

Swimming kinematics and efficiency of entangled North Atlantic right whales

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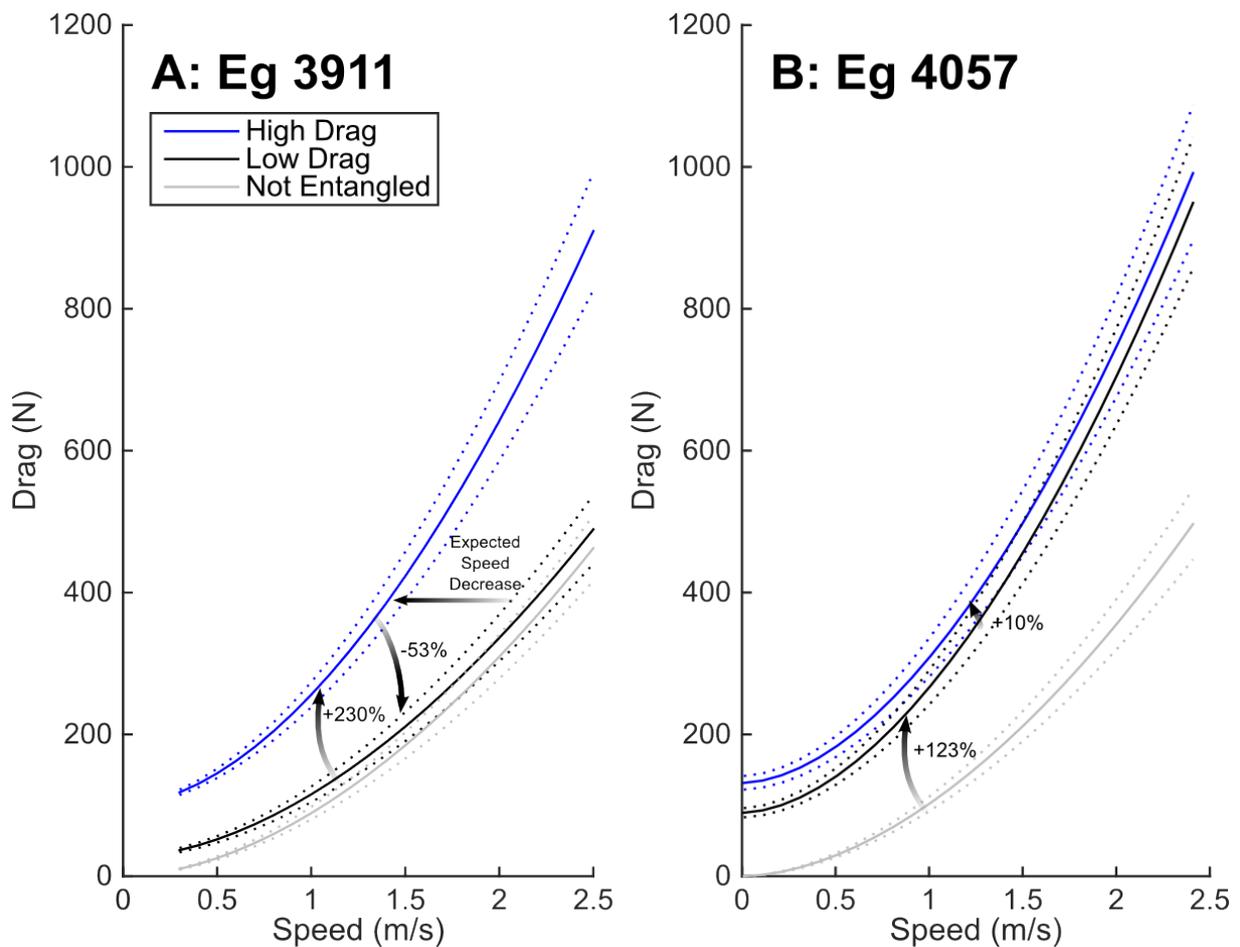


Figure S1. Drag forces on right whales Eg 3911 (A) and 4057 (B) when not entangled (grey), entangled in minimal fishing gear (low drag; black) and entangled in the high drag condition (blue). Dotted lines represent low and high estimates based on $\pm 10\%$ uncertainty for oscillation and gear drag estimates from van der Hoop et al. (2016). Arrows and numbers indicate the amount of drag increase over non-entangled conditions, or the change in drag during the disentanglement procedure. See text for details.

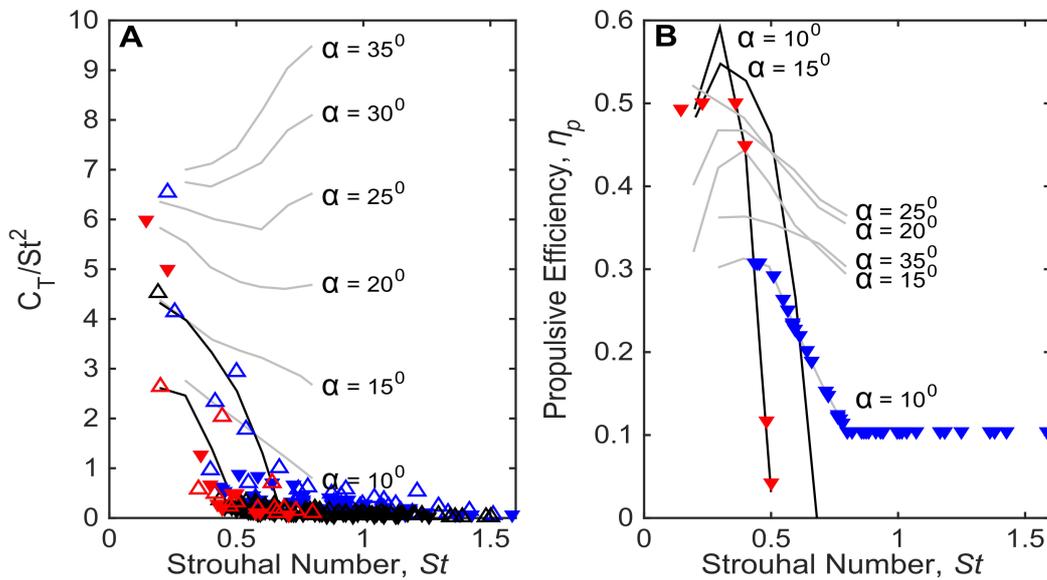
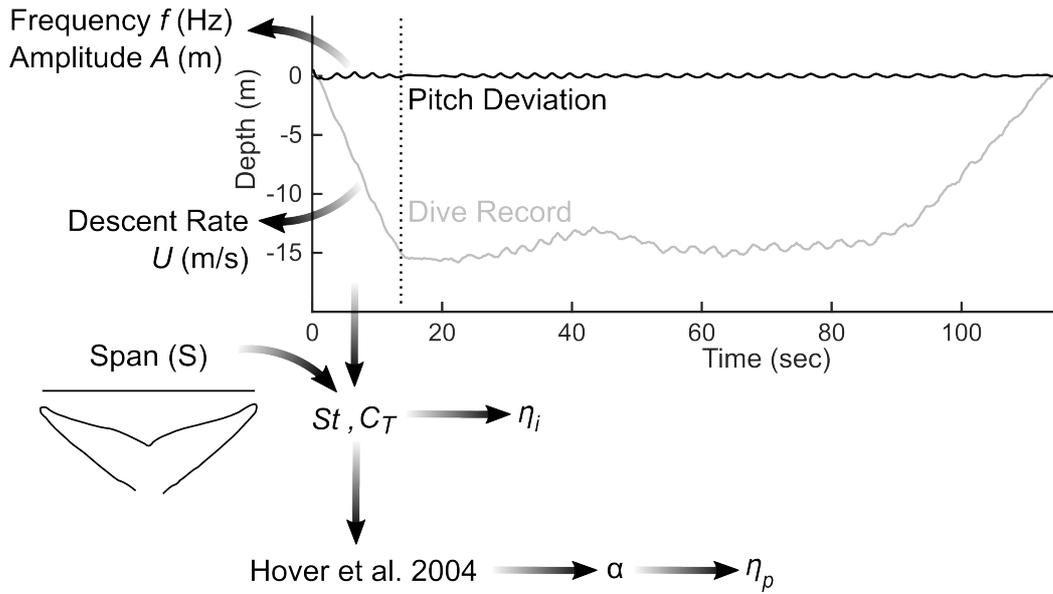


Figure S2. Description of the estimation of propulsive efficiency from tag data and studies on flexible foils. Top schematic shows the variables obtained during the descent of a dive and whale tail fluke measurement for estimation of the thrust coefficient (C_T) and Strouhal number (St). Ideal efficiency (η_i) is estimated from C_T (see text Eq. 3). Data from Hover et al. (2004) are used to estimate angle of attack (α) from contours C_T/St^2 vs. St (A), and propulsive efficiency (η_p) is estimated for values of St along contours of α (B). Estimates are made for descents (inverted filled triangles) and ascents (open triangles) of entangled (blue) and disentangled (black) dives. Red triangles represent dives where $St < 0.4$, where estimates are from harmonic profiles (black). Grey contours represent sawtooth wave profiles.

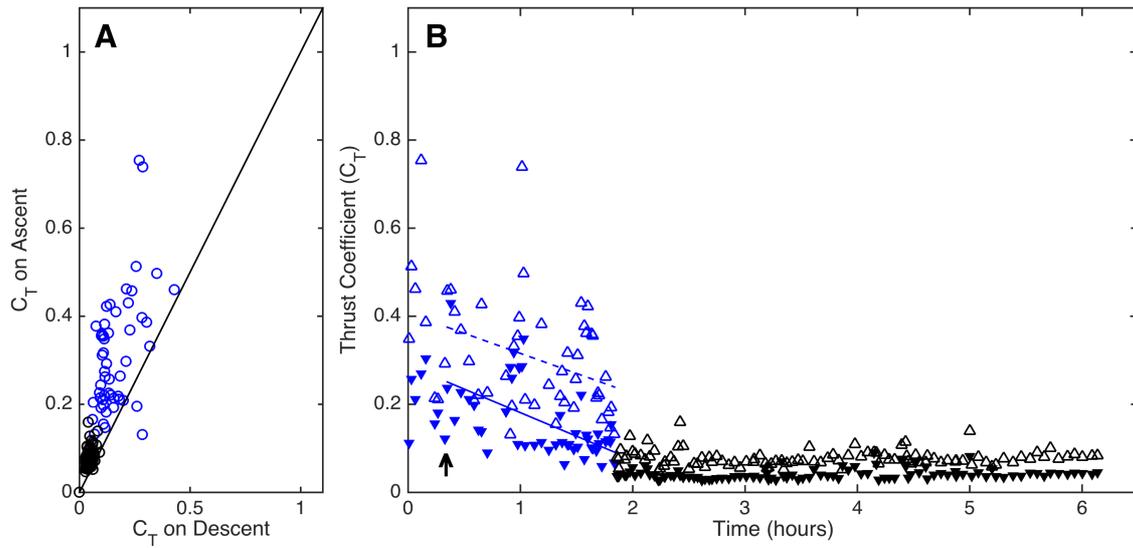


Figure S3. A. Thrust coefficient (C_T) on the descent vs. ascent of each dive of right whale Eg 3911 in low (black) and high (blue) drag conditions. B. Thrust coefficient on dive descents (filled, inverted triangles) and ascents (open triangles) through time during the tag deployment. Blue lines represent linear model fit for descent (solid) and ascent (dashed) following drug injection (time denoted by arrow).