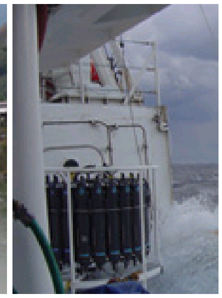

Intraspecific scaling of mass to length in pelagic animals: Ontogenetic shape change and its implications

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ABSTRACT: Intraspecific relationships between body mass (M) and length (L) are widely reported using the equation $M = aL^b$. The power term (b) holds fundamental information on how body proportions change with increasing size. A value of 3 suggests isometric enlargement, while a value < 3 describes relative elongation in shape (along the L axis) during ontogeny. We synthesize intraspecific patterns in b across a diverse range of pelagic aquatic animals. While many taxa show isometric scaling, others do not, and there is a great diversity in morphometric solutions. Salps (b = 2.37, ± 0.15, 95% confidence interval [CI]) and cephalopods (b = 2.58, ± 0.18, 95% CI), both of which locomote by jetting, radically elongating their body shape relative to other dimensions as they enlarge, while polychaetes and ctenophores (b = 2.41, ± 0.18, 95% CI) also demonstrate relative elongation. Oblate scyphozoans (b = 2.73, ± 0.10, 95% CI) and hydrozoans (b = 2.44, ± 0.32, 95% CI) increase their bell diameter at the expense of bell thickness. This will increase drag at a greater rate than isometric enlargement, but as drag-based predators this also potentially increases prey encounter rates. Fishes have a power term significantly greater than 3 (b = 3.04, ± 0.006, 95% CI). While the nauplii of copepods elongate their shape (b = 2.59 ± 0.27, 95% CI), their copepodites are isometric (b = 2.95, ± 0.16, 95% CI). Salps show distinct differences in the power term between their aggregate and solitary life stages. The implications of these patterns are explored and comparisons with benthic and terrestrial invertebrates made. This work should provide a useful reference to those undertaking mass – length analyses in future. The ontogenetic shape changes we describe should aid in the examination of theories dependent on ratios of surface area to volume and internal distribution networks, including the scaling of metabolic rates.

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