February 1, 2006

Emmett Brown, Executive Director
National Fresh Water Fishing Hall of Fame
P.O. Box 690
10360 Hall of Fame Drive
Hayward, Wisconsin 54843

Dear Mr. Brown:

We are writing you concerning the recent validation of Louie Spray's 1949 world record musky, on which you sought photographic analysis from each of us. It is our impression that there is not complete understanding of the results of the analyses we sent you, and we wanted to clarify this. We want to stress that there is no disagreement among the three of us. Moreover, none of us is willing to say, based on the limited information and investigations we have made up to this point, whether or not we believe the record is valid. However, we feel that it is important that the analysis we have contributed be correctly understood.

The Hall contacted each of us (via director Scott Allen). We were contacted at different times, and provided different photos. Arnold and Gallian were contacted on November 28. Arnold was provided only with what you call on the web site the "new photo." Gallian was provided with a different photo altogether, which has a building in the background. Goldfeld was contacted about one and a half weeks later and only supplied with the latter photo. Subsequently Gallian was also supplied with the "new photo" as well.

To draw any conclusions mathematically from these photos, it is necessary to make some assumptions. Ultimately the credibility of the results depends not only on the mathematical analysis, but also on the credibility of the assumptions.

Mr. Allen's letter to Prof. Arnold and later to Prof. Gallian suggested that from the "new photo" one could deduce the length of the fish by assuming a height of the angler of 72" and using direct scaling. Even if one assumes that the camera was not tilted, this is not so, unless one discounts the difference between the distance of the camera to the angler and to the fish. Discounting that distance leads to a fish length of somewhat less than 63" (the exact number is uncertain because it is not possible to say precisely where the bottom of the angler's foot is in the photo). However, since the fish is clearly in front of the angler, the length 63" must be reduced by a factor equal to the ratio of the camera distances. For instance, if the camera is 8' from the angler but only 7' from the fish, the fish length would change to 63" $\times$ 7/8 or about 55". This is the origin of Prof. Arnold's statement that "the only conclusion that we can draw with certainty is that the fish is shorter than 63", perhaps considerably so." If we do not discount the possibility of a tilted camera, even this conclusion is uncertain.

Different conclusions can be gleaned from the second photo, but again assumptions are needed. The key assumptions in this case are (1) that the vertical line segment through the Spray's raised hand passes through the fish and hits the ground at a point roughly 84" below it, (2) that the point where that line hits the ground has been correctly identified on the photo, and (3) that the camera was not tilted significantly from vertical. The first assumption is supported by the knowledge of Spray's height and observation of how his arm is extended. Mr. Allen provided a photo with lines

marked to indicate the range of possible positions of the point and asked Profs. Gallian and Goldfeld to accept these markings as correct, which they did. But, in fact, it is not clear that the markings are correct. As we understand it, these lines were drawn on the basis of the photogrammetric analysis performed by DCM (which was not provided to us and which we did not study), an analysis which is disputed by the Hall. Finally, the assumption of negligible camera tilt is open to debate. The DCM photogrammetric analysis suggests that the camera tilt is significant. On the other hand, Prof. Goldfeld observed that the tilt is not so large as to significantly effect the nearly equal spacing of the photographed siding boards when cut by a vertical line. In summary, if assumptions (1)–(3) are valid, then one can compute a fish length of about 63", but these form a big "if".

Finally let us say that we are concerned with the manner in which the Hall communicated with us. Although the Hall had multiple photos available, we were not provided with all the photos. Providing full, rather than selective, information, could likely have allowed for a more complete analysis. Moreover, the photos had marked points on them, whose accuracy is not certain, and which could possibly skew the analysis. In particular, the Hall's position of declaring the DCM analysis invalid, but then asking two of us to accept a range determined by that analysis for the ground point vertically below the angler's hand, is inconsistent. Finally, in the Hall's announcement of their decision we were disappointed that they included those results that they felt supported the decision, although without giving the full context, and did not present those results (the response of Prof. Arnold) that might support a shorter fish.

We believe that a much more definitive result can be obtained from the photos which are available. To this end, it is our recommendation that an independent group, including experts on mathematics and photogrammetry, be impaneled. This group should be supplied with the full information available, including all known photos of the fish in original format, and allowed to pursue the evidence as they feel most justified.

Sincerely yours,

Douglas N. Arnold, Ph.D.
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Director, Institute for Mathematics and its Applications

Joseph Gallian, Ph.D.
Professor of Mathematics, University of Minnesota Duluth
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