

SIZE AND POWER IN MAMMALS

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Summary

The relationship between basal metabolism P and body mass M of 391 mammalian species has been analysed by least-squares regression, robust regression and covariance analyses. This relationship is a power function:

$$P = aM^b,$$

where the mass exponent b is 0.678 ± 0.007 (mean \pm s.d.) and the mass coefficient a takes different values. Theory of measurement revealed that the $2/3$ mass exponent is due to an underlying dimensional relationship between the primary quantity of mass and the secondary quantity of power.

This paper shows that the $2/3$ mass exponent is not the physiological problem of interest. It is not the slope of the metabolic regression line, but its location in the mass/power plane, that must be explained. This location is given by the value of the mass coefficient, the explanation of which is, and remains, the central question in comparative physiology.

Introduction

The relationship between body size and energy metabolism in animals has been studied for more than 150 years. In recent years there has been a renewed interest in this problem (Calder, 1984; Economos, 1983; Heusner, 1982*a,b*, 1984, 1985, 1987; Jürgens, 1989; McMahon and Bonner, 1983; Peters, 1983; Schmidt-Nielsen, 1984; Wieser, 1984).

Theoretical speculations (Sarrus and Rameaux, 1838–1839; von Hoesslin, 1888), followed by experimental and statistical studies (Rubner, 1883; Brody and Proctor, 1932; Brody, 1945; Kleiber, 1931–1932, 1947, 1961), have established that body mass M and basal metabolism P are related by a power function:

$$P = aM^b, \tag{1}$$

where a is the mass coefficient and b is the mass exponent.

Speculations about mechanisms of heat loss in mammals (Sarrus and Rameaux, 1838–1839; Rubner, 1883) or biological similitude (Economos, 1983; Gunther, 1975; Lambert and Teissier, 1927) predicted a mass exponent of $2/3$, while statistical analyses actually revealed significantly larger mass exponents of

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0.73–0.75 (Brody, 1945; Kleiber, 1961). In 1963, the Third Symposium on Energy Metabolism (Kleiber, 1965) adopted the 0.75 mass exponent for standardizing basal metabolism. A few theoretical interpretations of the 0.75 mass exponent have been proposed (McMahon, 1973; Blum, 1977). However, none has proved to be a satisfactory explanation (Calder, 1987; Heusner, 1987; Speakman, 1990).

In 1982, the validity of 0.75 mass exponent was challenged. Heusner (1982a,b) questioned the meaning of the interspecific regression line between the logarithms of body mass and basal metabolism by showing that the average values of basal metabolism in seven mammalian species do not lie on a single regression line. Bartels (1982) reported a 0.66 mass exponent for mammals whose body mass ranged from 2.5 to 380×10^6 g. A re-analysis of Bartels' data by Jürgens (1989) revealed a mass exponent b of 0.678 ± 0.017 ($N=81$). These studies also indicated that within different mass ranges b took significantly different values. For example, in small mammals b was significantly lower than in large mammals ($M < 20\,000$ g: $b = 0.602 \pm 0.031$, $N=67$; $M > 20\,000$ g: $b = 0.772 \pm 0.033$, $N=14$; $t=5.15$, $P < 0.001$). Bartels and Heusner's results suggested that the metabolic data for mammals may not lie on a single linear regression line.

Hayssen and Lacy (1985) concluded that a linear regression line did not accurately describe the relationship between the logarithms of body mass and basal metabolism in 293 mammalian species. Their overall exponent $b = 0.693 \pm 0.010$ was significantly different from 0.75 ($t=5.7$, d.f.=291, $P < 0.001$). A re-analysis of their data by Jürgens (1989) has corroborated his earlier findings in Bartels' data, i.e. in small mammals the mass exponent ($b = 0.648 \pm 0.012$, $N=275$) tended to be lower than in large mammals ($b = 0.862 \pm 0.167$, $N=18$).

Metabolic data published by Elgar and Harvey (1987) revealed the same trends: the overall mass exponent was significantly different from 0.75 ($b = 0.710 \pm 0.011$, $t=3.64$, d.f.=263, $P < 0.001$), and in small mammals the mass exponent was lower than in large mammals ($b = 0.648 \pm 0.014$, $N=234$ versus $b = 0.837 \pm 0.088$, $N=31$).

A study by McNab (1988) confirmed that in 320 mammalian species the overall mass exponent is significantly different from 0.75 ($b = 0.714 \pm 0.009$; $t=4.25$, d.f.=318, $P < 0.001$). But these data did not show a significant difference between the mass exponent in small and large mammals ($b = 0.683 \pm 0.009$, $N=297$ for small mammals; $b = 0.601 \pm 0.172$, $N=23$ for large mammals).

What general conclusions can be drawn from these four studies? In each sample, small mammals represented 83–94 % of the data points and in these animals b was not significantly different from $2/3$. Except in McNab's study, b tended to be greater in large mammals. The inclusion of a relatively small number of large mammals was sufficient to make the overall value of b significantly greater than $2/3$. These observations can be statistically explained if we assume that large and small mammals lie on different, but parallel, regression lines with slopes of $2/3$, the line for large mammals being above that for small ones. Adding a few large mammals to the small ones would then cause the sample estimate of b to be greater than $2/3$. Also, depending on the width and location of the mass range within which data points are sampled, different values of b would be observed.

The aim of this paper is to show that, indeed, small and large mammals lie on parallel regression lines with slopes of $2/3$. The physical implications of this statistical model will be discussed.

The data sample

Metabolic data for 391 mammalian species from 17 orders (Artiodactyla, Carnivora, Chiroptera, Edentata, Hyracoidea, Insectivora, Lagomorpha, Macroscelidea, Marsupialia, Monotremata, Perissodactyla, Pholidota, Primates, Proboscidea, Rodentia, Scandentia and Sirenia) have been compiled from their original sources. I verified that body mass and energy metabolism were measured on the same animals and that the data were valid estimates of basal metabolism. The data have been standardized with respect to the units. Basal metabolism is expressed in Watts (W) and body mass in g (see Appendix). On the graphs, body mass is expressed in kg, to reduce the number of digits on the mass scale.

The coordinates of each data point were the averages of measurements from the same laboratory and made on individuals of the same mammalian species. When data for the same species, but from different sources, were available, the data for which the experimental conditions most closely approximated those of basal metabolism were selected. Each mammalian species was used only once in the statistical analysis, irrespective of the actual number of individuals from which the data point was derived.

Fig. 1 shows the bilogarithmic scatter diagram of the 391 data points. Each data point represents one species.

The dashed lines intersecting the x -axis represent the lower hinge, the median and the upper hinge of the box plot of the logarithm of body mass (Chambers *et al.* 1983). These lines divide the data sample into four equally sized groups or quartiles: 25 % of the mammals in this sample are smaller than 41.4 g, 50 % are smaller than 157.8 g, 75 % are smaller than 1581 g. Within the mass range from 2.5 to 3 672 000 g there is an overwhelming predominance of small mammals: only 29 mammals or 7.4 % are larger than 20 000 g.

Least-squares regression analysis

Least-squares regression between the logarithms of body mass and basal metabolism yielded the following statistics for the 391 mammals:

(1) the sample mean vector \bar{Y}

$$\bar{Y} = [2.449074 \ 0.063162];$$

(2) the covariance matrix S

$$S = \begin{bmatrix} 1.182002 & 0.838756 \\ 0.838756 & 0.624837 \end{bmatrix};$$

(3) the mass exponent b

$$b = 0.710 \pm 0.008.$$

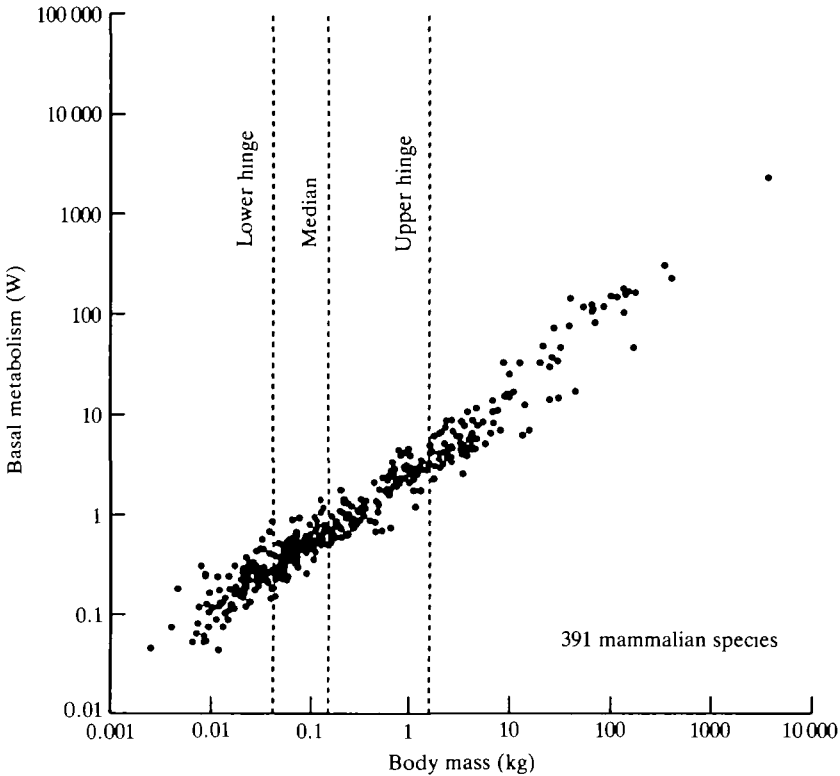


Fig. 1. Bilogarithmic scatter diagram of basal metabolism and body mass of 391 mammalian species. The vertical lines divide the data sample into four groups of equal size.

The regression was very significant: Snedecor's ratio of variances was $F=7808$, d.f. = 1, 389, $P<0.001$; the coefficient of determination was $r^2=0.952$. The mass exponent b was significantly different from 0.75 ($t=5.05$, d.f. = 389, $P<0.001$) and from $2/3$ ($t=5.37$, d.f. = 389, $P<0.001$).

In 362 small mammals ($M<20\,000$ g) the mass exponent ($b=0.663\pm 0.009$) was significantly lower than in 29 large mammals ($M>20\,000$ g: $b=0.794\pm 0.094$; $t=2.05$, $P<0.05$). Clearly, a single rectilinear regression line does not accurately describe these data.

Robust regression analysis

Subdividing the range of body mass according to arbitrary mass limits is too subjective for analyzing the relationship between body mass and basal metabolism. An objective approach is to determine how many data points within the total mass range can be accurately described by one regression line. Statistically, this amounts to the identification and regrouping of data points (outliers) whose probability of falling about the same regression line is very low ($P\leq 0.006$). The

Determination of outliers was performed by robust regression analysis (Rousseeuw and Leroy, 1987).

This technique, based on the least median of squares line (LMS line), partitioned the data sample into two groups. Group 1 consisted of 363 mammals (92.8%) within a mass range from 2.5 to 407 000 g. Their data points were randomly distributed about the LMS line with a slope of $b=0.665$ (unfortunately there was no method for estimating the error on the slope). The coefficient of determination was 0.959 and the scale estimate (or standard error of estimate) was 0.144. Group 2 consisted of 28 outliers (7.2% of the sample), 25 positive outliers (positive standardized residuals) and 3 negative outliers (negative standardized residuals). Since the leverage (Kleinbaum *et al.* 1988) of these negative outliers was small, they have been added to group 1. The positive outliers belonged to the following mammalian orders: Artiodactyla, 10 species (66%); Carnivora, 7 species (22%); Insectivora, 2 species (8%); Proboscidea, 1 species (100%) and Rodentia, 5 species (3%). The negative outliers belonged to the following orders: Chiroptera, 1 species (3%) and Insectivora, 2 species (8%).

Fig. 2 shows the data and regression lines for both groups. Least-squares

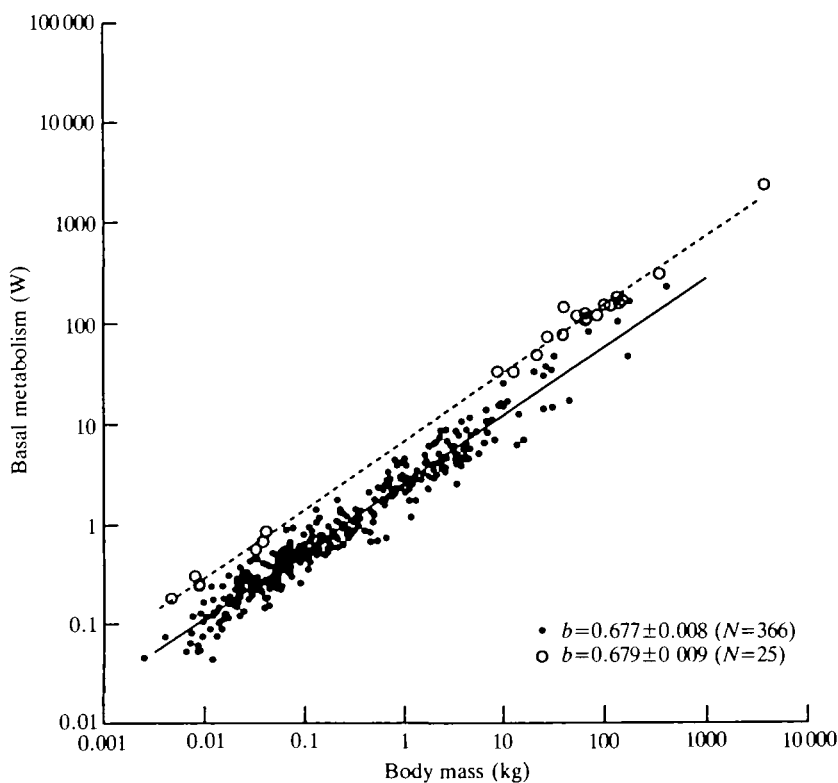


Fig. 2. Regression lines between the logarithms of basal metabolism and body mass in 391 mammalian species. The open symbols and dotted line show observations from the 25 positive 'outliers'. See text for further details.

regression analysis of group 1 yielded the following results: mass exponent $b=0.677\pm 0.008$, coefficient of determination $r^2=0.952$, standard error of estimate $s_{y|x}=0.146$, $F=7203$, d.f.=1, 364. Least-squares regression analysis of group 2 yielded the following results: $b=0.679\pm 0.009$, $r^2=0.996$, $s_{y|x}=0.077$, $F=5948$, d.f.=1, 23, $P<0.001$. In both groups, the regression was very significant; the mass exponents were not different and did not differ from $2/3$.

Covariance analysis of these two groups showed that the intragroup slope b was 0.678 ± 0.007 and the intragroup correlation coefficient r_i was 0.980. The difference in elevation of the two regression lines was very significant: $\log(a_1)=-1.623\pm 0.020$, $N=366$ and $\log(a_2)=-1.207\pm 0.037$, $N=25$, $F=182$, d.f.=1, 388, $P<0.001$.

In summary, the relationship between basal metabolism and body mass of 391 mammalian species can be accurately described by two regression lines with a common slope of $2/3$ and different intercepts.

Theoretical interpretation of the $2/3$ metabolic mass exponent

The foregoing statistical analysis has shown that a power function (equation 1) with a mass exponent of $2/3$ is a valid statistical model for describing the interspecific relationship between body mass and basal metabolism in mammals. This analysis has also shown that, contrary to common belief, the mass coefficient is not constant. Is this power function also a valid physical model – i.e. can a physical or physiological meaning be given to its parameters?

The power function or the so-called allometric equation has commonly been interpreted as revealing some kind of similitude among mammals (Gunther, 1975). In particular, the $2/3$ mass exponent has been considered to be a criterion of biological similitude (Lambert and Teissier, 1927) and the $3/4$ mass exponent a criterion of elastic similarity (McMahon, 1973). But comparative morphology clearly shows that small and large mammals are not geometrically similar. Furthermore, mammals and birds may fall on the same regression line with a slope of $2/3$. These observations call for a different explanation of the $2/3$ mass exponent.

The interspecific metabolic mass exponent of $2/3$, instead of revealing biological similitude among mammals, may very well reflect an underlying dimensional relationship between the physical quantities of mass and power. The following example from geometry illustrates this idea.

Geometry deals with three quantities: length L , surface area S , and volume V . These three quantities are dimensionally related:

$$[S] = L^2, \quad (2)$$

$$[V] = L^3, \quad (3)$$

therefore,

$$[S] = [V^{2/3}]. \quad (4)$$

The dimensional relationship (equation 4) is numerically implemented in any

given solid by relating the measures of surface area s and volume v by means of the volume coefficient c .

$$s = cv^{2/3}; \quad (5)$$

When s and v are expressed in units derived from the same unit of length ($\text{cm} \rightarrow \text{cm}^2$, $\text{cm} \rightarrow \text{cm}^3$), then c is determined by the form of the solid ($c=6$ in cubes and 4.84 in spheres). However, except for spheres, c is not form-specific, i.e. different forms may have the same value of c . Note that, depending on the values of c , the dimensional relationship (equation 4) can be numerically implemented in many different ways.

Equation 5 also expresses the relationship between volume and surface area in geometrically similar solids of different size, where changes in s and v are due only to changes in size. Equation 5 is not valid in solids that are not geometrically similar, where changes in s are also due to changes in form (c). The relationship between v and s is still a power function, but the underlying dimensional $2/3$ exponent is masked by the relationship between size and form. Now, the values of the volume exponent and volume coefficient are determined by the distribution of form within the volume range. In general, the volume exponent is different from $2/3$, with one exception – when form is randomly distributed within the volume range. In this case, the $2/3$ volume exponent does not reveal geometric similitude of the solids but the underlying dimensional relationship between the quantities of surface area and volume. The corollary of this is that the $2/3$ volume exponent is a necessary, but not sufficient, condition for geometric similitude.

This example shows that we must distinguish the dimensional relationship between quantities (equation 4) from the numerical relationship between the measures of these quantities (equation 5). We shall now apply these same principles to find the underlying dimensional relationship between the primary quantity of mass and the secondary quantity of power in the metabolic power function.

Primary quantities, such as mass M , length L and time T , are directly measurable. They have well-defined standards of measurement from which their units are derived. A secondary quantity, such as velocity ($L T^{-1}$), is a combination of the arbitrarily chosen primary quantities and has no standard.

With mass M , length L and time T as primary quantities, the dimensional equation of any secondary quantity Q is given by:

$$[Q] = M^{\alpha_1} L^{\beta_1} T^{\gamma_1}, \quad (6)$$

where the exponents α_1 , β_1 and γ_1 are the dimensions of mass, length and time, respectively (Bridgeman, 1931; Ellis, 1968). Since $\alpha_1=1$, $\beta_1=2$ and $\gamma_1=-3$ for energy metabolism, its dimensional equation is:

$$[P] = ML^2T^{-3}. \quad (7)$$

To establish the dimensional relationship between body mass M and basal metabolism P , we define a standard mammal that embodies the standards of volume, mass and time. In real, complex forms such as mammals, length and surface areas are fractals, i.e. their measure depends on the chosen units

(Mandelbrot, 1982). To avoid this complication we choose volume V , which is directly measurable, as one of the primary quantities. The period of a periodic process (cardiac or respiratory cycle) in this standard mammal is taken as the standard of time. With mass M , volume V and time T as primary quantities, the secondary quantities are then given by:

$$[Q] = M^{\alpha_2} V^{\beta_2} T^{\gamma_2}, \quad (8)$$

where α_2 , β_2 and γ_2 are the dimensions of mass, volume and time, respectively.

The dimensional equations of the secondary quantities of length, surface area and power (basal metabolism) are:

$$[L] = V^{1/3}, \quad (9)$$

$$[S] = V^{2/3}, \quad (10)$$

$$[P] = MV^{2/3}T^{-3}. \quad (11)$$

Since the standards of mass, volume and time are embodied in the same system, they, and the units that are derived from them, are linked by relationships of similitude. They cannot be independently changed. In two standard mammals which differ only in size, the following similitude relationships between their respective standards of mass (m_1, m_2), volume (v_1, v_2) and time (t_1, t_2) hold:

$$m_2 = \mu m_1, \quad (12)$$

$$v_2 = \nu v_1, \quad (13)$$

$$t_2 = \tau t_1, \quad (14)$$

where μ , ν and τ are similitude constants.

A change in a secondary quantity is then given by:

$$q_2 = q_1 \mu^{\alpha_2} \nu^{\beta_2} \tau^{\gamma_2}. \quad (15)$$

The similitude constants μ , ν and τ of the measures of M , V and T are themselves related by the following relationships. If the two standard mammals differ in size only, their density is the same. This is expressed by:

$$\nu = \mu. \quad (16)$$

Assuming that the measure of the time standard is proportional to length, then:

$$\tau = \mu^{1/3}. \quad (17)$$

Under these conditions, the relationship between the measures q_1 and q_2 of any secondary quantity is given by:

$$q_2 = q_1 \mu^{(\alpha_2 + \beta_2 + \frac{1}{3}\gamma_2)}. \quad (18)$$

Equation 18 defines a new system of units in which the dimensions of all the secondary quantities can be expressed in terms of only one primary quantity, mass. Dimensions have no intrinsic significance (Staicu, 1982). They are the result of arbitrarily chosen primary quantities. and, therefore, depend on the number and

nature of these primary quantities. Different quantities may have the same dimensional equation in the same system of units. For example, frequency and angular velocity have the same dimension T^{-1} in the M, L, T system. Flow, force and power are dimensionally equivalent ($[M^{2/3}]$) in the system based on mass alone.

The relationship between the measures of power (p_1, p_2) in two standard mammals is then:

$$p_2 = p_1 \mu^{2/3}, \quad (19)$$

which can be rewritten as:

$$p_2 = a m_2^{2/3}, \quad (20)$$

where a , the mass coefficient, is:

$$a = \frac{p_1}{m_1^{2/3}}. \quad (21)$$

Equation 20 is also the statistical model derived from regression analysis. The $2/3$ mass exponent is the dimension of the secondary quantity of power in terms of the primary quantity of mass. The $2/3$ mass exponent reveals the dimensional relationship between the units of mass and power, and not biological similitude in mammals. Indeed, with the large number of mammals, the values of the mass coefficient a tend to be randomized within the mass range. This randomization reveals the underlying, dimensional $2/3$ mass exponent.

Through the mass coefficient a , the dimensional relationship between mass and power is numerically implemented. With mass as the only primary quantity, a is dimensionless:

$$[a] = M^0; \quad (22)$$

i.e. a is mass-independent and a pure number.

Physiologically, a or the ratio $P/M^{2/3}$ is the energy spent per unit mass and per unit of the defined time scale: a is the mass-specific physiological power (Heusner, 1982*b*). The ratio $P/M^{2/3}$ is a mass-independent measure of basal metabolism (MIM, Heusner, 1985). Changes in this ratio measure the effect of metabolic factors other than mass. Animals with the same MIM lie on the same regression line. At the same body mass, these animals would have the same basal metabolism. Conversely, animals in which the MIM is different cannot have the same basal metabolism at the same body mass.

The system of units based solely on mass shows that the so-called allometric relationships are necessary consequences of the underlying dimensional relationships between mass and the various quantities that are measured in an organism and do not reveal special properties such as geometric, biological or elastic similarity in these organisms.

Conclusion

Theory of measurement reveals a necessary underlying dimensional relationship between mass and power, and statistical analysis confirms the existence of this

relationship in mammals. Statistics and the theory of measurement are both concerned with describing relationships accurately, not with providing physical explanations. An accurate description is a first and necessary step towards a physical explanation of a relationship. This paper shows that the mass exponent is not the physiological problem of interest. It is not the slope of the metabolic regression line, but its location in the mass/power plane that must be explained. This location is given by the value of the mass coefficient, the explanation of which is, and remains, the central question in comparative physiology.

Appendix

Species	M^* (g)	Bm† (W)	Source
ARTIODACTYLA			
<i>Bos taurus</i> ⁺	347 000.00	306.77	Blaxter (1966)
<i>Camelus dromedarius</i>	407 000.00	229.18	Schmidt-Nielson <i>et al.</i> (1967)
<i>Capreolus capreolus</i> ⁺	21 500.00	48.43	Weiner (1977)
<i>Cervus elaphu</i> ⁺	67 000.00	112.43	Brockway and Maloiy (1968)
<i>Connochaetes taurinus</i> ⁺	140 000.00	157.67	Taylor <i>et al.</i> (1969a)
<i>Kobus defassa ugandae</i> ⁺	100 000.00	152.04	Taylor <i>et al.</i> (1969b)
<i>Lama glama</i> ⁺	115 000.00	148.94	El-Nouty <i>et al.</i> (1978)
<i>Odocoileus virginianus</i> ⁺	65 320.00	106.67	Silver <i>et al.</i> (1969)
<i>Oreamnos americanus</i>	32 000.00	46.85	Krogh and Monson (1954)
<i>Ovis canadensis</i> ⁺	65 000.00	124.45	Chappel and Hudson (1978)
<i>Rangifer tarandus</i> ⁺	85 000.00	119.66	McEwan (1970)
<i>Sus scrofa</i>	135 000.00	104.15	Capstick and Wood (1922)
<i>Taurotragus oryx</i> ⁺	133 300.00	180.15	Taylor and Lyman (1967)
<i>Tayassu tajacu</i>	20 200.00	32.99	Zervanos (1975)
<i>Tragulus javanicus</i>	1 613.00	4.90	Whittow <i>et al.</i> (1977b)
CARNIVORA			
<i>Acinonyx jubatus</i> ⁺	39 000.00	76.86	Taylor and Rowntree (1973)
<i>Ailurus fulgens</i>	5 740.00	5.11	McNab (1988)
<i>Alopex lagopus</i>	3 600.00	7.74	Casey <i>et al.</i> (1979)
<i>Arctitis binturong</i>	14 280.00	12.54	McNab (1988)
<i>Canis latrans</i>	10 000.00	14.98	Golightly and Ohmart (1978a)
<i>Cerdocyon thous</i>	5 444.00	8.43	Hennemann <i>et al.</i> (1983)
<i>Enhydra lutris</i> ⁺	40 000.00	144.15	Iversen and Krog (1973)
<i>Fennecus zerda</i>	1 106.00	2.23	Noll-Banholzer (1979)

* M , body mass.

† Bm, basal metabolism.

⁺ Positive outliers; ⁻ negative outliers.

Species	M (g)	Bm (W)	Source
<i>Fossa fossa</i>	2260.00	5.09	McNab (1988)
<i>Genetta tigrina</i>	1700.00	4.21	Hennemann and Konecny (1980)
<i>Gulo gulo</i> ⁺	12700.00	32.90	Iversen (1972)
<i>Herpestes auropunctatus</i>	611.00	2.27	Ebisu and Whittow (1976)
<i>Herpestes sanguineus</i>	540.00	2.31	Kamau <i>et al.</i> (1979)
<i>Lutra lutra</i>	10000.00	25.34	Iversen (1972)
<i>Lycaon pictus</i> ⁺	8750.00	33.01	Iversen (1972)
<i>Martes americana</i>	1038.00	3.86	Worthen and Kilgore (1981)
<i>Martes martes</i>	920.00	4.14	Iversen (1972)
<i>Meles meles</i>	11050.00	16.80	Iversen (1972)
<i>Mustela erminea</i>	210.00	1.75	Iversen (1972)
<i>Mustela frenata</i>	225.00	1.39	Brown and Lasiewski (1972)
<i>Mustela vison</i>	660.00	2.75	Farrel and Wood (1968)
<i>Nandinia binotata</i>	4270.00	6.49	McNab (1988)
<i>Nasua nasua</i>	4000.00	5.63	Chevillard-Hugot <i>et al.</i> (1980)
<i>Paradoxurus hermaphroditus</i>	3410.00	4.03	McNab (1988)
<i>Phoca fasciata</i> ⁺	54000.00	118.59	Iversen and Krog (1973)
<i>Phoca groenlandica</i> ⁺	150000.00	168.93	Gallivan and Ronald (1981)
<i>Phoca vitulina</i> ⁺	27400.00	73.29	Hart and Irving (1959)
<i>Potos flavus</i>	2400.00	4.27	Muller and Kulzer (1977)
<i>Procyon cancrivorus</i>	1160.00	2.56	Scholander <i>et al.</i> (1950)
<i>Proteles cristatus</i>	7710.00	11.03	McNab (1984)
<i>Taxidea taxus</i>	9000.00	15.20	Harlow (1981)
<i>Vulpes macrotis</i>	1769.00	6.02	Golightly and Ohmart (1978a)

CHIROPTERA

<i>Anoura caudifer</i>	11.50	0.24	McNab (1969)
<i>Artibeus concolor</i>	19.70	0.22	McNab (1969)
<i>Artibeus jamaicensis</i>	47.00	0.30	Morrison and McNab (1967)
<i>Artibeus lituratus</i>	70.10	0.61	McNab (1969)
<i>Carollia perspicillata</i>	14.90	0.24	McNab (1969)
<i>Chrotopterus auritus</i>	96.10	0.80	McNab (1969)
<i>Cynopterus brachyotis</i>	37.00	0.26	McNab (1988)
<i>Desmodus rotundus</i>	29.40	0.20	McNab (1969)
<i>Diaemus youngi</i>	36.60	0.21	McNab (1969)
<i>Diphylla ecaudata</i>	27.80	0.22	McNab (1969)
<i>Dobsonia minor</i>	87.00	0.62	Bartholomew <i>et al.</i> (1970)
<i>Eonycteris spelaea</i>	52.00	0.27	McNab (1988)
<i>Eptesicus fuscus</i>	16.90	0.11	Herreid and Schmidt-Nielsen (1966)

Species	M (g)	Bm (W)	Source
<i>Eumops perotis</i>	56.00	0.22	Leitner (1966)
<i>Glossophaga soricina</i>	9.60	0.17	McNab (1969)
<i>Hipposideros galeritus</i>	8.50	0.05	McNab (1988)
<i>Histiotus velatus</i>	11.20	0.09	McNab (1969)
<i>Leptonycteris sanborni</i>	22.00	0.21	Carpenter and Graham (1967)
<i>Macroderma gigas</i>	148.00	0.78	Leitner and Nelson (1967)
<i>Molossus molossus</i>	15.60	0.13	McNab (1969)
<i>Myotis lucifugus</i>	6.50	0.05	Dodgen and Blood (1956)
<i>Myotis velifer</i> ⁻	11.89	0.04	Riedesel and Williams (1976)
<i>Noctilio albiventris</i>	27.00	0.18	McNab (1969)
<i>Noctilio leporinus</i>	61.00	0.40	McNab (1969)
<i>Nyctimene albiventer</i>	28.20	0.23	Bartholomew <i>et al.</i> (1970)
<i>Paranyctimene raptor</i>	21.30	0.17	Bartholomew <i>et al.</i> (1970)
<i>Phyllostomus discolor</i>	33.50	0.27	McNab (1969)
<i>Phyllostomus elongatus</i>	36.00	0.22	McNab (1969)
<i>Phyllostomus hastatus</i>	84.20	0.56	McNab (1969)
<i>Pteropus poliocephalus</i>	598.00	1.78	Bartholomew <i>et al.</i> (1964)
<i>Pteropus scapulatus</i>	362.00	1.37	Bartholomew <i>et al.</i> (1964)
<i>Rhinophylla pumilio</i>	9.50	0.10	McNab (1969)
<i>Sturnira lilium</i>	21.00	0.19	Morrison and McNab (1967)
<i>Syconycteris australis</i>	17.50	0.19	Bartholomew <i>et al.</i> (1970)
<i>Tadarida brasiliensis</i>	10.40	0.12	Herreid and Schmidt- Nielsen (1966)
<i>Tonatia bidens</i>	27.40	0.31	McNab (1969)
<i>Uroderma bilobatum</i>	16.20	0.18	McNab (1969)
<i>Vampyrops lineatus</i>	21.90	0.25	McNab (1969)

EDENTATA

<i>Bradypus variagatus</i>	3 790.00	3.86	McNab (1978b)
<i>Cabassous centralis</i>	3 810.00	4.57	McNab (1980)
<i>Chaetophractus nationi</i>	2 150.00	3.15	McNab (1980)
<i>Chaetophractus vellerosus</i>	1 110.00	1.73	McNab (1980)
<i>Chaetophractus villosus</i>	4 540.00	4.55	McNab (1980)
<i>Choloepus hoffmanni</i>	4 250.00	4.50	McNab (1978b)
<i>Dasypus novemcinctus</i>	3 320.00	4.49	McNab (1980)
<i>Euphractus sexcinctus</i>	8 190.00	6.96	McNab (1980)
<i>Myrmecophaga tridactyla</i>	30 600.00	14.65	McNab (1982)
<i>Priodontes maximus</i>	45 190.00	17.05	McNab (1980)
<i>Tamandua mexicana</i>	4 210.00	4.79	McNab (1984)
<i>Tamandua tetradactyla</i>	3 500.00	4.99	McNab (1984)
<i>Tolypeutes matacus</i>	1 160.00	1.18	McNab (1980)

Species	M (g)	Bm (W)	Source
<i>Zaedyus pichiy</i>	1 740.00	2.25	McNab (1980)
HYRACOIDEA			
<i>Dendrohyrax dorsalis</i>	2 210.00	4.18	Hildwein (1972)
<i>Heterohyrax brucei</i>	2 000.00	4.05	Taylor and Sale (1969)
<i>Procavia capensis</i>	2 400.00	3.65	Rubsamen <i>et al.</i> (1979)
<i>Procavia habessinica</i>	2 250.00	5.07	Taylor and Sale (1969)
<i>Procavia johnstoni</i>	2 750.00	6.81	Taylor and Sale (1969)
INSECTIVORA			
<i>Amblysomus hottentotus</i>	70.00	0.48	Kuyper (1979)
<i>Blarina brevicauda</i>	20.70	0.29	Platt (1974)
<i>Chrysochloris asiatica</i>	33.00	0.22	Withers (1978)
<i>Crocidura occidentalis</i>	33.16	0.25	Hildwein (1972)
<i>Crocidura russula</i>	13.70	0.15	Nagel (1977)
<i>Crocidura suaveolens</i>	7.50	0.12	Nagel (1980)
<i>Echinops telfairi</i>	116.40	0.75	Dryden <i>et al.</i> (1974)
<i>Echinorex gymnurus</i>	721.20	2.84	Whittow <i>et al.</i> (1977a)
<i>Erinaceus albiventris</i>	450.00	0.84	McNab (1980)
<i>Erinaceus europaeus</i>	2 000.00	2.91	McNab (1980)
<i>Hemiechinus auritus</i>	397.00	0.87	Shkolnik and Schmidt-Nielsen (1976)
<i>Neomys fodiens</i>	17.10	0.31	Nagel (1980)
<i>Notiosorex crawfordi</i>	4.00	0.07	Lindstedt (1980)
<i>Paraechinus aethiopicus</i>	453.00	0.68	Shkolnik and Schmidt-Nielsen (1976)
<i>Scalopus aquaticus</i>	48.00	0.38	McNab (1979)
<i>Scapanus latimanus</i>	61.00	0.43	Contreras (1983)
<i>Scapanus orarius</i>	61.20	0.35	Kenagy and Vleck (1982)
<i>Scapanus townsendi</i>	130.10	0.60	Kenagy and Vleck (1982)
<i>Setifer setosus</i> ⁻	530.00	0.69	McNab (1980)
<i>Sorex cinereus</i> ⁺	7.90	0.31	Kenagy and Vleck (1982)
<i>Sorex minutus</i> ⁺	4.60	0.18	Gebczynski (1971)
<i>Suncus etruscus</i>	2.50	0.05	Nagel (1980)
<i>Suncus murinus</i>	52.30	0.49	Dryden <i>et al.</i> (1974)
<i>Tenrec ecaudatus</i> ⁻	650.00	0.74	Hildwein (1970)
LAGOMORPHA			
<i>Lepus alleni</i>	3 362.00	8.54	Hinds (1977)
<i>Lepus arcticus</i>	3 004.40	6.09	Wang <i>et al.</i> (1973)
<i>Lepus californicus</i>	2 300.00	7.38	Schmidt-Nielsen <i>et al.</i> (1965)
<i>Ochotona daurica</i>	127.70	1.40	Weiner and Gorecki (1981)
<i>Ochotona princeps</i>	109.00	0.94	MacArthur and Wang (1973)

Species	M (g)	Bm (W)	Source
<i>Sylvilagus audubonii</i>	701.70	2.57	Hinds (1973)
MACROSCELIDEA			
<i>Elaphantalus rufescens</i>	53.00	0.32	McNab (1984)
<i>Elaphantalus edwardi</i>	49.80	0.31	Leon <i>et al.</i> (1983)
<i>Petrodromus tetradactylus</i>	210.00	0.72	McNab (1984)
MARSUPIALIA			
<i>Antechinomys spenceri</i>	24.20	0.13	MacMillen and Nelson (1969)
<i>Antechinus maculatus</i>	8.50	0.06	MacMillen and Nelson (1969)
<i>Antechinus stuartii</i>	22.10	0.19	MacMillen and Nelson (1969)
<i>Caluromys derbianus</i>	357.00	1.15	McNab (1978a)
<i>Cercartetus nanus</i>	70.00	0.34	Bartholomew and Hudson (1962)
<i>Chinorectes minimus</i>	946.00	3.09	McNab (1978a)
<i>Cyclopes didactylus</i>	240.00	0.64	McNab (1984)
<i>Dasyercus cristicaudata</i>	88.80	0.26	MacMillen and Nelson (1969)
<i>Dasyuroides byrnei</i>	89.00	0.44	MacMillen and Nelson (1969)
<i>Dasyurops Dasyurus? maculatus</i>	1782.00	3.01	MacMillen and Nelson (1969)
<i>Dasyurus geoffroii</i>	1300.00	2.82	Arnold and Shield (1970)
<i>Dasyurus viverrinus</i>	909.90	2.31	MacMillen and Nelson (1969)
<i>Dendrolagus matschiei</i>	6960.00	8.23	McNab (1988)
<i>Didelphis marsupialis</i>	1329.00	3.44	McNab (1978a)
<i>Didelphis virginiana</i>	3257.00	6.05	McNab (1978a)
<i>Echymipera kalabu</i>	695.00	1.92	Hulbert and Dawson (1974)
<i>Echymipera rufescens</i>	1276.00	3.02	Hulbert and Dawson (1974)
<i>Gymnobelideus leadbeateri</i>	166.30	0.58	Smith <i>et al.</i> (1982)
<i>Isoodon macrourus</i>	1551.00	3.23	Hulbert and Dawson (1974)
<i>Lagorchestes conspicillatu</i>	2660.00	4.79	Dawson and Bennet (1978)
<i>Lasiorhinus latifrons</i>	25000.00	14.08	Wells (1978)
<i>Lutreolina crassicaudata</i>	812.00	2.29	McNab (1978a)
<i>Macropus eugenii</i>	4796.00	7.78	Dawson and Hulbert (1970)
<i>Macropus robustus</i>	30000.00	34.46	Dawson (1973)
<i>Macrois lagotis</i>	1477.00	2.79	Kinnear and Shield (1975)
<i>Marmosa microtarsus</i>	13.00	0.13	Morrison and McNab (1962)

Species	M (g)	Bm (W)	Source
<i>Marmosa robinsoni</i>	122.00	0.55	McNab (1978a)
<i>Megaleia rufa</i>	25 000.00	30.13	Dawson (1973)
<i>Metachirus nudicaudatus</i>	336.00	1.15	McNab (1978a)
<i>Monodelphis brevicaudata</i>	111.00	0.43	McNab (1978a)
<i>Myrmecobius fasciatus</i>	480.00	1.05	McNab (1984)
<i>Perameles nasuta</i>	645.00	1.76	Hulbert and Dawson (1974)
<i>Petaurus breviceps</i>	128.10	0.50	Dawson and Hulbert (1970)
<i>Phalanger maculatus</i>	4 250.00	5.67	Dawson and Degabriele (1973)
<i>Phascogale tapotafa</i>	157.20	0.72	MacMillen and Nelson (1969)
<i>Phascolarctos cinereus</i>	4 700.00	5.72	Degabriele and Dawson (1979)
<i>Philander opossum</i>	751.00	1.90	McNab (1978a)
<i>Planigale gilesi</i>	9.40	0.07	Dawson and Wolfers (1978)
<i>Planigale ingrami</i>	7.10	0.06	Dawson and Wolfers (1978)
<i>Planigale maculata</i>	13.10	0.07	Morton and Lee (1978)
<i>Potorous tridactylus</i>	1 120.00	2.84	Nicol (1976)
<i>Pseudantechinus macdonnellensis</i>	43.10	0.15	MacMillen and Nelson (1969)
<i>Pseudocheirus occidentalis</i>	828.00	2.21	Kinnear and Shield (1975)
<i>Sarcophilus harrisii</i>	6 500.00	6.52	Nicol and Maskrey (1980)
<i>Satanellus hallucatus</i>	584.40	1.68	MacMillen and Nelson (1969)
<i>Setonyx brachyurus</i>	2 510.00	4.52	Kinnear and Shield (1975)
<i>Sminthopsis crassicaudata</i>	14.10	0.11	Dawson and Hulbert (1970)
<i>Trichosurus vulpecula</i>	1 982.00	3.52	Dawson and Hulbert (1970)
MONOTREMATA			
<i>Ornithorhynchus anatinus</i>	1 200.00	2.50	Grant and Dawson (1978)
<i>Tachyglossus aculeatus</i>	3 430.00	2.55	Dawson <i>et al.</i> (1979)
<i>Zaglossus bruijnii</i>	13 630.00	6.22	Dawson <i>et al.</i> (1979)
PERISSODACTYLA			
<i>Equus asinus</i>	177 500.00	164.92	Yousef and Dill (1969)
PHOLIDOTA			
<i>Manis crassicaudata</i>	15 910.00	6.99	McNab (1984)
<i>Manis javanica</i>	4 220.00	6.23	McNab (1984)
<i>Manis tricupis</i>	2 730.00	4.63	Hildwein (1972)

Species	M (g)	Bm (W)	Source
PRIMATES			
<i>Alouatta palliata</i>	4 670.00	11.57	Milton <i>et al.</i> (1979)
<i>Aotus trivirgatus</i>	1 020.00	2.56	Goffart (1977)
<i>Arctocebus calabarensis</i>	206.00	0.73	Hildwein (1972)
<i>Callithrix jachus</i>	190.00	0.86	Morrison and Simoes (1962)
<i>Cebuella pygmea</i>	105.00	0.55	Morrison and Middleton (1967)
<i>Cheirogaleus medius</i>	300.00	1.10	McCormick (1981)
<i>Euoticus elegantulus</i>	261.50	1.20	Hildwein (1972)
<i>Galago crassicaudatus</i>	1 039.00	2.93	Palacio (1977)
<i>Galago demidovii</i>	61.00	0.42	Hildwein (1972)
<i>Galago elegantulus</i>	261.50	1.20	Hildwein (1972)
<i>Homo sapiens</i>	70 000.00	82.78	Harris and Benedict (1919)
<i>Lemur fulvus</i>	2 330.00	4.20	Daniels (1984)
<i>Nycticebus coucang</i>	1 300.00	1.73	Muller (1979)
<i>Papio anubis</i>	9 500.00	16.05	Proppe and Gale (1970)
<i>Perodicticus potto</i>	1 011.00	2.07	Hildwein and Goffart (1975)
<i>Saguinus geoffroyi</i>	225.00	1.30	Scholander <i>et al.</i> (1950)
<i>Saimiri sciureus</i>	800.00	4.39	Stitt and Hardy (1971)
PROBOSCIDEA			
<i>Elephas maximus</i> ⁺	3 672 000.00	2 336.50	Benedict (1938)
RODENTIA			
<i>Acomys cahirinus</i>	42.00	0.26	Shkolnik and Borut (1969)
<i>Acomys russatus</i>	51.10	0.23	Shkolnik and Borut (1969)
<i>Aconaemys fuscus</i>	112.00	0.68	Contreras (1983)
<i>Agouti paca</i>	9 156.00	15.47	McNab (1988)
<i>Akodon azarae</i>	23.50	0.22	Dalby and Heath (1976)
<i>Alticola argentatus</i> ⁺	37.70	0.68	Weiner and Gorecki (1981)
<i>Ammospermophilus leucurus</i>	112.80	0.55	Kenagy and Vleck (1982)
<i>Aplodontia rufa</i>	630.00	1.56	McNab (1979)
<i>Apodemus flavicollis</i> ⁺	40.50	0.86	Fedick (1971)
<i>Arvicola richardsoni</i>	51.00	0.50	Bradley (1976)
<i>Arvicola terrestris</i>	97.50	0.64	Drozdz <i>et al.</i> (1971)
<i>Baiomys taylori</i>	7.30	0.08	Hudson (1965)
<i>Cannomys badius</i>	344.00	0.97	McNab (1979)
<i>Capromys pilorides</i>	2 630.00	3.36	McNab (1978b)
<i>Cavia porcellus</i>	728.00	2.25	Kibler <i>et al.</i> (1947)
<i>Chinchilla lanigera</i>	485.00	1.28	Kohl (1980)
<i>Citellus undulatus</i>	680.00	3.31	Casey <i>et al.</i> (1979)
<i>Clethrionomys gapperi</i>	23.00	0.26	Bradley (1976)
<i>Clethrionomys glareolus</i>	20.50	0.27	Pearson (1962)
<i>Clethrionomys rufocanus</i>	27.50	0.31	Pearson (1962)

Species	M (g)	Bm (W)	Source
<i>Clethrionomys rutilus</i>	28.00	0.43	Rosenmann <i>et al.</i> (1975)
<i>Coendou prehensilis</i>	3 280.00	5.17	McNab (1978b)
<i>Cricetus cricetus</i>	336.70	1.19	Gorecki and Wolek (1975)
<i>Cryptomys hottentotus</i>	71.00	0.38	Contreras (1983)
<i>Ctenomys fulvus</i>	300.00	1.06	Contreras (1983)
<i>Ctenomys maulinus</i>	215.00	1.05	Contreras (1983)
<i>Ctenomys peruanus</i>	490.00	1.24	McNab (1979)
<i>Cuniculus cuniculus</i>	2 000.00	6.42	Gelineo (1956)
<i>Cynomys ludovicianus</i>	1 112.30	2.40	Reinking <i>et al.</i> (1977)
<i>Dasyprocta azarae</i>	3 849.00	10.62	Arends (1985)
<i>Dasyprocta leporina</i>	2 687.00	8.78	Arends (1985)
<i>Dicrostonyx</i> <i>groenlandicus</i>	47.00	0.52	Casey <i>et al.</i> (1979)
<i>Dipodomys agilis</i>	61.00	0.36	Carpenter (1966)
<i>Dipodomys deserti</i>	107.50	0.49	Kenagy and Vleck (1982)
<i>Dipodomys merriami</i>	43.40	0.23	Kanagy and Vleck (1982)
<i>Dipodomys microps</i>	54.20	0.33	Yousef <i>et al.</i> (1974)
<i>Dipodomys ordii</i>	48.80	0.32	Kenagy and Vleck (1982)
<i>Dipodomys</i> <i>panamintinus</i>	56.90	0.38	Dawson (1955)
<i>Dipus aegyptius</i>	160.00	0.70	Kirmiz (1962)
<i>Dolichotis salincola</i>	1 613.00	4.09	Arends (1985)
<i>Epixerus wilsoni</i>	460.00	1.35	Hildwein (1972)
<i>Erithizon epixanthum</i>	6 790.00	13.76	Irving <i>et al.</i> (1955)
<i>Eutamias amoenus</i>	52.70	0.43	Kenagy and Vleck (1982)
<i>Eutamias merriami</i>	78.90	0.48	Wunder (1970)
<i>Eutamias minimus</i>	53.00	0.30	Willems and Armitage (1975)
<i>Eutamias palmeri</i>	69.40	0.64	Yousef <i>et al.</i> (1974)
<i>Funisciurus isabella</i>	60.00	0.57	Hildwein (1972)
<i>Funisciurus lemniscatus</i>	95.00	0.50	Hildwein (1972)
<i>Funisciurus mystax</i>	63.00	0.58	Hildwein (1972)
<i>Funisciurus pyrrhopus</i>	244.00	1.01	Hildwein (1972)
<i>Geomys bursarius</i>	197.00	0.78	Bradley and Yousef (1975)
<i>Geomys pinetis</i>	203.00	0.77	McNab (1966)
<i>Gis glis</i>	152.00	0.50	Gebczynski <i>et al.</i> (1972)
<i>Glaucomys volans</i>	62.80	0.37	Newman (1967)
<i>Heliophobius</i> <i>argenteocinereus</i>	88.00	0.42	McNab (1979)
<i>Heliophobius kapeti</i>	89.00	0.44	McNab (1966)
<i>Heliosciurus</i> <i>rufobrachium</i>	271.00	0.90	Hildwein (1972)
<i>Heterocephalus</i> <i>glaber</i>	39.00	0.14	McNab (1979)

Species	M (g)	Bm (W)	Source
<i>Hydrochaeris hydrochaeris</i>	26 385.00	37.14	Arends (1985)
<i>Hydromys chrysogaster</i>	900.00	2.97	Dawson and Fanning (1981)
<i>Jaculus jaculus</i>	74.50	0.52	Hooper and Hilali (1972)
<i>Jaculus orientalis</i>	139.10	0.78	Hooper and Hilali (1972)
<i>Kerodon rupestris</i>	801.00	2.03	McNab (1988)
<i>Lagostomus maximus</i>	6 804.00	10.65	Kohl (1980)
<i>Leggadina hermannsburgensi</i>	12.20	0.13	MacMillen <i>et al.</i> (1972)
<i>Lemmus sibericus</i>	70.00	0.67	Coady (1975)
<i>Lemniscomys griselda</i>	51.00	0.35	Haim (1981)
<i>Lemmus trimucronatus</i>	64.00	0.89	Casey <i>et al.</i> (1979)
<i>Lepus americanus</i>	2 100.00	6.65	Hinds (1977)
<i>Liomys irroratus</i>	48.10	0.30	Hudson and Rummel (1966)
<i>Liomys salvini</i>	43.80	0.26	Hudson and Rummel (1966)
<i>Marmota flaviventris</i>	4 294.90	8.78	Reinking <i>et al.</i> (1977)
<i>Marmota monax</i>	2 650.00	3.73	Benedict (1938)
<i>Meriones hurrianae</i>	72.30	0.30	Goyal <i>et al.</i> (1981)
<i>Meriones unguiculatus</i>	67.00	0.43	Weiner and Gorecki (1981)
<i>Mesocricetus auratus</i>	119.50	0.58	Tegowska and Gebczynski (1975)
<i>Microdipodops pallidus</i>	15.20	0.11	Bartholomew and McMillen (1961)
<i>Micromys minutus</i> ⁺	8.71	0.26	Gorecki (1971)
<i>Microtus agrestis</i>	22.30	0.38	Hansson and Grodzinski (1970)
<i>Microtus arvalis</i>	23.90	0.34	Jansky (1959)
<i>Microtus californicus</i>	44.00	0.38	Bradley (1976)
<i>Microtus longicaudus</i>	41.40	0.40	Kenagy and Vleck (1982)
<i>Microtus mexicanus</i>	28.00	0.26	Bradley (1976)
<i>Microtus minutus</i> ⁺	8.70	0.24	Gorecki (1971)
<i>Microtus montanus</i>	30.79	0.46	Packard (1968)
<i>Microtus nivalis</i>	32.80	0.46	Bienkowski and Marszalek (1974)
<i>Microtus ochrogaster</i>	51.00	0.34	Bradley (1976)
<i>Microtus oeconomus</i> ⁺	32.00	0.57	Casey <i>et al.</i> (1979)
<i>Microtus pennsylvanicus</i>	38.00	0.41	Bradley (1976)
<i>Microtus pinetorum</i>	25.00	0.28	Bradley (1976)
<i>Microtus townsendii</i>	52.20	0.48	Kenagy and Vleck (1982)
<i>Mus musculus</i>	17.00	0.16	Pearson (1947)
<i>Mus musculus alb.</i>	26.00	0.34	Hart (1950)
<i>Mustela rixosa</i>	75.00	0.93	Casey <i>et al.</i> (1979)
<i>Myoprocta acouchy</i>	914.00	2.83	Arends (1985)
<i>Napaeozapus insignis</i>	21.60	0.22	Brower and Cade (1966)

Species	M (g)	Bm (W)	Source
<i>Neotoma albigula</i>	172.40	0.72	Brown (1968)
<i>Neotoma cinerea</i>	320.90	1.41	Brown (1968)
<i>Neotoma fuscipes</i>	186.70	0.83	Lee (1963)
<i>Neotoma lepida</i>	106.00	0.36	Nelson and Yousef (1979)
<i>Notiomys macronyx</i>	62.00	0.47	Contreras (1983)
<i>Notomys alexis</i>	32.30	0.25	MacMillen and Lee (1970)
<i>Notomys cervinus</i>	34.20	0.23	MacMillen and Lee (1970)
<i>Ochrotomys nuttalli</i>	19.50	0.15	Layne and Dolan (1975)
<i>Ocodon degus</i>	206.00	1.08	Arends (1985)
<i>Octodontomys gliroides</i>	152.00	0.74	Arends (1985)
<i>Ondatra zibethicus</i>	842.00	3.89	Sherer and Wunder (1979)
<i>Onychomys torridus</i>	19.10	0.17	Whitford and Conley (1971)
<i>Oryctolagus cuniculus</i>	2350.00	8.60	Terroine and Trautman (1927)
<i>Oxymycterus roberti</i>	83.50	0.51	McNab (1984)
<i>Perognathus californicus</i>	22.00	0.12	Tucker (1965)
<i>Perognathus hispidus</i>	40.00	0.28	Wang and Hudson (1970)
<i>Perognathus intermedius</i>	14.60	0.09	Bradley <i>et al.</i> (1975)
<i>Perognathus longimembris</i>	8.90	0.05	Chew <i>et al.</i> (1967)
<i>Perognathus parvus</i>	19.20	0.16	Kenagy and Vleck (1982)
<i>Perognathus penicillatus</i>	16.00	0.13	Brower and Cade (1966)
<i>Perom leucopus noveboracensis</i>	26.00	0.32	Hart (1953)
<i>Peromyscus boylii</i>	23.20	0.31	Mazen and Rudd (1980)
<i>Peromyscus californicus</i>	48.00	0.25	McNab and Morrison (1963)
<i>Peromyscus crinitus</i>	13.60	0.10	Kenagy and Vleck (1982)
<i>Peromyscus eremicus</i>	20.70	0.15	McNab and Morrison (1963)
<i>Peromyscus floridanus</i>	30.80	0.29	Glenn (1970)
<i>Peromyscus gossypinus</i>	21.50	0.21	Glenn (1970)
<i>Peromyscus leucopus</i>	22.30	0.19	Pearson (1947)
<i>Peromyscus maniculatus</i>	17.00	0.17	Kenagy and Vleck (1982)
<i>Peromyscus megalops</i>	66.20	0.51	Musser and Shoemaker (1965)
<i>Peromyscus pirrensis</i>	137.80	0.68	Hill (1975)
<i>Peromyscus polionotus</i>	12.00	0.12	Glenn (1970)
<i>Peromyscus sitkensis</i>	28.33	0.26	Hayward (1965)
<i>Peromyscus thomasi</i>	110.80	0.70	Musser and Shoemaker (1965)
<i>Peromyscus truei</i>	33.00	0.26	McNab (1973)
<i>Phodopus sungorus</i>	33.20	0.30	Weiner and Gorecki (1981)
<i>Pitymys pinetorum</i>	25.00	0.28	Bradley (1976)
<i>Praomys natalensis</i>	41.49	0.18	Haim and le Fourie (1980)
<i>Proechimys semispinosus</i>	498.00	1.77	McNab (1982)

Species	M (g)	Bm (W)	Source
<i>Pseudomys gracilicaudatus</i>	79.80	0.47	Dawson and Dawson (1982)
<i>Rattus melta</i>	67.40	0.33	Goyal <i>et al.</i> (1981)
<i>Rattus norvegicus wild</i>	170.00	0.96	Morrison and Ryser (1951); Hart (1971)
<i>Rattus rattus</i>	117.00	0.77	Hildwein (1972)
<i>Reithrodontomys megalotis</i>	9.00	0.13	Pearson (1960)
<i>Rhabdomys pumilio</i>	39.62	0.18	Haim and le Fourie (1980)
<i>Sciurus aberti</i>	624.00	2.42	Golightly and Ohmart (1978b)
<i>Sciurus carolinensis</i>	440.00	2.08	Bolls and Perfect (1972)
<i>Scotinomys teguina</i>	12.00	0.18	Hill and Hooper (1971)
<i>Scotinomys xerampelinus</i>	15.20	0.18	Hill and Hooper (1971)
<i>Sigmodon fulviventer</i>	137.80	1.17	Bowers (1971)
<i>Sigmodon hispidus</i>	152.40	0.71	Scheck (1982)
<i>Sigmodon leucotis</i>	128.60	1.05	Bowers (1971)
<i>Sigmodon ochrognathus</i>	115.10	0.87	Bowers (1971)
<i>Spalacopus cyanus</i>	136.00	0.57	Contreras (1983)
<i>Spalax ehrenbergi</i>	128.00	0.62	Nevo and Shkolnik (1974)
<i>Spalax leucodon</i>	177.90	0.63	Gorecki and Christov (1969)
<i>Spermophilus armatus</i>	312.80	0.88	Hudson <i>et al.</i> (1972)
<i>Spermophilus beecheyi</i>	599.60	1.79	Baudinette (1972)
<i>Spermophilus beldingi</i>	288.56	0.80	Hudson <i>et al.</i> (1972)
<i>Spermophilus citellus</i>	240.00	1.28	Kayser (1939)
<i>Spermophilus franklinii</i>	607.00	2.19	Haberman and Fleharty (1971)
<i>Spermophilus lateralis</i>	270.16	0.74	Hudson <i>et al.</i> (1972)
<i>Spermophilus leucurus</i>	96.00	0.54	Hudson (1962)
<i>Spermophilus mohavensis</i>	239.50	0.63	Hudson <i>et al.</i> (1972)
<i>Spermophilus richardsoni</i>	273.07	0.74	Hudson <i>et al.</i> (1972)
<i>Spermophilus saturatus</i>	261.15	0.80	Kenagy and Vleck (1982)
<i>Spermophilus spilosoma</i>	157.80	0.50	Hudson <i>et al.</i> (1972)
<i>Spermophilus tereticaudus</i>	167.20	0.53	Hudson <i>et al.</i> (1972)
<i>Spermophilus townsendi</i>	212.52	0.60	Hudson <i>et al.</i> (1972)
<i>Spermophilus tridecemlineatus</i>	182.30	0.59	Hudson <i>et al.</i> (1972)
<i>Spermophilus undulatus</i>	1000.00	4.50	Erikson (1956)
<i>Stochomys longicaudatus</i>	82.33	0.55	Hildwein (1972)
<i>Tachyoryctes splendens</i>	234.00	0.92	McNab (1966)
<i>Tamias amoenus</i>	57.00	0.54	Jones and Wang (1976)
<i>Tamias merriami</i>	75.00	0.44	Wunder (1970)

Species	M (g)	Bm (W)	Source
<i>Tamias striatus</i>	87.40	0.51	Wang and Hudson (1971)
<i>Tamiasciurus hudsonicus</i>	224.00	1.41	Pauls (1981)
<i>Tatera indica</i>	86.80	0.43	Goyal <i>et al.</i> (1981)
<i>Thomomys bottae</i>	143.00	0.68	Vleck (1979)
<i>Thomomys talpoides</i>	82.60	0.55	Kenagy and Vleck (1982)
<i>Thomomys umbrinus</i>	95.30	0.46	Bradley <i>et al.</i> (1974)
<i>Trichomys apereoides</i>	323.00	1.16	Arends (1985)
<i>Zapus hudsonicus</i>	30.00	0.25	Morrison and Ryser (1962)

SCANDENTIA

<i>Ptilocercus lowii</i>	57.50	0.24	Whittow and Gould (1976)
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SIRENIA

<i>Trichechus inunguis</i>	170 000.00	46.91	Gallivan and Best (1980)
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