|  |  |
| --- | --- |
| ***Symbol*** | ***Definition*** |
| *GSD* | Ground sampling distance (m) |
| *Lbody* | Body length (m) |
| *npix* | Number of pixels (count) |
| *a* | Altitude (m) |
| *lfoc* | Focal length (mm) |
| *Sw* | Sensor width (mm) |
| *Pw* | Image resolution width (px) |
| *Fa* | Planar fluke area (m2) |
| *C* | Chord length of tail (m) |
| *Mbody* | Body mass (kg) |
| *Sa* | Wetted surface area of body (m2) |
| *Uavg* | Mean swimming velocity (m s-1) |
| *f* | Oscillatory frequency (Hz) |
| *Tbeat* | Duration of a tailbeat (s) |
|  | Mechanical thrust power (W) |
| *CD* | Coefficient of drag (dimensionless) |
|  | Froude efficiency (dimensionless) |
| *σ* | Reduced frequency (dimensionless) |
| *ω* | Angular frequency of fluking (Hz) |
| *θ* | Feathering parameter (dimensionless) |
| *α* | Angle of attack of flukes (degrees) |
| *h* | Heaving amplitude (m) |
| *CT* | Coefficient of thrust (dimensionless) |
|  | Mean thrust force (N) |
| *ρ* | Density of seawater (Kg m-3) |
|  | Mean drag force (N) |
|  | Mean acceleration (m s-2) |
| *Uf* | Final tailbeat swimming speed (m s-1) |
| *Ui* | Initial tailbeat swimming speed (m s-1) |
| *∆U* | Change in tailbeat swimming speed (m s-1) |
| *kadded* | Shape drag correction factor (dimensionless) |
| *CDroutine* | Mean drag coefficient for all routine tailbeats from a single whale (dimensionless) |
| *Tlunge* | Thrust power for a lunge-associated tailbeat (W) |
| *CDmod* | Drag coefficient from rigid airship model |
| *Wmax* | Maximum body diameter (m) |
| *Re* | Reynold’s number (dimensionless) |
|  | Kinematic viscosity (m2 s-1) |
|  | Parasitic drag (N) |
| *Uopt* | Optimal swimming speed (m2 s-1) |

Table S1. All symbols and corresponding definitions (with units) used throughout the manuscript. Symbols are presented in the order in which they appear in the text.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Species*** | ***Source*** | ***Body Length (m)*** | ***Surface Area (m2)*** | ***Surface Area Equation*** |
| ***Humpback*** | CFD model – Kennedy (2021) | 14.78 | 82 | *Sa* = 5.55*×Lbody* |
| ***Blue*** | Kermack, 1948 | 25.91 | 175.59 | *Sa* = 6.78*×Lbody* |
| ***Antarctic Minke*** | CFD model – Kennedy (2021) | 8 | 28 | *Sa* = 3.50*×Lbody* |
| ***Bryde’s*** | Fish (pers comm.) | - | - | *Sa* = 0.43185*×Lbody*1.9103 |
| ***Fin*** | Parry, 1949 | 19.8 | 137 | *Sa* = 5.81*×Lbody* |
| Kermack, 1948 | 20.12 | 115.11 |
| Kermack, 1948 | 21.1 | 126.07 |
| Bose and Lien, 1989 | 14.5 | 67.35 |
| ***Sei*** | Fish (pers comm.) | - | - | *Sa* = 0.43185*×Lbody*1.9103 |

Table S2. Equations used to calculate the wetted surface area of each species as well as literature sources.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Species*** | ***Swim Speed (m s-1) or (bl s-1)\**** | ***Total Length (m)*** | ***Froude Efficiency*** | ***Source(s)*** |
| ***Homo sapien***  *Human (Female)* | 0.95 | 2.38 | 0.29 | von Loebbecke et al., 2009 |
| ***Ondatra zibethicus***  *Muskrat* | 0.75 | 0.44 | 0.33 | Fish, 1984 |
| ***Pterophyllum eimekei***  *Freshwater Angelfish* | 0.04 | 0.08 | 0.16 | Blake, 1979; Blake, 1980 |
| ***Danio rerio***  *Zebra Danio* | Multiple | 0.0315 | 0.80 | McCutchen, 1975 |
| ***Cymatogaster aggregata***  *Shiner Perch* | 0.57 | 0.143 | 0.65 | Webb, 1975 |
| ***Oncorhynchus mykiss***  *Rainbow Trout* | Ucrit | 0.293 | 0.75 | Webb, 1975 |
| ***Euthynnus affinis***  *Mackerel Tuna (Kawakawa)* | 1.52 | 0.40 | 0.90 | Magnuson, 1978 |
| ***Pusa hispida***  *Ringed Seal* | 0.75 | 1.03 | 0.88 | Fish et al., 1988 |
| ***Pagophilus groenlandicus***  *Harp Seal* | 1.04 | 1.43 | 0.87 | Fish et al., 1988 |
| ***Trichechus manatus***  *American Manatee* | 0.30\* | 3.23 | 0.83 | Kojeszewski and Fish, 2007 |
| ***Delphinapterus leucas***  *Beluga Whale* | 3.00 | 3.64 | 0.84 | Fish 1998 |
| ***Lagenorhynchus obliquidens***  *Pacific White-Sided Dolphin* | 5.30 | 2.00 | 0.89 | Webb, 1975; Yates, 1983; Blickhan and Cheng, 1994 |
| ***Orcinus orca***  *Killer Whale* | 6.50 | 4.74 | 0.88 | Fish, 1998 |
| ***Pseudorca crassidens***  *False Killer Whale* | 3.80 | 3.75 | 0.90 | Fish, 1998 |
| ***Sotalia guianensis***  *Guiana Dolphin* | 2.40 | 1.90 | 0.83 | Blickhan and Cheng, 1994 |
| ***Tursiops truncatus***  *Common Bottlenose Dolphin* | 2.401, 3.802 | 2.501, 2.612 | 0.781, 0.862 | Blickhan and Cheng, 19941; Fish, 19982 |
| ***Megaptera Novaeangliae***  *Humpback Whale* | 2.09 ± 0.066 (Routine Effort Swimming) | 11.06 ± 0.35 | 0.909 ± 0.003 | Current Study |
| ***Balaenoptera musculus***  *Blue Whale* | 2.20 ± 0.054 (Routine Effort Swimming) | 22.41 ± 0.33 | 0.863 ± 0.004 | Current Study |
| ***Balaenoptera bonaerensis***  *Antarctic Minke Whale* | 2.35 ± 0.052 (Routine Effort Swimming) | 7.30 ± 0.34 | 0.920 ± 0.004 | Current Study |
| ***Balaenoptera brydei***  *Bryde’s Whale* | 1.71 ± 0.47 (Routine Effort Swimming) | 12.04 ± 2.07 | 0.868 ± 0.022 | Current Study |
| ***Balaenoptera physalus***  *Fin Whale* | 2.88 ± 0.020 (Routine Effort Swimming) | 18.90 ± 0.43 | 0.889 ± 0.018 | Current Study |
| ***Balaenoptera borealis***  *Sei Whale* | 2.21 (Routine Effort Swimming) | 16.62 | 0.878 | Current Study |

Table S3. Froude efficiency and metadata collected from various sources for the creation of figure 7.