Body size allometry surface area water loss energy storage

Is mass allometry caused by body size dependent energy storage?

Through a combination of experiment and theoretical analysis of the organismal energy balance,we further show that the mass allometry is caused by body size dependent energy storage. Our results reveal the physiological origins of Kleiber's law in planarians and have general implications for understanding a fundamental scaling law in biology.

What is allometry in biology?

Nature Education Knowledge 3 (10):2 Allometry is the study of how these processes scale with body size and with each other,and the impact this has on ecology and evolution. Allometry,in its broadest sense,describes how the characteristics of living creatures change with size.

What is an example of a physiological allometry?

For physiological allometries,the slope and intercept are also important. For example,the slope of the evolutionary allometry between metabolic rate (in calories/day) and body sizeis the same in both marsupials (mammals that carry their young in a pouch) and eutherian mammals (mammals that have a placenta).

What is the difference between isometric and allometry?

How the size of a particular feature of an organism changes in relation to body size. If scaling is in proportion, it is said to be 'isometric'; allometry is negative if the trait scales less than isometry, and positive if the trait scales more than isometry. Basal metabolic rate The rate of energy use per unit time by endothermic animals at rest.

What does the slope of allometry indicate?

For ontogenetic allometry,the slope of the allometry reflects the difference in growth rate between an organ and body size. For static and evolutionary allometries it reflects how variation in trait size is accompanied by variation in body size within a species (static allometry) or between species (evolutionary allometry).

Are systemic effects responsible for allometric metabolic scaling in whole organisms?

The lack of a relationship between in vitro cellular metabolic rates and body mass suggests that systemic effects,not intrinsic cellular effects are responsible for allometric metabolic scaling observed in whole organisms.

Conversely, large body size (lower surface-area-to-volume ratio) effectively reduces heat loss, thus is favorable in cold conditions 2. Allen''s rule states that animals with longer appendages ...

The body surface is a critically important phenotype, acting as both a protective barrier and a site of energy and mass exchange between organisms and the external environment (Feder and Burggren 1985) amphibians, a permeable skin makes the body surface central to water uptake and loss, as well as the transport of respiratory gases into and out of the body (Hutchison et al. ...

If all metabolism was dependent on the cell surface-to-volume ratio of cells, then the scaling of the MR at an organismal level would be 1 under a body size increase in a lineage purely via cell number or 0.67 under a body size increase purely via cell size. Because only part of metabolism is required to maintain potentials on the ...

According to the MLBH, at high levels of resting metabolism, the scaling slope should be chiefly influenced by surface-area-related resource uptake and (or) metabolic waste (including heat) loss (thus approaching 2/3, assuming ...

The harbor porpoise model has a calculated surface area of 0.70 m 2, a volume of 0.036 m 3, and a body mass of 35 kg. The blue whale model has a surface area of 204 m 2, a volume of 144 m 3, and a body mass of 142,815 kg. These are realistic estimates for both animals based on their morphology.

The gill oxygen limitation hypothesis (GOLH) suggests that hypometric scaling of metabolic rate in fishes is a consequence of oxygen supply constraints imposed by the mismatched growth rates of gill surface area (a two-dimensional surface) and body mass (a three-dimensional volume). GOLH may, therefore, explain the size-dependent spatial distribution of ...

This means, for example, that the energy consumed by a gram of tissue during the whole life is the same irrespective of body size, and that the total numbers of heartbeats and breaths over a ...

Positive allometry occurs when morphological characters have greater growth than body size, while negative allometry is associated with lower growth of morphological characters than body size ...

Larger organisms living in hot regions find it hard to keep cool as their heat loss is relatively slow. The large animal could develop large flat ears which increases surface area, allowing them to lose more heat - elephants do this.

Uptake and elimination patterns often depend on a complex combination of factors that scale with body size including surface area to volume ratios, metabolism, ingestion rate, growth efficiency ...

Allometry--the study of proportional growth of body parts, and the relationship of body size to an organism"s morphology, physiology and behaviour--is a fundamental influencer of ecological and evolutionary diversity. Allometric studies can focus on scaling across an individual"s development (ontogenetic allometry), among individuals at the same ...

The observation that resting and cold-induced metabolic rates in both mammals and birds tend to scale as M

~2/3 further suggests that, during these physiological states, external surface area constraints on heat loss (scaling as M 2/3: Rubner 1883; Calder 1984; Reynolds 1997; White & Seymour 2005) predominate over internal surface area ...

Optimal body size must be placed in the size range for which the production rate divided by mortality rate, P(w)/m(w), where w is body mass, is concave downwards. P(w)/m(w) is ...

Animals expend energy to survive, forage, grow and reproduce, and the processes that cause variation in metabolic rate (R m) have fascinated biologists for over a century 1,2,3,4,5,6,7,8,9,10,11.R ...

First, a set of studies have argued that larger leaves are disproportionately more carbon expensive, based on the fact that the leaf area fails to keep pace with increases in leaf dry mass, at ...

Collectively these observations and those presented in Figure 2 provide strong evidence that biological regulation plays an important role in the metabolic scaling of birds and mammals, albeit in the context of body-size dependent structural constraints--i.e., surface area to volume relationships that affect body heat loss (also see [7,30,39 ...

Surface-area-to-volume ratio explained. The surface-area-to-volume ratio or surface-to-volume ratio (denoted as SA:V, SA/V, or sa/vol) is the ratio between surface area and volume of an object or collection of objects.. SA:V is an important concept in science and engineering. It is used to explain the relation between structure and function in processes occurring through the surface ...

As organisms grow and develop, all body parts may not grow proportionally. The scaling relationship between a morphological trait and the whole-body size of an organism is termed allometry (Huxley and Tessier, 1936). Adult body size in insects is a phenotypically plastic trait determined during the juvenile growth period (Koyama et al. 2013).

Numbers of prey captured by A. xanthognammica continued to follow a surface-area function. Once the largest size classes of prey can be captured, further energy intake is probably directly related to feeding surface. ... 1976). Such patterns indicate that size may be set by the difference between local energy intake and cost. The body size at ...

Moreover, differences between sexes in starvation resistance and mass loss across temperature treatments for both species could be explained by different energy use and energy storage strategies ...

Equation 2 predicts that S will scale isometrically (one-to-one) with respect to increases in M t provided that all the parameters in the bracketed expression are invariant, or a is invariant and (? h - ? nh) = 0.However, this isometric relationship is lost when four hydraulic conditions are met: (1) the rate of water flowing into any portion of the lamina, dV/dt, equals ...

They reasoned that since heat loss is proportional to body surface area, which scales as M 2/3, ... (e.g., energy-flux variability and energy-storage ability) and the size of the network . As the ... (USA) scales with negative allometry in relation to their water volume above the thermocline (b = 0.833 ± 0.100; see Figure 3), but with an ...

Arguments can be made for scaling micronutrients by either metabolic body size, body surface area, or nutrient density [16].Metabolic body size scaling is based on Kleiber''s law, the observation ...

Power Laws and Scaling Theory. David Clayton Schneider, in Quantitative Ecology (Second Edition), 2010. 16.2 The Role of Theory in Body-Size Scaling. The word allometry usually refers to a special case of allometric rescaling: the scaling of organism form or function according to body size (Gould, 1966; Calder, 1984).Allometric rescaling to body size was developed by Darcy ...

Many physiological and life-history traits correlate with body weight in interspecific comparisons. To explain these allometries, we assume that the parameters of within-species functions describing the size dependence of production and mortality rates differ between species of the same taxon and that natural selection has optimized body size through optimal allocation of ...

In many vertebrates, the absolute eye size often varies allometrically with body size-associated traits [e.g., body length (Burton, 2008), body weight (Howland et al., 2004), head size (Kirk, 2006 ...