Quantitative Analysis of Modern Fish Kills and Fossil Fish: Algae Rafting in the Fossil Record

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The Green River Formation (GRF) is a group of lakes that occupied present day Utah, Wyoming, and Colorado 58 million to 38 million years ago. These lakes were home to a variety of plant and animal species, their fossils preserved as the lakes filled with sediment and volcanic ash. The GRF is the source of worldwide known fossils and is used in several studies to understand the past. Recently, Mitzumoto et al., (2017) hypothesized that a shoal of fish (the extinct *Erismatopterus levatus*) from the GRF were preserved in formation, and that the specimen described provides evidence of schooling behavior. We present an alternative hypothesis that the fish were instead incorporated into a floating mat of filamentous algae, which caused them to be preserved together, aligned when the mat sunk to the lake bottom. To test this hypothesis, we compared 6 fossils and present-day fish kills to the “schools” fossil described from the GRF and quantitatively compare fish directionality. We show that patterns described by Mitzumoto et al., (2017) are in fact consistent with modern day non-schooling fish kills, in which wave action causes fish to align in the same direction. This is consistent with observations of other clusters of fossils, for example, oriented water boatmen insects from the Solite Formation (Olsen et al., 2018). Therefore, we find that the hypothesis that the GRF fossil was the product of filamentous algal binding and rafting to be a more parsimonious hypothesis than the sinking in formation of a school of fish.

Mitzumoto et al., (2017) Inferring collective behaviour from a fossilized fish shoal. Proceedings of the Royal Society B **286:** 2019089

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