The Relationship Between Body Mass and Basal Metabolic Rate in Non-subterranean Mammals

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**Introduction**

Mammals rely on many physiological processes to convert energy to complete everyday activities like finding food, reproducing, finding a habitat, defending their habitat, along with many others. Mammals go through an energy chain, first is the gross energy consumption which is turned into net energy which is converted into available energy for use in the mammal’s systems (Lovegrove 2003). The basal metabolic rate, which is the minimum rate of energy that is required to maintain the homeostatic level in endothermic animals, is an idle or at rest process (Mueller and Diamond 2001). In a wide variety of environments, specifically in different temperatures, Endothermic animals maintain a consistent body temperature (Naya et al. 2018). The energy processes, specifically the basal metabolic rate, are necessary for the mammal’s survival and fitness. The effective energy conversion increases longevity and decreases mortality (Lovegrove). For instance, these mammals rely on internal processes to maintain a certain body temperature regardless of the environment. If the processes were not effective, the mammal may overheat.

Basal metabolic rate can differ depending taxonomic organization, body mass, food availability, habitat, life-history, and/or temperature (Lovegrove). Understanding the variations in basal metabolic rate is beneficial for fields like ecology, evolution, and animal behavior. This understanding will aid in developing theses and to further study the fitness of mammals (Lovegrove).

In this paper, the body mass and the basal metabolic readings of 458 non-subterranean non-armored mammals were taken into consideration to test that there is positive correlation between basal metabolic rate and body mass in non-subterranean non-armored mammals.

**Methods and Materials**

**Data**

For this study, data was gathered from a study conducted by (Naya et al. 2018). The body mass measured in grams and basal metabolic rate measured in ml O2 h-1 was recorded on 458 species of mammals. All were non-subterranean meaning that they live about ground and non-armored. The selection of non-subterranean animals is most likely due to the fact that subterranean mammals usually show a lower basal metabolic rate which is considered to offset the high risks and cost of foraging (Lovegrove 2003). Also, non-armored mammals show a lower basal metabolic rate which is considered to be linked to the limited mobility of the species (Lovegrove 2003). Using the non-subterranean and non-armored mammals, the study was more effective because it studied the basal metabolic rates were not known to be low to record how body mass affects it.

We know that species are not independent of one another, in order to compare multiple species it is beneficial to use the phylogenetically corrected data. This corrected data allows the species to be viewed as independent, but on the grounds that we are assuming the traits evolved under a specific model. An example of a model is the Brownian motion where the time since the common ancestor of the species and the variation between two species is linearly proportional. I used Vertlife.org to download the phylogeny subsets for the species included in the data set.

**Regression Analysis**

To test this hypothesis, the data was analyzed through R version 4.03 GUI 1.73 Catalina to build a phylogenetic linear regression. The phylogenetic tree for the mammals included in this study has 390 tips and 389 internal nodes using read.nexus(‘output.nex”) in R. I first obtained the log10 body mass and log10 basal metabolic rate data excel sheet through the dryad database linked to the research article. In this study, I used the log10 data for both body mass and basal metabolic rate to record the individual effects to prevent skewed results based on the wide mass range. Then I used the package phytools, nlme, and RRphylo to analyze the relationship between body mass (g) and basal metabolic rate (O2 h-1).

**Results**

The figure below includes the 458 mammals, represented by each dot, placed according to their body mass which is represented on the y axis and basal metabolic rate which is represented on the x axis. Looking at Figure 1, there is in fact a positive correlation between basal metabolic rate and body mass of the mammals that were included in this study. The blue regression line that is found on the figure represents the phylogenetic correct regression line. This takes into consideration the phylogenetic nature of the species. The red line represents the non-phylogenetic data. In this study, the phylogenetic correct regression, which is represented by the blue regression line, was used to conclude the relationship between body mass and basal metabolic rate. 

Figure : Relationship between body mass (g) and basal metabolic rate (O2 h-1). For 458 small mammals.

**Discussion**

This study shows that as body mass increases the basal metabolic rate also increases in non-subterranean non-armored mammals. The mammal’s high basal metabolic rate can increase the efficiency of feeding and guarding offspring. These of which decrease mortality in young offspring which increases the parental organisms fitness (Brz k et al. 2014). Also, mammals in an enviroment that has an abundance of food have evolved a higher basal metabolic rate (Mueller and Diamond 2001). This could be due to the energy that is spent foraging and eating that when the body is at rest the basal metabolic rate must increase overtime to keep the body at the homeostatic level.

Although this study proved that there is a positive correlation between body mass and basal metabolic rate in this data set, there are outlying conditions that could skew the results. The basal metabolic rate included in this data does not take into consideration the seasonal differences. Research in specific seasons could potentially be a solution to this condition. Studying the basal metabolic rate and what affects it could help determine the fitness of the mammals, and also help determine the environment that the mammals will the most successful in.

**Works Cited**

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