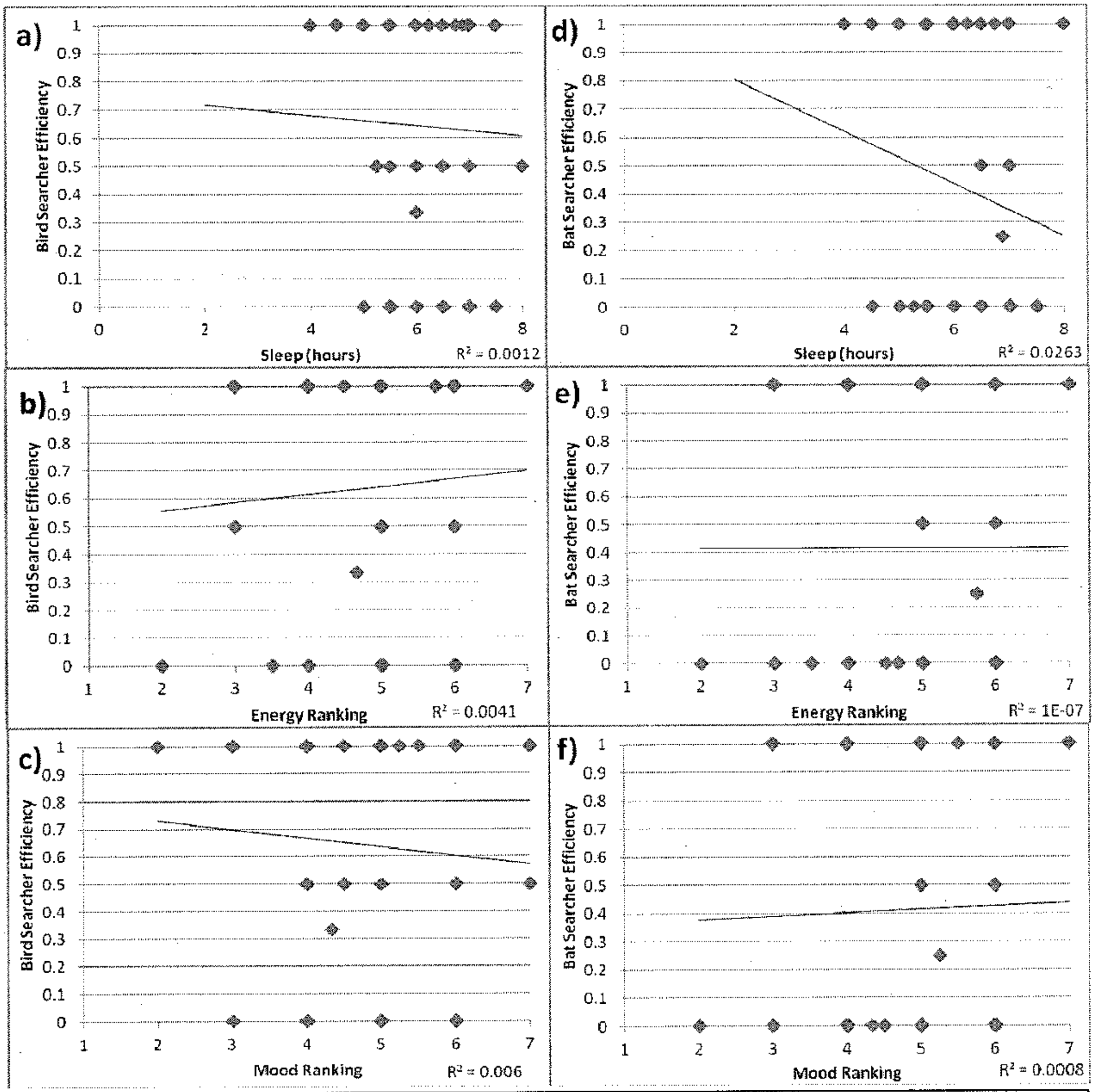

Figure 4: Graphed above are the searcher efficiencies for bird and bat mortality a wind farm in Southeastern Wisconsin. These searcher efficiencies are averages for each day during both field seasons (spring and fall of 2009). Bird and bat searcher efficiencies were calculated separately. Inter-personal factor data (sleep, energy level, and mood) was gathered by daily surveys before searching—sleep to the nearest ½ hour, ranking of energy level and mood on a scale from 1(low) to 7 (high). The survey data was then averaged by day. The six graphs above show a) bird searcher efficiency versus hours of sleep prior to searching b) bird searcher efficiency versus energy level ranking c) bird searcher efficiency versus mood ranking d) bat searcher efficiency versus hours of sleep prior to searching e) bat searcher efficiency versus energy level ranking and f) bat searcher efficiency versus mood ranking.

Figure 5: Correlations Over Time

	Spring 2009					Fall 2009				
Factor	Bat Searcher Efficiency	Bird Searcher Efficiency	Sleep	Energy Level	Mood	Bat Searcher Efficiency	Bird Searcher Efficiency	Sleep	Energy Level	Mood
R^2	0.5008	0.0871	0.0003	0.0742	0.0668	0.0592	0.0013	0.1379	0.0017	0.1379

Figure 5: Values above are the R^2 values for interpersonal factors and searcher efficiencies for searchers of bird and bat mortality at wind farms in Southeastern Wisconsin. The searcher efficiencies are averages per day. Bird and bat searcher efficiencies were calculated separately. Interpersonal factor data (sleep, energy level, and mood) was gathered by daily surveys before searching—sleep to the nearest ½ hour, ranking of energy level and mood on a scale from 1(low) to 7 (high). The survey data was then averaged by day. All of these factors were analyzed with linear regression to look for a correlation with time.

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