

Hydrodynamic role of longitudinal dorsal ridges in a leatherback turtle swimming

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Affiliations

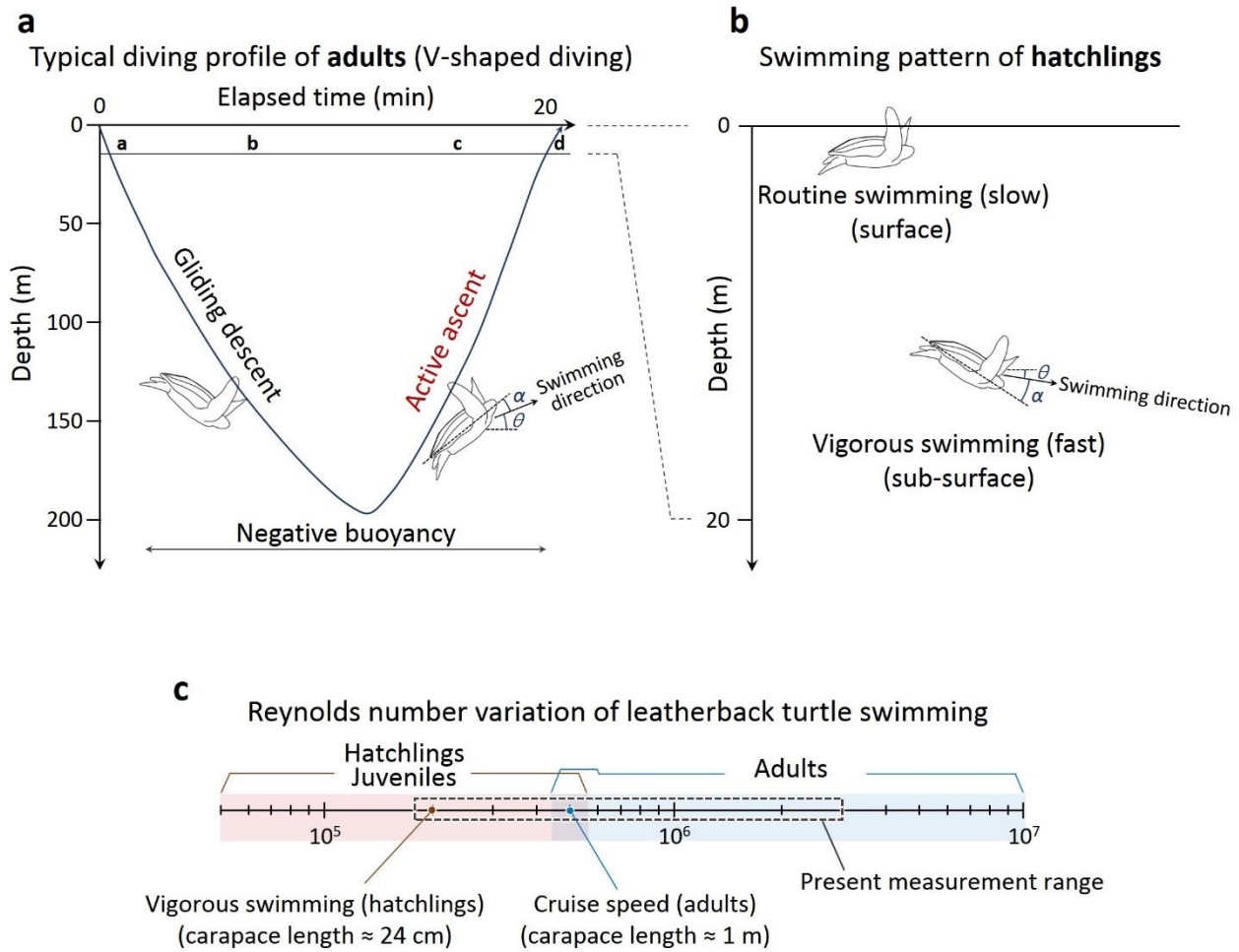
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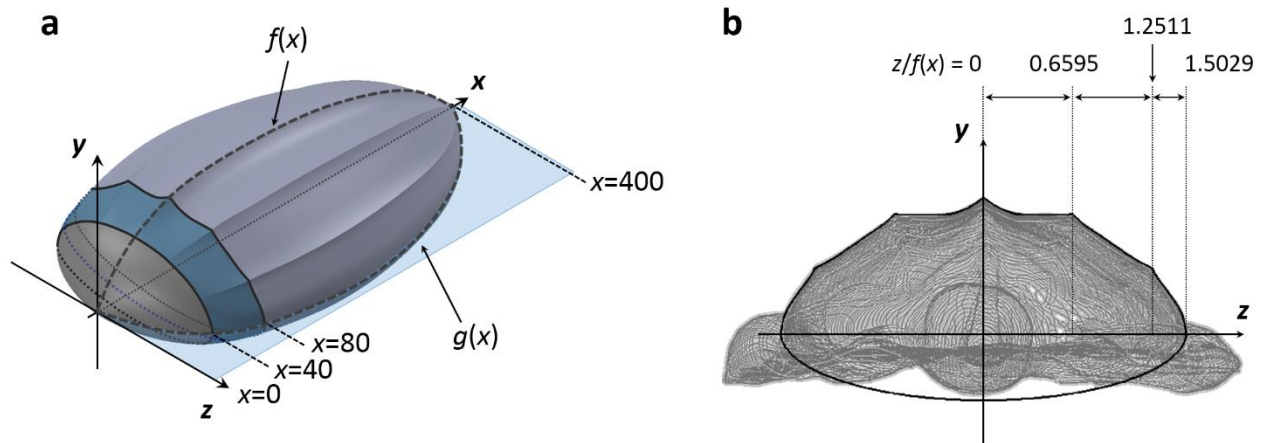
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Supplementary Figure S1 | Schematic diagrams of diving patterns and Reynolds number variation of leatherback turtles. (a) Typical diving pattern of adult leatherback turtles⁵. (b) Swimming pattern of hatchling leatherback turtles²⁶. (c) Variation of the Reynolds number in leatherback turtle swimming based on the carapace length and different stages of growth. Carapace length of hatchlings is about 24 cm at $Re = 2 \times 10^5$ ²⁶ and carapace length of adults is about 1 m at $Re = 5 \times 10^5$ ²¹. The present measurement range is drawn in dashed gray line. In (a) and (b), α is the angle of attack (i.e., the angle between the swimming direction and the body alignment), and θ is the angle between the swimming and horizontal directions. The values of θ are $20^\circ - 30^\circ$ during active ascending swimming⁵, and near 0° during vigorous swimming²⁶.

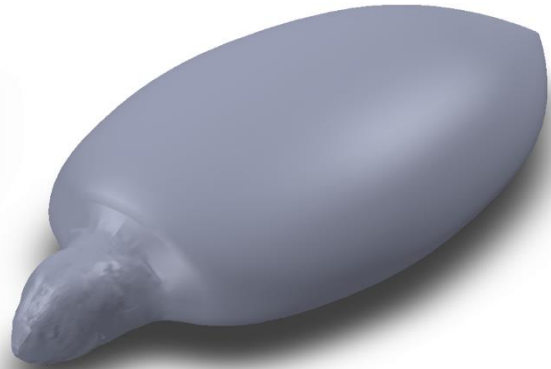


Supplementary Figure S2 | Construction of the carapace model. (a) Perspective view. (b) Cross-sectional view.

a

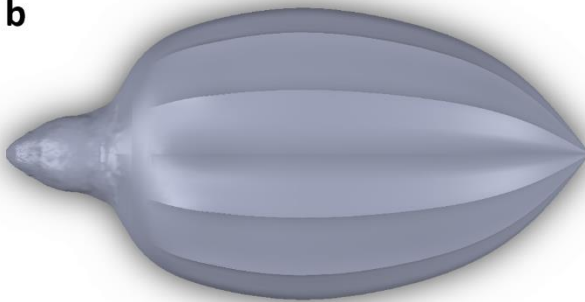


Carapace model with the head
(with the ridges)



Carapace model with the head
(without the ridges)

b

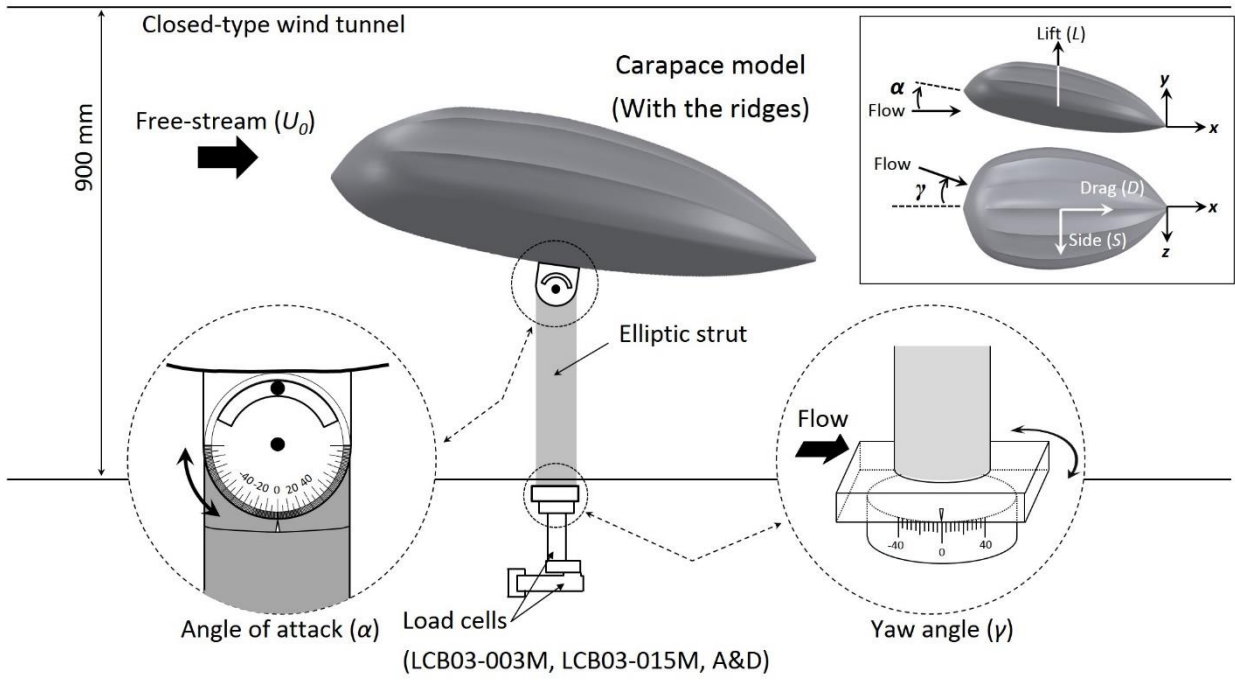


Top view

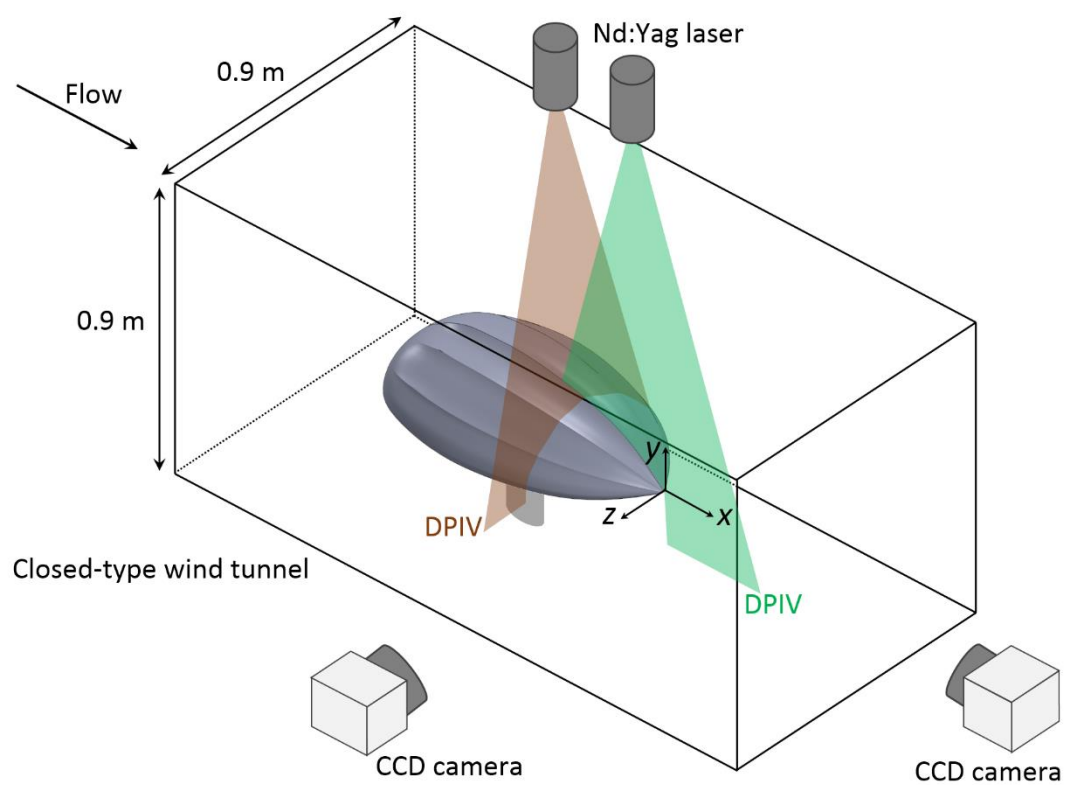


Side view

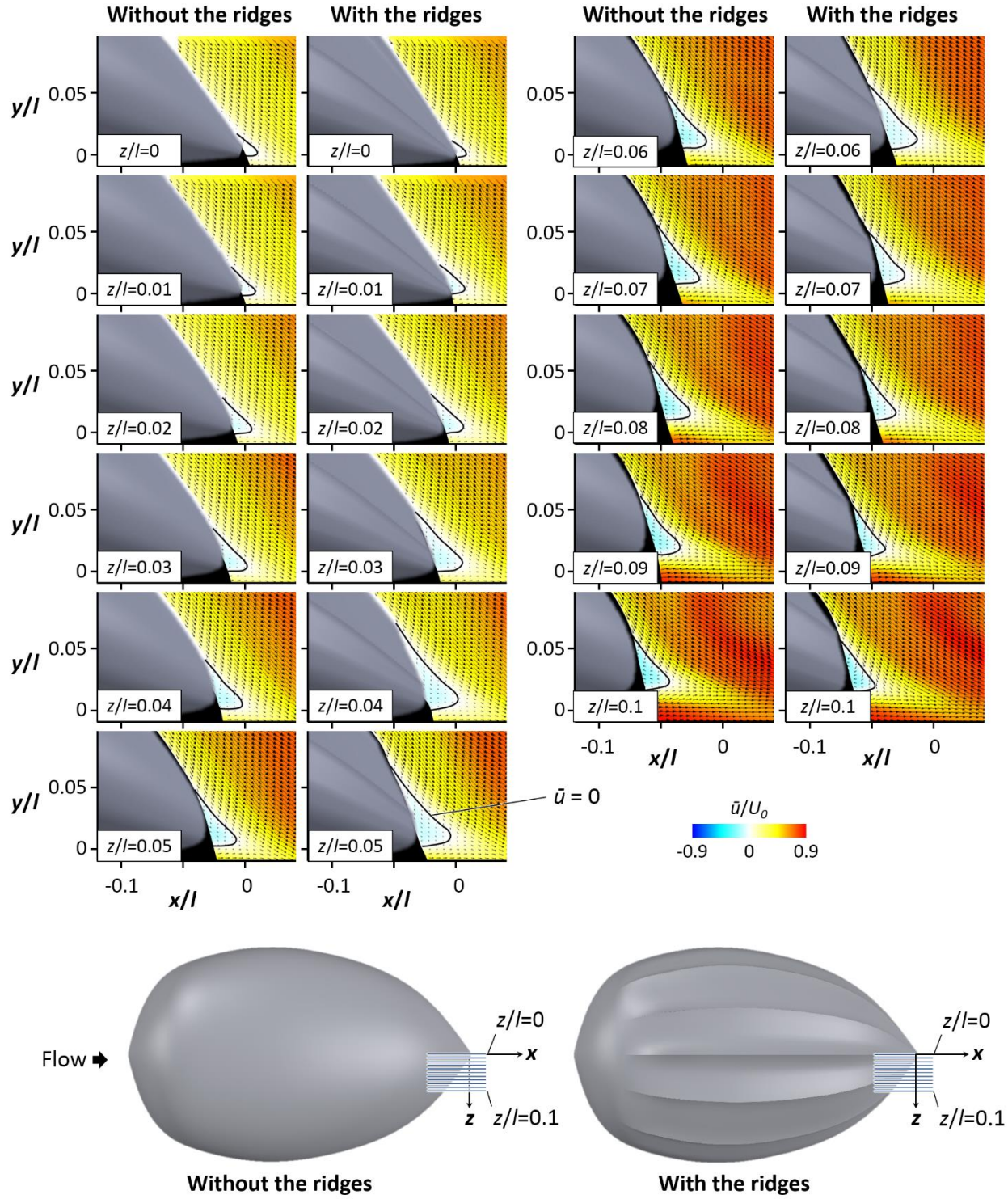
Supplementary Figure S3 | Carapace models with the head. (a) Perspective view. **(b)** Top and side views. The shape of the head was constructed based on the three-dimensional surface data of a stuffed leatherback turtle.



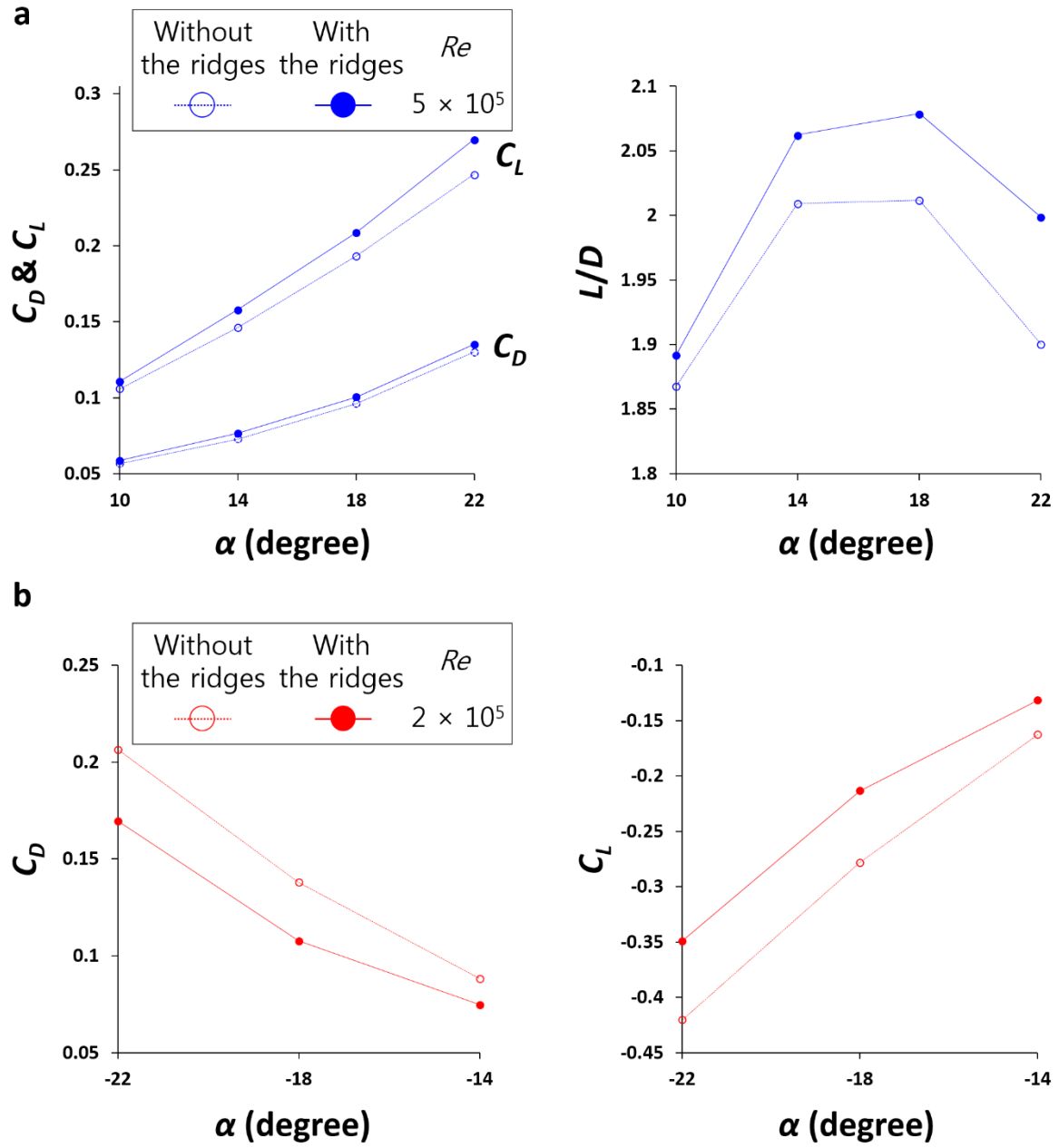
Supplementary Figure S4 | Schematic diagram of force measurements. Here, L , D , and S denote the lift, drag, and side forces, respectively, and γ is the yaw angle.



Supplementary Figure S5 | Schematic diagram of velocity measurements with DPIV.



Supplementary Figure S6 | Results from velocity measurements at $\alpha = 18^\circ$ and $Re = 5 \times 10^5$ that represents the active ascending swimming of adults ($\gamma = 0^\circ$). Contours of the time-averaged streamwise velocity and velocity vectors on x-y planes at eleven spanwise locations from $z/l = 0$ to 0.1 with increments of 0.01 . Solid black lines denote the locations where the time-averaged streamwise velocity is zero.



Supplementary Figure S7 | Force measurements on the carapace models with the head ($\gamma = 0^\circ$).
(a) Active ascending swimming of adults. **(b)** Vigorous swimming of hatchlings.