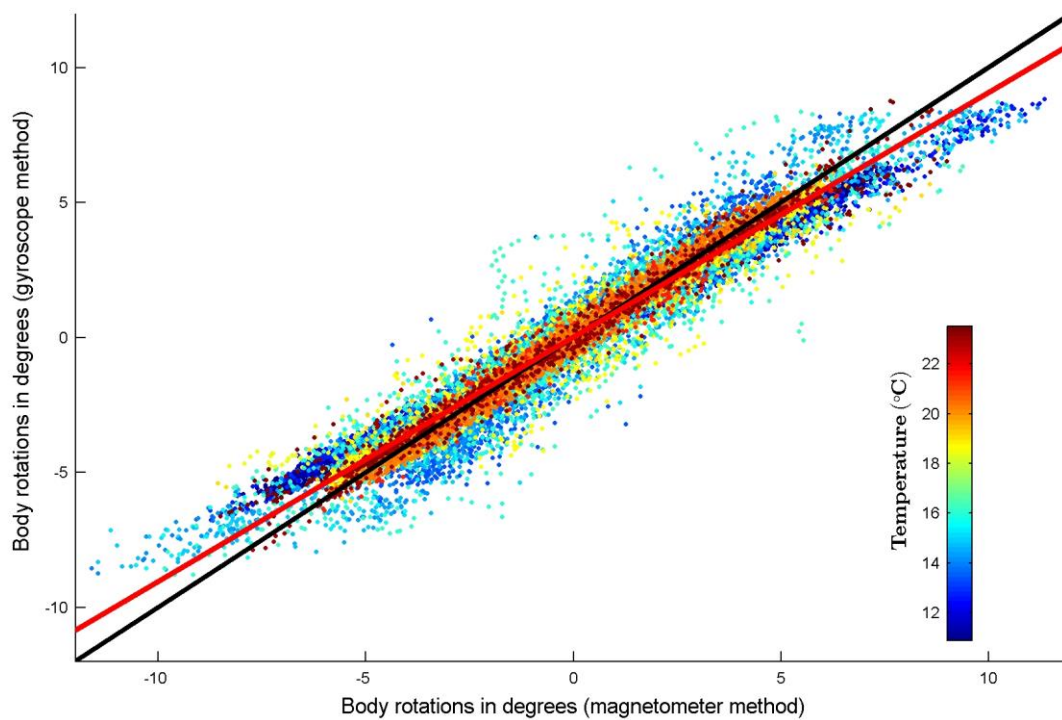


## SUPPLEMENTARY MATERIAL



**Figure S1.** Comparison of y-axis body rotations estimated using the magnetometer and gyroscope methods during steady swimming in dive descents and ascents, coloured by approximate tag temperature ( $^{\circ}\text{C}$ ). The slope of the least-squares linear regression (red line  $N=70604$   $R^2=0.94$   $P<0.0001$ ) through all data points was not significantly different from unity (black line). The relationship between the body rotations estimated by both sensors broadens and changes slope slightly at cooler temperatures (i.e. when the tag temperature deviated most from the  $22^{\circ}\text{C}$  temperature during gyroscope calibration). Temperature influences both the offset and scale factor of MEMS gyroscopes but should have little impact on the kinematic parameters estimated using the magnetometer method as this is ratiometric.

**Table S1.** Advantages and disadvantages of the magnetometer and gyroscope methods for estimating body rotations and specific acceleration (both sensors are assumed to be triaxial).

	<b>Magnetometer method</b>	<b>Gyroscope method</b>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Magnetometers are already included in some tags as heading sensors.</li> <li>• Sensor can be switched off between samples to save power.</li> <li>• No acoustic signature.</li> <li>• Processing is ratiometric so is insensitive to sensor gain and field strength changes.</li> </ul>	<ul style="list-style-type: none"> <li>• Equally sensitive in all orientations.</li> <li>• Rotations around all three body axes are measured.</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Body rotations unobservable in some orientations (when the axis of rotation is parallel to the field vector)</li> <li>• Only able to track rotations around one axis, e.g., pitch or yaw in caudal propulsion.</li> </ul>	<ul style="list-style-type: none"> <li>• High power consumption cannot be reduced by sensor switching.</li> <li>• Frame vibration generates acoustic noise within the hearing range of some marine mammals.</li> <li>• Sensitivity can change with temperature.</li> </ul>
<b>Applications</b>	Long duration tags on animals with planar movements (e.g., caudal-oscillation swimmers)	Short duration tags on animals with any movement style.