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Characterization of the Boundary Layer on Full-Scale Bluefin Tuna BRIAN AMARAL, KIMBERLY CIPOLLA, CHARLES HENOCH, NAVSEA Newport — The physics that enable tuna to cross large expanses of ocean while feeding and avoiding predators is not presently understood, and could involve complex control of turbulent boundary layer transition and drag reduction. Typical swimming speeds of Bluefin tuna are 1-2 m/s, but can be higher during strong accelerations. The goal of this work is to experimentally determine the approximate lateral location at which transition to turbulence occurs on the tuna for various speeds. The question is whether laminar flow or an advanced propulsion mechanism (or both) allows them to swim at high speeds. Uncertainties include the surface roughness of the skin, local favorable and adverse pressure gradients, and discontinuities such as the open mouth or juncture at the fins. Historically, much of the fluid mechanics work in the area of fish locomotion has focused on vortex shedding issues rather than the boundary layer. Here, the focus is obtaining information on the boundary layer characteristics of a rigid tuna model. A full scale model of a Pacific Bluefin tuna was fabricated using a mold made from an actual deceased tuna, preserving the surface features and details of the appendages. The model was instrumented with 32 wall pressure sensors and experiments performed in a tow tank. Results from flow visualization, drag and wall pressure measurements over a range of speeds and varying angles of attack will be presented.

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