

## Appendix S1: Comments by Anonymous Reviewers

A recurring theme in the reviews was Carl Sagan's quote, "extraordinary claims require extraordinary evidence," but the Ivory-billed Woodpecker is not a mythical creature, such as the Unicorn or Bigfoot. This species is known to science, and it is easy to understand why it has a long history of rediscoveries and elusiveness on the basis of its habitat and behaviors. There is no reason to require extraordinary evidence to demonstrate the persistence of the Ivory-billed Woodpecker. All that should be required is evidence that shows characteristics that are consistent with that species but no other species and for those characteristics to be sufficient in number to rule out the plausibility of any alternative explanation. The videos provide such evidence, and it is extraordinary evidence in the sense that it is the strongest to be obtained in several decades and it reveals fascinating flights and other behaviors of the Ivory-billed Woodpecker that do not appear in the 1935 film.

Some reviewers claimed that attempts to glean information from the historical record of sightings (Roberts et al. 2009; Elphick et al. 2009; Gotelli et al. 2011; Solow et al. 2011) have produced a convincing case that the Ivory-billed Woodpecker is extinct. It might be possible to obtain a reasonable estimate of the extinction date of a species from a data base of sightings that is adequately sampled throughout the range of the species, but the record of sightings of the Ivory-billed Woodpecker is extremely sparse both spatially and temporally, and the intensity of efforts to find these birds has varied substantially with the comings and goings of searchers such as Arthur Allen, John Dennis, Whitney Eastman, John Fitzpatrick, and Geoffrey Hill. It seems unlikely that reliable information can be obtained from such a data set, but Gotelli et al. (2011) claimed that these studies "point to the inescapable conclusion that the Ivory-billed Woodpecker is now extinct."

The analysis of the 2008 video is based on using flap rate to rule out the Pileated Woodpecker. It is not based on any assumptions about the flap rate of the Ivory-billed Woodpecker, but some reviewers suggested that the high flap rate of the bird in the video is not consistent with the Ivory-billed Woodpecker. They claimed that flap rate decreases as size increases and that the Ivory-billed Woodpecker should therefore have a lower flap rate than the Pileated Woodpecker, but it was established decades ago that flap rate depends on multiple parameters. Pennycuik (1990, 1996) applied a large data set involving a wide range of species to develop an empirical flap rate model that is based on three parameters. His model predicts that flap rate tends to increase as body mass increases, which is the opposite of the dependence claimed by reviewers. The other parameters in the model are the wingspan and the surface area of the wings. There is a relatively small difference between the wingspans of the two large woodpeckers, but the Ivory-billed Woodpecker has narrower wings, which favors a high flap rate in the model. The prediction of the model is consistent with Tanner's account that the Ivory-billed Woodpecker has a high flap rate.

For a submission to *BMC Ecology* in 2011, one of the reviewers claimed, "Tanner's statements are qualitative, and we have no way of knowing what he meant." Tanner would have had no reason to state that the Ivory-billed Woodpecker flies with "rapid wing-beats" unless it meant something; and the comment would make sense only if it were a tacit comparison with the flap rate of the Pileated Woodpecker, the only species of the region that is even remotely similar to the Ivory-billed Woodpecker. Since all of Tanner's accounts of flights are based

on observations in the field (no flights appear in the 1935 film), the Ivory-billed Woodpecker would need to have a substantially higher flap rate than the Pileated Woodpecker in order for Tanner to have been in a position to make a definitive statement about this issue. The flap rate of the bird in the 2008 video is about double the flap rate of the Pileated Woodpecker, and everything is consistent between the video, Tanner's account, and the model. A film that was published less than a year after the submission to *BMC Ecology* reveals that the even larger Imperial Woodpecker also has rapid wingbeats (Lammertink et al. 2011).

The flap rate of the bird in the 2008 video is about ten standard deviations greater than the mean flap rate of the Pileated Woodpecker. Despite having some training and experience in statistics, I sought the opinion of an expert with extensive experience in applications of statistics regarding what may be concluded from ten standard deviations for the types of distributions that occur in nature. According to David Banks of Duke University, ten standard deviations is sufficient to conclude with "statistical certainty" that the bird in the 2008 video is not a Pileated Woodpecker. One of the reviewers of the submission to *BMC Ecology* made the comments: "I reject the validity of the quote from David Banks. He is not an ornithologist. Banks clearly thinks that the Pileated Woodpecker only has a single wingbeat frequency." Banks was aware that the flap rate of the Pileated Woodpecker is a statistical quantity that varies within a distribution that has a mean and standard deviation.

Reviewers also questioned the 15.2 m/s flight speed of the bird in the video, which is substantially above the range of 7.5 to 11.6 m/s that Tobalske (1996) obtained for the Pileated Woodpecker. There were claims that the high flight speed could have been affected by a tail wind, but the video shows delicate strands of Spanish moss hanging motionless on a morning that was still (as can be verified from weather archives). One of the reviewers of the submission to *BMC Ecology* made the following comments:

Estimates of flight speeds from wild birds are highly uncertain. It is not valid to use 11.6 m/s measured by Tobalske as the maximum flight speed. In fact there are a lot of absurd or bogus estimates of flight speeds of all kinds of birds in the literature. Likely this number was limited in some way by Tobalske's measurement technique, and that he was being conservative—this was the maximum speed he measured, rather than the actual maximum speed. I would guess Pileated reaches at least 18 or 20 m/s, as this is a speed reached by birds smaller than Pileated, such as large passerines or doves or parrots, when they are tested in a wind tunnel. The only safe numbers to use for flight speed are those obtained from a wind tunnel study, or perhaps with radar. To suggest that the pileated has an actual maximum speed of 11 m/s is ludicrous, it is to suggest that it cannot fly as fast as many medium-sized passerines, or even a hummingbird!

The reviewer implied that larger birds have greater flight speeds than smaller birds, but there are several examples of the opposite dependence (by a large margin in some cases) in the data set obtained by Pennycuik (1990). The reviewer claims that estimates of flight speeds obtained in the field are "absurd or bogus," but it is straightforward to obtain reliable estimates of flight speed using landmarks (Tobalske 1996). The most reliable

predictor of flap rate that has been developed to date is based on the physics of vortex shedding (Taylor et al. 2003; Nudds et al. 2004); according to the model, there is a linear relationship between flap rate and flight speed for a bird in cruising flight. An implication of the model is that, if either the flap rate or the flight speed has a relatively narrow distribution, then the other quantity should also have a relatively narrow distribution; both of these quantities have a relatively narrow distribution for the data obtained by Pennycuik (1990, 1996) and Tobalske (1996). If it were true that the Pileated Woodpecker can achieve a cruising flight speed of 20 m/s, which is approximately double Tobalske's mean flight speed of 9.6 m/s, the model would suggest a flap rate of approximately double Tobalske's mean flap rate of 5.2 Hz, which would be more than ten standard deviations above the mean flap rate of that species.

One of the reviewers of a submission to the *Proceedings of the National Academy of Sciences* in 2009 made the following claims: (1) "A sample size of one flight from one bird is not conclusive," but it is indeed possible to rule out the Pileated Woodpecker in a single flight on the basis of the known flap rate statistics of that species; (2) the prominent white patches on the dorsal surfaces of the wings "could potentially derive from solar specular reflection," but the video reveals that the sky was overcast that morning (as can be verified from weather archives); and (3) "The low temporal resolution of the camera precludes detailed assessment of wingbeat motions," but Tobalske had no problem digitizing the wingtip motion from the NTSC video, which is sampled at 60 frames per second and clearly reveals the motions of the wings. The same reviewer made the following comments:

The estimates of wingbeat frequency suggest values much higher than those known to characterize flight of Pileated Woodpeckers, but the inference that the sequence is therefore necessarily that of an Ivory-billed Woodpecker (for which no frequency data are available in any event) is flawed. The larger size of the latter species should correspond to lower and not higher wingbeat frequencies given the well-characterized negative allometry of this quantity in birds and other flying animals. In fact, an alternative explanation is simply that the time base is incorrect, i.e., that the sequence corresponds to 30 frames/second rather than 60 frames/second, thus yielding a wingbeat frequency for the sequence that is closer to 3.5 Hz and well within the range for a Pileated Woodpecker. If this is the case, then the flight speed estimate is also too high by a factor of two, which would bring the value to 7.5 m/s which is more realistically consistent with reported flight speeds for a Pileated Woodpecker.

Some of these comments are similar to comments that have already been discussed; they reflect a lack of awareness of Pennycuik's findings, Tanner's account of a high flap rate, and the fact that the analysis of the video does not require any information about the flap rate of the Ivory-billed Woodpecker. By speculating that the temporal sampling had been altered, the reviewer essentially conceded that the large woodpecker in the video cannot be a Pileated Woodpecker. That line of discussion could be interpreted as an implication of fraud, but I was not given an opportunity to provide the original digital videotape for inspection. From that tape, it would have been easy to confirm that the temporal sampling is correct.

A submission to *PLOS ONE* in 2013 was recommended for publication by two of the three reviewers. One of the positive reviews contains the following comments:

This is a fascinating paper, laying a claim of a highly controversial topic, namely, the flight characteristics of the Ivory-billed Woodpecker, actually, the very continuing existence of it. The work is indirect but the effort is highly methodical and justifiable. It will surely create disagreement but I strongly recommend the paper for publication so that there is a framework to foster open discussion and debate.

The reviewer understood that it is essential to publish relevant findings in a timely manner in order to "foster open discussion and debate." The other positive review contains the following comments:

The manuscript contains an insightful analysis of flight characteristics of the Ivory-billed and Imperial woodpeckers, using analysis of historical and video data to make a case for considering the footage in the putative videos to be that of the Ivory-billed woodpecker. Flight characteristics are the key to the analysis, although other aspects of wing shape and markings are also pointed out. Looking at the putative video before seeing the analysis, one may wonder how any progress on deciding if the video is of the Ivory-billed woodpecker can be made, since it is fleeting footage from far away. I am impressed by the author's being able to provide an analysis of flap rate and takeoff and landing characteristics that is very compelling.

When asked to evaluate video evidence for the persistence of the Ivory-billed Woodpecker, it is only natural to hope to see images that are as clear as in the film that was obtained in 1935, but nobody has managed to obtain high-quality footage in recent decades. As the reviewer discovered, however, the videos contain evidence that is "very compelling" when carefully examined. The negative review contains the following claims: (1) "The poor quality of the data does not allow proper kinematic analysis," but an expert on woodpecker flight mechanics had no problem analyzing the video, which unquestionably shows the wings folding closed in the middle of each upstroke; and (2) "The strange attempt to use a kinematic model shows the ignorance of the author," but it would be a trivial matter for any scientist to apply that model, which is based on a simple equation involving the flap rate, flight speed, and wingspan (Taylor et al. 2003; Nudds et al. 2004). The reviewer did not provide any details to support the claim that the model was used improperly, but I consulted with one of the developers of the model, Adrian Thomas of Oxford University, who confirmed that I applied it properly for a previous submission. When asked why the positive reviews were dismissed and the submission was rejected on the basis of a negative review that contains no valid criticisms, the editor responded with the following:

For your information, there is a long list of potential reviewers for this ms who have all declined, including all the ones you have suggested. The reasons they gave for declining have also contributed to my decision, which was reached in consultation with the editors.

The editor did not provide any supporting information, such as discussions of the data and analysis.

In discussing criticism of the work of Fitzpatrick and his colleagues, Haney mentioned that “one cannot entirely discount envy, turf-guarding, or other human motivations as contributing to some of the criticism” (Haney 2007). Some of the reviews contain comments that are suggestive of motivations other than a desire to establish the truth. A reviewer of a submission to *MDPI Biology* in 2016 made the following comments:

We have what is called the ‘scientific method’ for a reason. Nearly 500 years ago science existed in an age when men of wealth and power made declarations of what is true and what isn’t true in science—and progress and understanding in science was abysmal. The development of the scientific method gave science a yardstick by which to measure whether something was true or not—whether something existed or not. Scientific credibility—not wealth or power—is the foundation on which decisions to expend vast sums of public resources. Of course wealth and power still give sway to some major expenditures—such as in the case of the Ivory-billed Woodpecker, but science gives us the tool to call them on it.

The reviewer pontificated about the scientific method but did not discuss the analysis of the videos, which happens to be based on the scientific method (e.g., the analysis of the 2008 video is based on woodpecker flight mechanics and the statistics of flap rate). A reviewer of a submission to *Frontiers in Zoology* in 2010 made the following comments:

I know as a result of discussions with others, including members of the Ivory-billed Woodpecker Recovery Team and others associated with the searches of recent years, that the videos mentioned at the beginning of the results section and presented with this manuscript have been thoroughly analyzed by members of the Ivory-billed Woodpecker Recovery Team and convincingly dismissed as being videos of a pileated woodpecker, red-headed woodpecker, and possibly a third species – but almost certainly not one of the images is of an ivory-billed woodpecker.

Without providing any supporting information, the reviewer claimed that unspecified individuals had “thoroughly analyzed” and “convincingly dismissed” the videos. Another reviewer of the same submission (who disclosed his identity in the review) happened to be a member of the group that had supposedly “convincingly dismissed” the videos; but he recommended publication and provided the comment, “After a rather intensive and careful review of the evidence provided by the author, I am inclined to agree that this manuscript offers relatively strong evidence of at least one observation of ivorybill in 2008.”

## References (continued)

- Elphick, C. S., Roberts, D. L., and Reed, M. J. (2009), “Estimated dates of recent extinctions for North American and Hawaiian Birds,” *Biological Conservation*, 143, 617–624.
- Gotelli, N. J., Chao, A., Colwell, R. K., Hwang, W., and Graves, G. R. (2011), “Specimen-based modeling, stopping rules, and the extinction of the Ivory-billed Woodpecker,” *Conservation Biology*, 26, 47–56.
- Haney, J. C. (2007), “Technical Comments on the U.S. Fish & Wildlife Service’s Ivory-billed Woodpecker Draft Recovery Plan,” Defenders of Wildlife (October 5, 2007).
- Nudds, R. L., Taylor, G. K., and Thomas, A. L. R. (2004), “Tuning of Strouhal number for high propulsive efficiency accurately predicts how wingbeat frequency and stroke amplitude relate and scale with size and flight speed in birds,” *Proc. R. Soc. Lond. B*, 271, 2071–2076.
- Roberts, D. L., Elphick, C. S., and Reed, M. J. (2009), “Identifying anomalous reports of putatively extinct species and why it matters,” *Conservation Biology*, 24, 189–196.
- Solow, A., Smith, W., Burgman, M., Rout, T., Wintle, B., and Roberts, D. (2011), “Uncertain sightings and the extinction of the Ivory-billed Woodpecker,” *Conservation Biology*, 26, 180–184.
- Taylor, G. K., Nudds, R. L., and Thomas, A. L. R. (2003) “Flying and swimming animals cruise at a Strouhal number tuned for high power efficiency,” *Nature*, 425, 707–711.