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Mechanisms of force production during linear accelerations in bluegill sunfish Lepomis macrochirus[1] ERIC D. TYTELL, TYLER N. WISE, ALEXANDRA L. BODEN, ERIN K. SANDERS, MARGOT A. B. SCHWALBE, Tufts Univ — In nature, fish rarely swim steadily. Although unsteady behaviors are common, we know little about how fish change their swimming kinematics for routine accelerations, and how these changes affect the fluid dynamic forces and the wake produced. To study force production during acceleration, particle image velocimetry was used to quantify the wake of bluegill sunfish *Lepomis macrochirus* and to estimate the pressure field during linear accelerations and steady swimming. We separated "steady" and "unsteady" trials and quantified the forward acceleration using inertial measurement units. Compared to steady sequences, unsteady sequences had larger accelerations and higher body amplitudes. The wake consisted of single vortices shed during each tail movement (a '2S' wake). The structure did not change during acceleration, but the circulation of the vortices increased, resulting in larger forces. A fish swimming unsteadily produced significantly more force than the same fish swimming steadily, even when the accelerations were the same. This increase is likely due to increased added mass during unsteady swimming, as a result of the larger body amplitude. Pressure estimates suggest that the increase in force is correlated with more low pressure regions on the anterior body.

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