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Article *in* Functional Ecology · April 2004

DOI: 10.1111/j.0269-8463.2004.00856.x

Functional Ecology 2004
18, 257–282

FORUM

The predominance of quarter-power scaling in biology

V. M. SAVAGE,*‡† J. F. GILLOOLY,§ W. H. WOODRUFF,*‡ G. B. WEST,*‡
A. P. ALLEN,§ B. J. ENQUIST¶ and J. H. BROWN*§

**The Santa Fe Institute, 1399 Hyde Park Road., Santa Fe, NM 87501 USA, ‡Los Alamos National Laboratory, Los Alamos, NM 87545 USA, §Department of Biology, The University of New Mexico, Albuquerque, NM 87131 USA, and ¶Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721, USA*

Summary

1. Recent studies have resurrected the debate over the value for the allometric scaling exponent that relates whole-organism metabolic rate to body size. Is it $^3/_4$ or $^2/_3$? This question has been raised before and resolved in favour of $^3/_4$. Like previous ones, recent claims for a value of $^2/_3$ are based almost entirely on basal metabolic rate (BMR) in mammals.
2. Here we compile and analyse a new, larger data set for mammalian BMR. We show that interspecific variation in BMR, as well as field metabolic rates of mammals, and basal or standard metabolic rates for many other organisms, including vertebrates, invertebrates, protists and plants, all scale with exponents whose confidence intervals include $^3/_4$ and exclude $^2/_3$. Our analysis of maximal metabolic rate gives a slope that is greater than and confidence intervals that exclude both $^3/_4$ and $^2/_3$.
3. Additionally, numerous other physiological rates that are closely tied to metabolism in a wide variety of organisms, including heart and respiratory rates in mammals, scale as $M^{-1/4}$.
4. The fact that quarter-power allometric scaling is so pervasive in biology suggests that different allometric relations have a common, mechanistic origin and provides an empirical basis for theoretical models that derive these scaling exponents.

Key-words: Body size, metabolic rates, physiological times, quarter-power scaling

Functional Ecology (2004) **18**, 257–282

Introduction

Many fundamental characteristics of organisms scale with body size as power laws of the form:

$$Y = Y_0 M^b, \qquad \text{eqn 1}$$

where Y is some characteristic such as metabolic rate, stride length or life span, Y_0 is a normalization constant, M is body mass and b is the allometric scaling exponent. A longstanding puzzle in biology is why the exponent b is usually some simple multiple of $^1/_4$ rather than a multiple of $^1/_3$, as would be expected from Euclidean scaling.

Renewed interest in allometry is due at least in part to recent theories that purport to explain the quarter-power scaling (West, Brown & Enquist 1997, 1999a; Banavar, Maritan & Rinaldo 1999; Banavar *et al*. 2002). These theories derive the scaling for metabolic rate based on the designs of resource distribution networks, such as animal and plant vascular systems. In particular, the model of West *et al*. assumes that these networks have three properties: (1) they branch hierarchically to supply all parts of three dimensional organisms; (2) they have terminal units, such as capillaries or petioles, that do not vary with body size; and (3) natural selection has optimized hydrodynamic flow through the network so that the work required to distribute resources has been minimized. This model predicts many other characteristics of plant and animal circulatory systems, including dimensions of vessels, total volume of fluid, rates of flow and delivery times. This model has been extended to explain the quarter-power scaling of many biological traits, including mitochondrial densities (West, Woodruff & Brown 2002), ontogenetic growth rates (West, Brown & Enquist 2001), the partitioning and allocation of production between plant organs such as roots, stems, leaves, and reproductive structures (Enquist & Niklas 2002; Niklas & Enquist 2002), times of life-history events (Gillooly *et al*. 2002; Savage *et al*. 2004), and population growth rates (Savage *et al*. 2004).

Ever since the seminal studies of Kleiber (1932) and Brody *et al*. (1934, 1945), some biologists have questioned

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†Author to whom correspondence should be sent. E-mail: van@santafe.edu

whether the exponent for whole-organism metabolic rate really is $^3/_4$ or whether it might be $^2/_3$ as expected from Euclidean geometric scaling (Heusner 1982a,b, 1987, 1991; Kooijman 2000; Dodds, Rothman & Weitz 2001; White & Seymour 2003). These questions have focused on metabolic rate because it is such a fundamental characteristic for all organisms. It is the rate at which energy and materials are transformed within organisms and exchanged with the environment.

In the present study, we evaluate the evidence for the scaling exponents for basal metabolic rate (BMR) and other traits. We analyse three kinds of data. First, we compile and analyse a new comprehensive data set for the basal metabolic rate of mammals. Second, we present analyses of field and maximal metabolic rates for mammals, because these rates are more relevant to the normal function of free-living mammals than BMR, and we present reanalyses of data for mammalian heart and respiratory rates. Third, we perform meta-analyses (i.e. we calculate the mean and standard error) of scaling exponents reported in the literature for other biological rates and times, some of which can be measured more accurately than BMR. Finally, we identify problems with recent studies that have claimed that BMR of mammals scales as $M^{2/3}$ (at least over a limited range of M) (Dodds *et al*. 2001; White & Seymour 2003). We conclude that the evidence supports the pervasiveness of quarter-power allometric scaling in biology and, by extension, the models of West *et al*. (1997, 1999a).

Historical perspective

The idea that power laws characterize size-related variation is old and well established in biology. Rubner (1883) originally observed that metabolic rate depended on organismal body size and proposed that the relationship followed from a surface-area rule (see also Bergman 1847). In the 1920s Julian Huxley investigated the body size dependence of ontogenetic growth and other biological attributes and coined the term 'allometric equation' for equation 1 (Huxley 1932; see also Thompson 1942). In the 1930s, Brody (1934, 1945) and Kleiber (1932) independently measured the whole-organism metabolic rates of diverse kinds of birds and mammals and fitted the data with allometric equations. Their results were slightly different: Brody obtained a value of 0·73, whereas Kleiber concluded the exponent was exactly $^3/_4$. Both investigators were surprised that the value was different from $^2/_3$, because they expected that metabolic rate in endotherms would vary with heat dissipation and therefore scale with body surface area, as hypothesized by Rubner. Explaining the observed exponents established a puzzle that has challenged biologists ever since.

Subsequent studies have given similar results. In a major monograph, Hemmingsen (1960) compiled data for endothermic birds and mammals, ectothermic vertebrates and invertebrates, and unicellular prokaryotes and eukaryotes. The fitted data for each group had allometric exponents of $b \approx {}^3/_4$. Extensive research on allometry in the 1970s and early 1980s was synthesized in four influential books by Peters (1983), McMahon & Bonner (1983), Calder (1984) and Schmidt-Nielsen (1984). These volumes reviewed the empirical evidence and found that it overwhelmingly supported quarter-power scaling for BMR and numerous other attributes of organismal form, function, physiology and life history. Peters (1983) remarks, 'one cannot but wonder why the power formula, in general, and the mass exponents of $^3/_4$, $^1/_4$, and $-^1/_4$, in particular, are so effective in describing biological phenomenon.' Calder (1984) claims, 'Despite shortcomings and criticisms [including the lack of a theoretical model], empirically most of the scaling does seem to fit $M^{1/4}$ scaling …'. Schmidt-Nielsen (1984) declares that, 'It has been widely accepted that the slope of the metabolic regression line for mammals is 0·75 or very close to it, and most definitely not 0·67 (as far as the "surface rule" would suggest)', and that '… it is overwhelmingly certain that the exponent differs from 0·67 …'.

As suggested by the last quote, empirical studies forced scientists to conclude that biological allometry does not reflect simple geometric scaling. Not only does whole-organism metabolism scale as $M^{3/4}$, but mass-specific metabolic rate and most other biological rates scale as $M^{-1/4}$ (e.g. heart and respiratory rates, stride frequencies) and most biological times scale as $M^{1/4}$ (e.g. life spans, times to first reproduction, muscle twitch contraction times) (Lindstedt & Calder 1981).

So compelling was the empirical evidence for quarter-power scaling that several mechanistic theories were developed to explain it. None of these, however, were sufficiently general to account for the ubiquity of quarter-power scaling across diverse kinds of organisms and environments. McMahon proposed a theory of elastic similarity based on biomechanical adaptations to gravitational forces (McMahon 1973, 1975). While his arguments might apply to the bones of mammals or the trunks of trees, it is doubtful that they are applicable to aquatic or unicellular organisms. Blum (1977) suggested that quarter powers could be attributed to a fourth dimension, which he identified as time. He did not, however, present an explicit, testable model. Patterson (1992) developed a model based on diffusion of respiratory gases across boundary layers in aquatic organisms. Its application to terrestrial organisms has not been attempted and would be problematic. Barenblatt & Monin (1983) proposed that quarter-power scaling might reflect the fractal-like nature of biology, thereby anticipating West *et al*. (1997), but again, they did not provide a mechanistic, dynamical model.

However, quarter-power scaling has not been universally accepted. For a decade, beginning in the 1980s, Heusner presented analyses and arguments that the exponent for mammalian BMR was $^2/_3$ rather than $^3/_4$ (Heusner 1982a, 1982b). Heusner's criticisms were answered by Bartels (1982) and Feldman & McMahon

(1983) (see also Schmidt-Nielsen 1984, pp. 60–62). As a consequence, the debate subsided, the ubiquity of quarter powers was widely accepted, and there was relatively little research in allometry until the late 1990s when a series of theoretical papers appeared (West *et al.* 1997, 1999a, 2001, 2002; Enquist, Brown & West 1998; Banavar *et al.* 1999, 2002; West, Brown & Enquist 1999b; Enquist & Niklas 2001, 2002; Niklas & Enquist 2001, 2002; Gillooly *et al.* 2002; Savage *et al.* 2004).

West, Brown, Enquist and their collaborators developed detailed models for the geometry and hydrodynamics of hierarchically branched mammal and plant vascular systems that accurately predicted empirically determined allometric scaling relations for many structural and functional traits (West *et al.* 1997, 1999a). Extensions of these models predict the allometries of ontogenetic growth trajectories (West *et al.* 2001), population growth rates and other life-history attributes (Savage *et al.* 2004), variability in biomass, abundance and productivity of plant communities (Enquist *et al.* 1998; West *et al.* 1999b; Enquist & Niklas 2001, 2002; Niklas & Enquist 2001, 2002; Belgrano *et al.* 2002; Niklas, Midgely & Enquist 2003), and metabolic rates at cellular, organelle and molecular levels (West *et al.* 2002). The theory of West, Brown & Enquist and its extensions quantitatively explain and predict a large body of empirical measurements taken across broad scales for a variety of biological phenomena; this includes not only quarter-power allometric exponents but, just as importantly, details of hierarchical branching and hydrodynamic flow.

Analyses: basal metabolic rate of mammals

The debate as to whether BMR scales as $M^{3/4}$ or $M^{2/3}$ has recently been resurrected. Dodds *et al.* (2001) reanalysed Heusner's (1991) and some other existing data sets using different statistical methods and concluded that the $^{2}/_{3}$ exponent for BMR in mammals and birds cannot be statistically rejected and that over a limited range it is, in fact, favoured. White & Seymour (2003) compiled and analysed a large data set on BMR in mammals and reached similar conclusions. We argue here that there are two reasons why these studies are inadequate to address the generality of quarter- *vs* third-power allometric scaling. First, each study uses questionable, *ad hoc* methods. Second, these studies focus exclusively on the BMR of mammals and birds and ignore the large number of published empirical scaling relations for different taxonomic groups and for other traits, many of which are easier to measure accurately and are closely tied to metabolism.

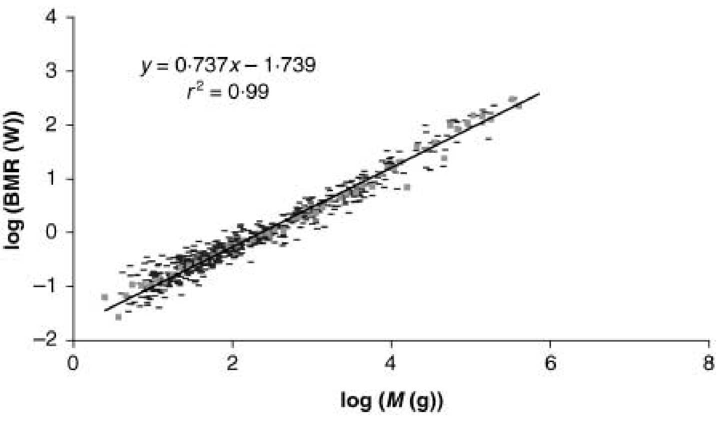

Fig. 1. Plot of the combined mammalian data sets of Hart (1971), Heusner (1991), Lovegrove (2000, 2003) and White & Seymour (2003), which yields a total of 626 species data points. The numerous bars are the raw data. The regression line is fitted to the average of the logarithms for every 0·1 log unit interval of mass, represented by the squares. Note that the slope is very close to $^{3}/_{4}$, b = 0·737 (P < 0·0001, n = 52, 95% C.I. 0·711, 0·762), and the 95% C.I. exclude $^{2}/_{3}$.

QUESTION 1: HOW DOES MAMMALIAN BMR SCALE?

Much of the interest in allometry has focused on mammalian BMR. There have been many studies, which have generated a large quantity of data, representing measurements for hundreds of species. The vast majority of these studies were designed to address specific questions about the physiology of mammals in particular environments or taxonomic groups. They were not designed to address the question of allometric scaling of BMR across all mammals. Consequently, these large compilations of data represent an opportunistic collection that may not be representative of the Class Mammalia. In addition, these data seriously violate assumptions of the parametric statistics used to fit regression lines and calculate allometric exponents (Sokal & Rohlf 1981). Two problems are especially serious. First, the vast majority of data are for small mammals (i.e. M < 1 kg) (see Fig. 1). Unless some correction is made for this imbalance, the calculated regression statistics (slope, intercept and confidence intervals) will be biased. Second, because BMR databases contain multiple values for species in certain genera or families and few or no values for other genera or families, the data are neither independent nor representative. For example, measurements for rodents are abundant and thus contribute an undue influence on the scaling of BMR.

Methods

We compiled data on mammalian BMR from the large data sets used in the previous studies of Hart (1971), Heusner (1991), Lovegrove (2000, 2003) and White & Seymour (2003). In compiling this data set we found several discrepancies between the data sets of Heusner (1991), Lovegrove (2000, 2003) and White & Seymour (2003), e.g. values that differed by an order of magnitude in mass and BMR for the same species taken from the same study. These discrepancies were the result of incorrect or changed scientific names in Heusner (1991), apparent transcription and conversion errors in Lovegrove (2000, 2003), and misplaced decimal points (e.g. the reported mass for *Ursus ursinus*) and the shifting of rows in the BMR column for the Order Chiroptera in the appendix of White & Seymour (2003). When different data sets contained significantly different values for the same species from the same study, we referred to the original source and used the values reported there. The original sources that were consulted are given in the References section and are listed by the relevant species data in Appendix 1. Moreover, there were many species whose scientific names have changed over the period spanned by these data sets, so the list was checked extensively in order to standardize the scientific names. All names were standardized according to Wilson & Reeder (1993), and consequently, some scientific names given here differ from the ones given in the original studies. We then eliminated duplicate data, i.e. values for the same species taken from the same study that appear in multiple data sets, keeping only one datum for each of these cases. Often, for the duplicate data there were slight differences between values reported in Heusner (1991), Lovegrove (2000, 2003) and White & Seymour (2003) due either to different methods of averaging or to differing procedures for rounding before and after conversions. In an attempt to further standardize the data, we took the datum from the most recent compilation when there was this sort of discrepancy.

For the corrected, non-duplicate data, there were still multiple, independent values for the same species. In previous data sets, subspecies were often listed. We did not differentiate at the subspecies level. To address multiple data for the same species we calculated an average of the logarithms for each species, resulting in values for 626 species. The complete metabolic rate data set and the species averages are listed in Appendix 1. We then divided these species data into equally spaced logarithmic mass bins of size 0·1, resulting in 52 bins; thus, a typical bin covers a mass range from M to $M + \Delta M$, where $\Delta M = 0{\cdot}1M$. All values within each bin were averaged to give a single data point for each size class. These values are also available in Appendix 2. Note that the values for M and BMR in Appendix 2 are computed from the average of the logarithms and then rounded. Then, the binned data were plotted, and since the error in the measurements of mass, corresponding to the x-axis, are much less than the error in the measurements of BMR, corresponding to the y-axis, regression lines were fitted using Ordinary Least Squares (OLS) (Type I) regression. By distributing samples uniformly with respect to mass, mass effectively becomes a treatment effect, and the regression statistics should reliably characterize the relationship between the dependent (logarithm of BMR) and independent (logarithm of M) variables. The slopes and confidence intervals represent the effects of mass on BMR.

Results

The original data for all species together with the average values for the binned data are plotted in Fig. 1. A regression line (not shown) fitted to all data gives a slope of 0·712 ($P < 0{\cdot}0001$, $n = 626$, 95% CI 0·699, 0·724). Notice that these 95% CI exclude *both* $^2/_3$ and $^3/_4$. However, this analysis is biased by the disproportionately large representation of small body sizes. For our study there are 477 species with $M < 1$ kg, leaving only 149 species with $M > 1$ kg. After accounting for this bias by binning the data as described above in order to obtain a uniform distribution, the slope is 0·737 ($P < 0{\cdot}0001$, $n = 52$, 95% CI 0·711, 0·762). The 95% CI include $^3/_4$ and exclude $^2/_3$. Thus, we find more support for an exponent of $^3/_4$ than of $^2/_3$.

QUESTION 2: HOW DO OTHER MAMMALIAN PHYSIOLOGICAL RATES SCALE?

There are two concerns in using BMR as a standard for assessing the scaling of metabolic rate and related physiological processes in mammals. First, BMR is notoriously difficult to measure according to the standard criteria. Metabolic rate is measured by a variety of techniques, including direct calorimetry, oxygen consumption and carbon dioxide production, and is known to vary with body temperature, activity and other factors (e.g. see Schmidt-Nielsen 1984 and McNab 2002). Therefore, it is difficult to ensure that individuals are in comparable physiological states, especially across the eight orders of magnitude variation in body size for mammals. Second, since BMR requires the individuals to be resting and fasting, it is not an energetic steady state and is of questionable biological relevance. At least as relevant are two other measures of metabolic rate commonly taken by physiologists. Field metabolic rate is a measure of the average rate of energy expenditure by free-living individuals under natural conditions. Maximal metabolic rate, or $V_{\mathrm{o_2,max}}$, is the rate of energy expenditure during maximum aerobic activity. While there are also problems with standardizing these rates, they represent important measures of whole-organism performance that can be used to evaluate allometric scaling. The model of West *et al.* argues that natural selection has optimized the delivery rates of resources to cells, which is relevant to all levels of activity. Indeed, one might suspect that natural selection has operated primarily on field metabolic rate, not basal. The theory predicts that the primary differences among metabolic states will be reflected in the normalization constants (intercepts), i.e. $B_{0,\mathrm{max}} > B_{0,\mathrm{field}} > B_{0,\mathrm{basal}}$, but it does not preclude differences in the exponents, especially for maximal metabolic rate.

Allometric equations have been fitted to data for many structural and functional traits that are closely related to metabolic rate. The processes of resource supply require a high level of functional integration. In particular, characteristics of the circulatory and respiratory systems must be coordinated with metabolic rate. Indeed, the model of West *et al.* predicts the scaling exponents for 32 such characteristics (see Table 1

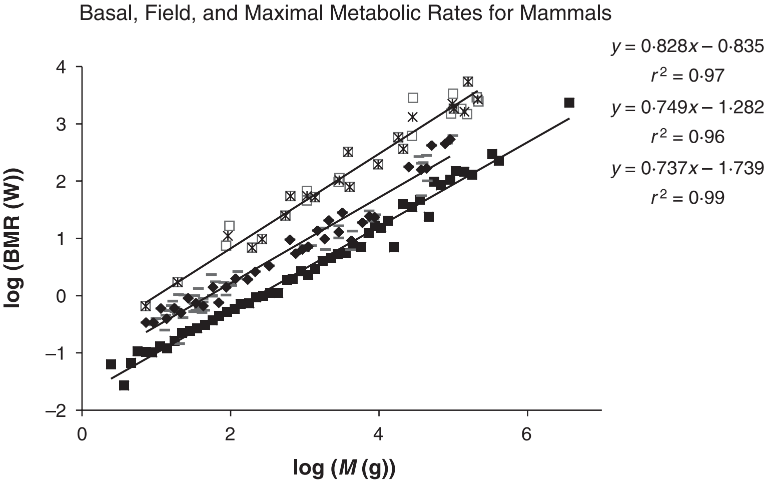

Fig. 2. Plots of the basal (Hart 1971; Heusner 1991; Lovegrove 2000; Lovegrove 2003; White & Seymour 2003), field (Nagy *et al.* 1999) and maximal metabolic rates (Pasquis *et al.* 1970; Hart 1971; Lechner 1978; Prothero 1979; Taylor *et al.* 1981; Taylor *et al.* 1988; Bishop 1999; Sapoval *et al.* 2002). The regression lines are fitted to the average of the logarithms for every 0·1 log unit interval of mass. This was done in order to give equal weighting to big and small mammals. For the basal metabolic rate only the averages are shown because the raw data is shown in Fig. 1. Both raw and averaged data for basal metabolic rate are shown in Fig. 1, but here only the averages (filled squares) are shown. For the field and maximal data, diamonds and stars are the average data, and bars and open squares are the raw data, respectively. While the slope for the maximal metabolic rate is slightly higher than that for the field or basal rates, all of the slopes are close to $^3/_4$. The slope for basal is $b = 0{\cdot}737$ ($P < 0{\cdot}0001$, $n = 52$, 95% CI 0·711, 0·762), for field is 0·749 ($P < 0{\cdot}0001$, $n = 35$, 95% CI 0·697, 0·801), and for maximal is 0·828 ($P < 0{\cdot}0001$, $n = 21$, 95% CI 0·758, 0·897).

in West *et al.* 1997), many of which can be measured more accurately than metabolic rate. In particular, heart and respiratory rates, which are predicted to scale as $M^{-1/4}$, have been measured in a variety of mammals. Consequently, analyses of these rates provide additional strong tests of the theory.

Methods

Data for field metabolic rates were taken from Nagy, Girard & Brown (1999). Data for maximal metabolic rates were compiled from multiple sources (Pasquis, Lacaise & Dejours 1970; Hart 1971; Lechner 1978; Prothero 1979; Taylor *et al.* 1981; Taylor, Longworth & Hoppeler 1988; Bishop 1999; Sapoval, Filoche & Weibel 2002). We processed the maximal metabolic rate compilations in the same way as the BMR compilations. That is, duplicate data were identified in the maximal metabolic rate compilations, and only one datum was kept in each case. Then, for the non-duplicate data, we computed an average for each species. For both field and maximal metabolic rates, as for BMR, we divided the data into body size bins, calculated an average for each bin, and performed an OLS regression analysis on the averaged data. Data for heart rates are from Brody (1945), and we quote a reported value for the exponent for heart rates from Stahl (1967). Respiratory rates are taken from Calder (1968). Once again, we binned, averaged and calculated OLS regression statistics.

Results

In Fig. 2 we present the data for basal, field and maximal metabolic rates. The slopes of the regression lines for binned data for basal, field and maximal metabolic rates are 0·737 ($P < 0{\cdot}01$, $n = 52$, 95% CI 0·711, 0·762), 0·749 ($P < 0{\cdot}0001$, $n = 35$, 95% CI 0·695, 0·802) and 0·828 ($P < 0{\cdot}0001$, $n = 21$, 95% CI 0·758, 0·897), respectively. The 95% CI for the exponents of basal and field metabolic rates include $^3/_4$, while for maximal metabolic rate they exclude $^3/_4$. The slope of the binned data for field metabolic rates is almost exactly $^3/_4$ and very similar to that calculated by Nagy, Girard & Brown who treated each of the 79 species as an independent data point: 0·749 *vs* 0·744, respectively. The slope of the binned data for maximal metabolic rates is slightly higher than that obtained for the original unbinned data ($n = 28$): 0·828 *vs* 0·811. As expected, the normalization constants (intercepts) are different for the three metabolic states: at 1 kg the maximal rates from the regression equation are five times field rates and field rates are three times basal rates. We conclude that field and basal metabolic rates scale similarly with exponents very close to $^3/_4$.

The exponent for maximal metabolic rates is greater than $^3/_4$. Perhaps this can be explained by selection of species or methodological differences in addition to small sample size. Alternatively, it may well reflect a fundamental difference in the scaling of this process, perhaps due to vascular and respiratory adjustments, not operable under either field or basal conditions, that support maximal activity of the muscles used in exercise. Clearly, maximal metabolic rate does not scale as $M^{2/3}$. This is especially relevant for considerations of surface area and heat dissipation because maximal metabolic rate maximizes heat production.

In Fig. 3 we plot the data for mammalian heart and respiratory rates. After binning, the slope for the heart rate is –0·251 ($P < 0{\cdot}0001$, $n = 17$, 95% CI –0·218, –0·285), based on 26 species. Although Stahl (1967) does not give his original data, he reported that mammalian heart rate scales exactly as –0·25 (95% CI –0·23, –0·27). The slope for respiratory rate is –0·256 ($P < 0{\cdot}0001$, $n = 18$, 95% CI –0·187, –0·320), based on 22 species. All of these exponents are almost exactly $-^1/_4$ and are statistically different from $-^1/_3$.

QUESTION 3: HOW DO METABOLIC RATES IN OTHER ORGANISMS SCALE? HOW DO OTHER BIOLOGICAL RATES AND TIMES SCALE?

Seemingly lost in the detailed discussions and analyses of mammalian metabolic rates are the extensive data for other allometric scaling relations. Metabolic rates have been measured and scaling exponents have been calculated for many groups of organisms in addition to mammals. The theory of West *et al.* (1997) predicts, and previous empirical studies suggest, that whole-organism metabolic rates in these other groups also

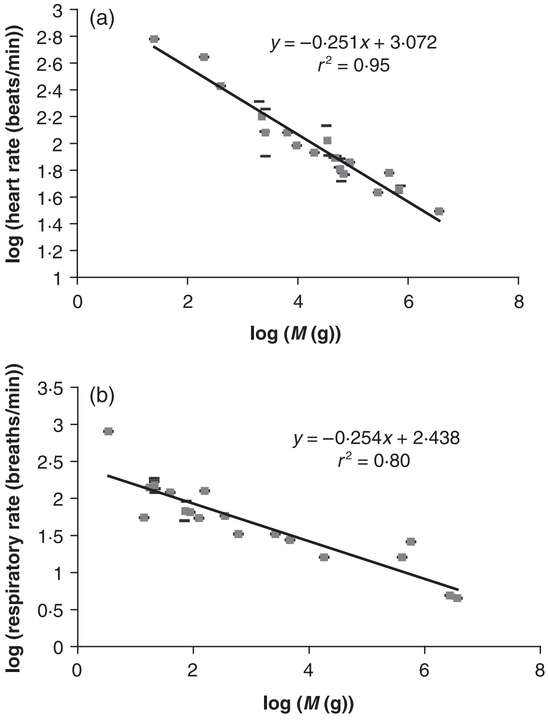

Fig. 3. Plot of (a) heart rates (Brody 1945) and (b) respiratory rates of mammals at rest (Calder 1968). The regression lines are fitted to the average of the logarithms for every 0·1 log unit interval of mass, but both the average (squares) and raw data (bars) are shown in the plots. Both slopes clearly include $-^{1}/_{4}$ and exclude $-^{1}/_{3}$, for heart rate the slope is −0·251 ($P < 0{\cdot}0001$, $n = 17$, 95% CI −0·221, −0·281) and for respiratory rate −0·256 ($P < 0{\cdot}0001$, $n = 18$, 95% CI −0·194, −0·318).

scale as $M^{3/4}$. In addition, extensions and applications of the theory predict that mass-specific metabolic rates and most other biological rates scale as $M^{-1/4}$, and biological times, which are the inverse of rates, scale as $M^{1/4}$. Although largely overlooked in recent work, the seminal treatments of biological allometry (McMahon & Bonner 1983; Peters 1983; Calder 1984; Schmidt-Nielsen 1984) had reached similar conclusions by the 1980s. Recent studies have shown that these allometric equations also apply to both unicellular algae and higher plants – including both gymnosperms and angiosperms (Enquist *et al.* 1998; West *et al.* 1999b; Enquist & Niklas 2001; Niklas & Enquist 2001; Enquist & Niklas 2002; Niklas & Enquist 2002). For example, both whole plant rates of biomass production and whole plant chlorophyll content scale as $M^{3/4}$ (Niklas 1994). Further, intraspecific rates of production for 45 species of tropical trees scale with exponents indistinguishable from the predicted $M^{3/4}$ scaling of metabolism (Enquist *et al.* 1999).

Methods

The four books by McMahon & Bonner (1983), Peters (1983), Calder (1984) and Schmidt-Nielsen (1984) in the 1980s still contain the most comprehensive treatments of biological allometry, including compilations of allometric equations for many different traits and taxonomic groups. We present meta-analyses of these data by compiling the allometric scaling exponents in histograms and by calculating the average and standard error for each histogram. Data for whole organism and mass-specific biological rates are from Peters (1983), and for biological times are from Lindstedt & Calder (1981). We also present the results of a recent compilation of rates of annual biomass production for numerous groups of plants and animals as compiled by Ernest *et al.* (2003).

Further, we reanalyse data on whole plant xylem flow from Enquist *et al.* (1998). Xylem flow is directly related to plant metabolic rate due to the stoichiometry of photosynthesis and respiration. When these data were collected (in litres of fluid transported vertically through the plant per day), xylem flux was measured in relation to stem diameter. To facilitate comparison with allometric equations for animals, we converted stem diameter, D (in cm), to above-ground plant mass, M (in g), using the empirical relationship $M = 124D^{2{\cdot}53}$, as outlined by Enquist & Niklas (2001). This relation of diameter to mass is well supported both theoretically and empirically (West *et al.* 1999b; Enquist 2002). We then divided the data into biomass bins, calculated an average for each bin, and performed a Reduced Major Axis (RMA) regression on the averaged data. Since the biomass is only an estimate, there are larger errors in the mass data than for the other plots in this paper. Furthermore, the errors for the masses are now comparable to the errors in measurement for the whole plant xylem flow, resulting in comparable errors for the variables on the x and y-axes of our plot. Consequently, reduced major axis (RMA) regression was used to fit these data (Niklas 1994).

Results

Exponents of whole-organism biological rates are plotted in Fig. 4. These data (see also Fig. 4.1 in Peters 1983) show a distinct mean and mode at $^{3}/_{4}$ and not at $^{2}/_{3}$ ($\bar{b} = 0{\cdot}749 \pm 0{\cdot}007$, SE). These data are for metabolic and other biological rates, e.g. feeding and defecation rates, and include values for a wide variety of organisms, including insects, crustaceans, mollusks, nematodes, cnidarians, porifera, algae, protists and all classes of vertebrates; they include freshwater, marine and terrestrial organisms.

There is considerable variation around $^{3}/_{4}$. This is understandable because there are many uncontrolled sources of variation (e.g. sample size, range of variation in mass, experimental methods). Peters includes all studies that met minimal criteria, and we used all of his data.

Figure 4 shows a similar histogram for exponents of mass-specific metabolic rates and other related biological rates. Values clustered around $-^{1}/_{4}$ ($\bar{b} = -0{\cdot}247 \pm 0{\cdot}011$, SE). Figure 4 also contains a histogram for exponents of biological times, from muscle contractions to

Table 1. Regression statistics for annual biomass production and population-level energy use. The group 'animals' includes mammals, birds, fish, zooplankton, insects and the protist *Paraphysomonas imperforata*. Data from Ernest *et al.* (2003)

Group	Spp. no.	Scaling exponent	95% CI	Normalization constant	95% CI	r^2
Production						
Plants	387	0·759	0·76–0·75	10·15	10·18–10·12	0·995
Mammals	305	0·755	0·78–0·73	10·25	10·29–10·21	0·910
Birds	33	0·740	0·85–0·63	10·66	10·79–10·53	0·858
Fish	9	0·761	0·84–0·68	10·85	11·03–10·67	0·984
Animals	361	0·719	0·74–0·70	10·30	10·34–10·26	0·934

life spans. Values cluster closely around $^{1}/_{4}$ ($\bar{b} = 0·250 \pm 0·011$, SE).

A summary of regression statistics from Ernest *et al.* (2003) for annual biomass production across multiple plant and animal taxa are listed in Table 1. The fitted exponents for plants, mammals, birds and fish are statistically indistinguishable from $^{3}/_{4}$ and, apart from birds, have 95% CI that exclude $^{2}/_{3}$.

Figure 5 plots xylem flow rate as a function of plant mass. The RMA regression line fitted to the binned data gives an exponent of 0·736 ($P < 0·0001$, $n = 31$, 95% CI 0·647, 0·825). The regression fitted to the entire unbinned data set gives a similar exponent of 0·735 ($P < 0·0001$, $n = 69$, 95% CI 0·682, 0·788). The exponent for the binned data has confidence intervals that include both $^{3}/_{4}$ and $^{2}/_{3}$, while that for the unbinned data includes only $^{3}/_{4}$.

Discussion

The results shown above raise the question: How is it that two recent studies reach the conclusion that mammalian BMR scales closer to $M^{2/3}$ than to $M^{3/4}$? This is especially puzzling because both of these studies and our analyses use much of the same data, including data compiled by Heusner (1991). The discrepancies in the exponent for mammalian BMR obviously depend on the methods of analysis. We now address these issues.

Two issues are particularly relevant. The first is whether the data points can be considered statistically independent, because the species differ in phylogenetic relatedness and closely related species tend to be more similar in body size, metabolic rate and most other biological attributes (Harvey & Pagel 1991). The second issue is that the available data for mammalian BMR are overly weighted towards species of small size. Binning the data according to intervals of logarithmic mass as described above is a reasonable but perhaps not ideal method for addressing both of these problems. By definition, it gives each size class equal weight. This prevents any size class from having an undue effect on the value of b. Moreover, because closely related species are almost always similar in size, it also prevents phylogenetic relatedness from having an undue influence. The effect of size on a function such as metabolic rate is best resolved by comparisons among species that differ in mass by several orders of magnitude, which means that the species compared are almost always distantly related.

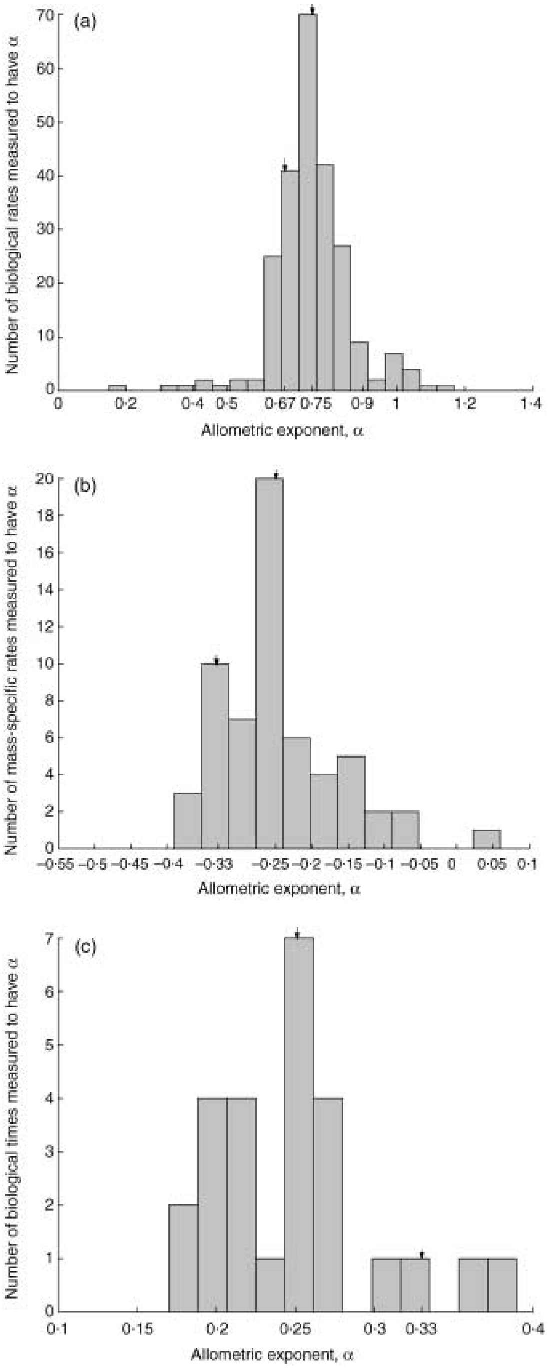

Fig. 4. Histograms of the exponents of (a) biological rates (Peters 1983), (b) mass-specific biological rates (Peters 1983) and (c) biological times (Lindstedt & Calder 1981). At the top of each histogram, arrows are placed to identify the positions of the relevant third- and quarter-power exponents. Note that the peak of the histogram for biological rates is near 0·75, not 0·67 ($\bar{b} = 0·749 \pm 0·007$). Moreover, the histogram for mass-specific rates peaks near −0·25, not −0·33 ($\bar{b} = -0·247 \pm 0·011$), and the histogram for biological times peaks at 0·25, not 0·33 ($\bar{b} = 0·250 \pm 0·011$). All errors quoted here are the standard error from the mean for the distribution. Therefore, in all cases, the majority of biological rates and times exhibit quarter-power, not third-power, scaling.

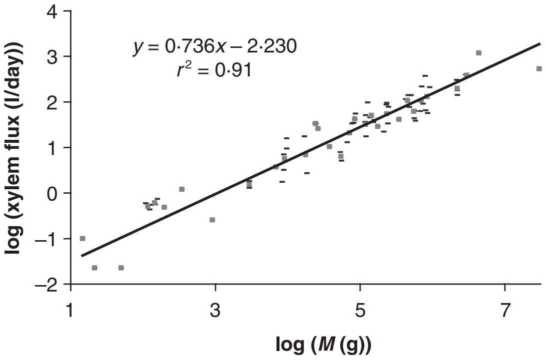

Fig. 5. Plot of maximum reported xylem flux rates (litres of fluid transported vertically through a plant stem per day) for plants from Enquist *et al.* (1998). The RMA regression line is fitted to the average of the logarithm for every 0·1 log unit interval of plant biomass, but both the average (squares) and raw data (bars) are shown in the plot. The slope is 0·736 ($P < 0{\cdot}0001$, $n = 31$, 95% CI 0·647, 0·825).

Both of these issues arise in the recent work by Dodds *et al.* (2001) and White & Seymour (2003). Dodds *et al.* (2001) ignore phylogeny, even to the point of combining passerines and non-passerines to calculate a single allometric equation for all birds. In this case, there is an *a priori* basis, supported by phylogenetic analyses, for subdividing the data into two groups of birds (Garland & Ives 2000). The passerines, which constitute about half of existing bird species, are a monophyletic lineage that resulted from an extensive and separate radiation during the Tertiary (Garland & Ives 2000). Additionally, since the work of Lasiewski & Dawson (1967) in the 1960s, physiologists have recognized that when analysed separately, the two groups have very similar exponents (e.g. 0·72–0·75). The normalization constant, however, is higher for passerines than non-passerines (Lasiewski & Dawson 1967). Since the majority of passerines are smaller than non-passerines, the effect of combining the two groups is to reduce the apparent value of the exponent. The higher normalization constant for passerines is probably due in part to their slightly but consistently higher body temperatures. White & Seymour (2003) addressed the issue of phylogeny by calculating average values of the logarithms of mammalian body size and BMR for each taxonomic level: species, genus, family and order, and then fitted regression equations for each level. This is questionable for several reasons, including greatly reducing the sample size (from 619 data points (590 species after subspecies are removed and all scientific names are standardized) to 17 orders) and total range of variation in mass (by about an order of magnitude). The latter practice artefactually reduces the calculated value of the OLS regression slope, and hence underestimates the exponent (Pagel & Harvey 1988; Harvey & Pagel 1991).

Dodds *et al.* (2001) recognized there was a preponderance of data for small mammals and a curvilinearity across the entire body size range shown in our Fig. 1. They addressed this issue by calculating regression equations after progressively eliminating data for all species above some threshold body size. As the size threshold was reduced, they found a systematic decrease in the exponent, with an apparent break at $M \sim 10$ kg and $b \sim 2/3$ below this threshold. For $M > 10$ kg the CI included $3/4$, and for $M < 10$ kg the CI did not include $3/4$ and closely approached $2/3$. White & Seymour's (2003) compilation, while quite accurate and extensive, does not contain some of the data available for the largest mammals. Consequently, their data set and analysis are even more strongly biased by the values for small mammals.

The original paper by West *et al.* (1997), which derives a model for the mammalian arterial system, predicts that smaller mammals should show consistent deviations in the direction of higher metabolic rates than expected from $M^{3/4}$ scaling. Thus, metabolic scaling relationships are predicted to show a slight curvilinearity at the smallest size range. Therefore, fitting a regression through an allometric metabolic rate data set that samples a disproportionate number of small mammals will artificially give a slightly shallower slope. Prior to Dodds *et al.* (2001), Bartels (1982) found that above a threshold of 260 g, BMR data was best fit with an exponent of 0·76, and that below this threshold, the exponent was less than $2/3$ or $3/4$. Additionally, Calder (1984) noted that the smallest birds (hummingbirds) and mammals (shrews) have BMRs that are consistently above the predictions from allometry. Both Dodds *et al.* (2001) and White & Seymour (2003) ignore this prediction of the West *et al.* model. Ironically, the apparent deviation from $3/4$ for small mass is therefore supportive of the West *et al.* (1997) model.

In addition to these statistical issues, White & Seymour (2003) use two biological arguments to adjust or exclude data. First, as shown in Gillooly *et al.* (2001), variation in body temperature may cause significant variation in BMR. White & Seymour (2003) find a weak but significant correlation between body temperature and size in mammals:

$$T_b = 35{\cdot}8 + 0{\cdot}21 \log \mathrm{M}. \qquad \text{eqn 2}$$

They corrected their BMR data to a constant body temperature using a Q_{10} factor. Second, White & Seymour (2003) eliminated data for entire taxonomic groups (artiodactyls, macropodid marsupials, lagomorphs and shrews) because these data may not meet the strict criteria required for BMR. After using these two procedures, they found that the temperature-adjusted BMR for the remaining species or orders scaled approximately as $M^{2/3}$.

We can explicitly calculate the influence of body temperature on the scaling exponent. Substituting equation 2 into a Q_{10} factor, we derive that

$$b_{\text{measured}} = b_{\text{actual}} + 0{\cdot}02,$$

where b_{measured} is the value of b that is measured when no correction has been made for temperature. Note that this agrees exactly with the difference between 0·69 and 0·67 shown in Fig. 2(a)–(b) in White & Seymour (2003). Since the difference between exponents of $^2/_3$ and $^3/_4$ is 0·08, variation in body temperature among mammals must play a minor role in determining whether the exponent is $^2/_3$ or $^3/_4$. Additionally, by excluding certain taxa from their analysis, White & Seymour (2003) eliminate most of the smallest and largest mammals from their data set. This reduces the original 5·5 orders of magnitude variation in mass to 4·5 at the species level and to only 2·5 at the order level. Regardless of the problems of meeting the strict criteria for BMR, the exclusion of so much data clearly affects the ability to fit a power law that is representative of all mammals.

By comparing the analyses of Dodds *et al.* (2001) and White & Seymour (2003) with ours, it is obvious that values of b ranging from $^2/_3$ to $^3/_4$ can be obtained from data on mammalian BMR, depending on which data are included and how they are analysed. Our analyses and meta-analyses provide strong support for an exponent of $^3/_4$. Theoretical work also supports this value. Detailed mechanistic models of mammal and plant vascular systems both predict this scaling (West *et al.* 1997, 1999a; Banavar *et al.* 1999; Banavar *et al.* 2002). This is noteworthy because of the major differences between the mammal and plant systems: pulsatile *vs* smooth flow, and a few large tubes branching into multiple smaller ones *vs* a constant number of microcapillary tubes diverging in bundles at branch points. Conversely, there are no dynamic, mechanistic models to explain why the exponent should be $^2/_3$ in all organisms. Historically, Euclidean $^2/_3$ scaling was expected due to surface area to volume relations. A physical argument is that endothermic mammals and birds maintain a constant body temperature by varying metabolic heat production to match heat loss to the environment (see Bergmann 1847 and discussion in Schmidt-Nielsen 1972). If heat dissipation is some simple function of skin surface area, A (i.e. emissivity and conductivity are assumed not to change with size), one might expect that $B \propto A \propto M^{2/3}$. This argument lost most of its support, however, when research on endotherms showed that thermal balance is maintained by actively regulating heat exchange through changes in posture, fur and feather insulation, blood flow to peripheral tissues, and through evaporative cooling by sweating and panting, e.g. see McNab (2002).

The idea that biological allometries scale with quarter powers of body mass now rests on a strong theoretical and empirical foundation. Long before the recent surge of renewed interest in allometry, it was well established that the scaling exponents are much closer to quarters than to thirds. The extensive data compiled here, along with the new analyses, provide still further support. The evidence for quarter-power scaling is based not only on mammalian BMR, but also on a wide variety of biological rates and times in a multitude of organisms, from microbes to plants to mammals.

Peters (1983) summarized this when he wrote, ‘The surface law has a number of disadvantages when used to explain the $M^{2/3}$ law. … Nevertheless, the simplicity of the surface law as an explanation proved so attractive that over a century of science was distorted by trying to fit observations to this inappropriate model (McMahon 1980).’ Let us not waste another century.

Acknowledgements

We are very grateful to Morgan Ernest for help with taxonomy. V.M.S., J.F.G., G.B.W., A.P.A. and J.H.B. are grateful for the support of the Thaw Charitable Trust, a Packard Interdisciplinary Science Grant, and an NSF Biocomplexity Grant. V.M.S., W.H.W., G.B.W., B.J.E. and J.H.B. are grateful for the support of LANL/LDRD Grant 20030050DR. W.H.W. is grateful for the support of NIH Grant DK36263, and B.J.E. is grateful for the support of an NSF CAREER award (NSF DEB-0133974). G.B.W. is also grateful for NSF Award PHY-0202180.

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Received 26 September 2003; revised 13 November 2003; accepted 21 November 2003

Note added in proof

Through communications from Prof. Ewald Weibel, we learned that there is a paper in press (Weibel, E. R., Bacigalupe, L. D., Schmitt, B., Hoppeler, H., *Respiration Physiology*, in press) in which a larger data set (35 mammalian species based on 57 estimates) for maximal metabolic rate is analysed. They report that maximal metabolic rate scales with an allometric exponent of 0·872 ($P < 0{\cdot}000\,01$, $n = 35$, 95% CI 0·813–0·932). They investigated the relationship between maximal metabolic rates and mitochondrial and capillary densities in the locomotor muscle system.

Appendix 1

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Artiodactyla	Antilocapridae	*Antilocapra americana*	32 000	49·984	34 779·3	50·973	Lovegrove (2000)
Artiodactyla	Antilocapridae	*Antilocapra americana*	37 800	51·981			White & Seymour (2003)
Artiodactyla	Bovidae	*Bos taurus*	347 000	306·770	347 000·0	306·770	Heusner (1991)
Artiodactyla	Bovidae	*Cephalophus monticola*	4 200	10·075	4 200·0	10·075	Lovegrove (2000)
Artiodactyla	Bovidae	*Connochaetes taurinus*	196 500	230·073	196 500·0	230·073	White & Seymour (2003), Rogerson (1968)
Artiodactyla	Bovidae	*Kobus ellipsiprymnus*	100 000	148·949	100 000·0	148·949	Lovegrove (2000)
Artiodactyla	Bovidae	*Madoqua kirkii*	4 290	11·966	4 290·0	11·966	Lovegrove (2000)
Artiodactyla	Bovidae	*Oreamnos americanus*	32 000	46·414	32 000·0	46·414	Lovegrove (2000)
Artiodactyla	Bovidae	*Ovis canadensis*	65 000	123·287	67 030·8	114·674	Lovegrove (2000)
Artiodactyla	Bovidae	*Ovis canadensis*	69 125	106·663			White & Seymour (2003)
Artiodactyla	Bovidae	*Raphicerus campestris*	9 600	20·619	9 600·0	20·619	Lovegrove (2000)
Artiodactyla	Bovidae	*Taurotragus oryx*	133 300	180·150	141 403·7	190·209	Heusner (1991)
Artiodactyla	Bovidae	*Taurotragus oryx*	150 000	200·830			Lovegrove (2000)
Artiodactyla	Camelidae	*Camelus dromedarius*	407 000	224·779	407 000·0	224·779	Lovegrove (2000)
Artiodactyla	Camelidae	*Lama glama*	115 000	148·940	115 000·0	148·940	Heusner (1991)
Artiodactyla	Canidae	*Cervus elaphus*	67 000	112·430	67 000·0	112·430	Heusner (1991)
Artiodactyla	Cervidae	*Alces alces*	325 000	286·847	325 000·0	286·847	White & Seymour (2003)
Artiodactyla	Cervidae	*Capreolus capreolus*	21 500	46·347	21 500·0	46·347	Weiner (1977)
Artiodactyla	Cervidae	*Odocoileus virginianus*	58 588	142·863	61 862·5	123·447	White & Seymour (2003)
Artiodactyla	Cervidae	*Odocoileus virginianus*	65 320	106·670			Heusner (1991)
Artiodactyla	Cervidae	*Rangifer tarandus*	85 000	119·660	85 000·0	119·660	Heusner (1991)
Artiodactyla	Suidae	*Sus scrofa*	135 000	104·150	135 000·0	104·150	Heusner (1991)
Artiodactyla	Tayassuidae	*Pecari tajacu*	20 500	33·165	20 500·0	33·165	White & Seymour (2003)
Artiodactyla	Tragulidae	*Tragulus javanicus*	1 613	4·900	1 615·5	4·883	Heusner (1991)
Artiodactyla	Tragulidae	*Tragulus javanicus*	1 618	4·865			Lovegrove (2000)
Carnivora	Canidae	*Alopex lagopus*	3 600	7·665	3 600·0	7·665	White & Seymour (2003)
Carnivora	Canidae	*Canis latrans*	10 000	14·990	10 148·9	19·423	White & Seymour (2003)
Carnivora	Canidae	*Canis latrans*	10 300	25·167			Lovegrove (2000)
Carnivora	Canidae	*Canis mesomelas*	7 720	21·533	7 720·0	21·533	White & Seymour (2003)
Carnivora	Canidae	*Cerdocyon thous*	5 444	8·502	5 444·0	8·502	White & Seymour (2003)
Carnivora	Canidae	*Lycaon pictus*	8 750	33·010	8 750·0	33·010	Heusner (1991)
Carnivora	Canidae	*Vulpes velox*	1 769	4·948	1 769·0	4·948	White & Seymour (2003)
Carnivora	Canidae	*Vulpes vulpes*	4 440	13·623	4 580·3	13·731	White & Seymour (2003)
Carnivora	Canidae	*Vulpes vulpes*	4 725	13·841			White & Seymour (2003)
Carnivora	Canidae	*Vulpes zerda*	1 106	2·230	1 159·2	2·693	Heusner (1991)
Carnivora	Canidae	*Vulpes zerda*	1 215	3·252			White & Seymour (2003)
Carnivora	Felidae	*Acinonyx jubatus*	37 900	50·107	38 446·1	61·770	White & Seymour (2003)
Carnivora	Felidae	*Acinonyx jubatus*	39 000	76·148			Lovegrove (2000)
Carnivora	Felidae	*Felis concolor*	37 200	49·326	37 200·0	49·326	White & Seymour (2003)
Carnivora	Felidae	*Herpailurus yaguarondi*	8 400	9·690	8 400·0	9·690	White & Seymour (2003)
Carnivora	Felidae	*Leopardus pardalis*	10 500	17·439	10 500·0	17·439	White & Seymour (2003)
Carnivora	Felidae	*Leopardus wiedii*	3 600	5·227	3 600·0	5·227	White & Seymour (2003)
Carnivora	Felidae	*Leptailurus serval*	1 012	1·440	1 012·0	1·440	Lovegrove (2000)
Carnivora	Felidae	*Lynx rufus*	9 400	23·542	9 400·0	23·542	White & Seymour (2003)
Carnivora	Felidae	*Panthera leo*	98 000	94·580	98 000·0	94·580	White & Seymour (2003)
Carnivora	Felidae	*Panthera onca*	50 400	62·419	50 400·0	62·419	White & Seymour (2003)
Carnivora	Felidae	*Panthera tigris*	137 900	133·859	137 900·0	133·859	White & Seymour (2003)
Carnivora	Herpestidae	*Galerella sanguinea*	500	2·120	519·6	2·202	Kamau *et al.* (1979)
Carnivora	Herpestidae	*Galerella sanguinea*	540	2·287			White & Seymour (2003)
Carnivora	Herpestidae	*Herpestes javanicus*	611	2·248	611·0	2·248	White & Seymour (2003)
Carnivora	Herpestidae	*Suricata suricatta*	850	1·729	850·0	1·729	White & Seymour (2003)
Carnivora	Hyaenidae	*Hyaena hyaena*	34 300	31·954	34 300·0	31·954	White & Seymour (2003)
Carnivora	Hyaenidae	*Proteles cristatus*	7 710	10·925	7 902·6	11·563	Lovegrove (2000)
Carnivora	Hyaenidae	*Proteles cristatus*	8 100	12·239			White & Seymour (2003)
Carnivora	Mustelidae	*Eira barbara*	2 950	6·811	2 950·0	6·811	White & Seymour (2003)
Carnivora	Mustelidae	*Enhydra lutris*	18 000	67·278	26 832·8	98·479	Lovegrove (2000)
Carnivora	Mustelidae	*Enhydra lutris*	40 000	144·150			Heusner (1991)
Carnivora	Mustelidae	*Gulo gulo*	12 700	31·765	12 700·0	31·765	White & Seymour (2003)
Carnivora	Mustelidae	*Lutra lutra*	10 000	25·104	10 000·0	25·104	White & Seymour (2003)
Carnivora	Mustelidae	*Martes americana*	900	3·319	966·5	3·579	White & Seymour (2003)
Carnivora	Mustelidae	*Martes americana*	1 038	3·860			Heusner (1991)
Carnivora	Mustelidae	*Martes martes*	920	4·000	920·0	4·000	White & Seymour (2003)
Carnivora	Mustelidae	*Meles meles*	11 050	16·647	11 050·0	16·647	White & Seymour (2003)
Carnivora	Mustelidae	*Mustela erminea*	75	0·930	125·5	1·276	Heusner (1991)
Carnivora	Mustelidae	*Mustela erminea*	210	1·750			Heusner (1991)
Carnivora	Mustelidae	*Mustela frenata*	225	1·344	225·0	1·344	White & Seymour (2003)
Carnivora	Mustelidae	*Mustela vison*	660	2·722	660·0	2·722	White & Seymour (2003)
Carnivora	Mustelidae	*Spilogale putorius*	624	1·674	624·0	1·674	White & Seymour (2003)
Carnivora	Mustelidae	*Taxidea taxus*	9 000	15·062	9 000·0	15·062	White & Seymour (2003)
Carnivora	Phocidae	*Phoca fasciata*	54 000	118·590	54 000·0	118·590	Heusner (1991)
Carnivora	Phocidae	*Phoca groenlandica*	150 000	168·930	150 000·0	168·930	Heusner (1991)
Carnivora	Phocidae	*Phoca vitulina*	27 400	73·290	27 400·0	73·290	Heusner (1991)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Carnivora	Procyonidae	*Ailurus fulgens*	5 740	4·898	5 740·0	4·898	White & Seymour (2003)
Carnivora	Procyonidae	*Bassariscus sumichrasti*	1 280	3·537	1 280·0	3·537	White & Seymour (2003)
Carnivora	Procyonidae	*Nasua narica*	3 670	6·733	3 670·0	6·733	White & Seymour (2003)
Carnivora	Procyonidae	*Nasua nasua*	3 850	5·649	3 924·3	5·591	Lovegrove (2000)
Carnivora	Procyonidae	*Nasua nasua*	4 000	5·534			White & Seymour (2003)
Carnivora	Procyonidae	*Potos flavus*	2 215	4·177	2 318·0	4·294	Lovegrove (2000)
Carnivora	Procyonidae	*Potos flavus*	2 343	4·441			White & Seymour (2003)
Carnivora	Procyonidae	*Potos flavus*	2 400	4·270			Heusner (1991)
Carnivora	Procyonidae	*Procyon cancrivorus*	1 160	2·588	1 160·0	2·588	White & Seymour (2003)
Carnivora	Procyonidae	*Procyon lotor*	4 620	12·191	4 842·2	10·428	Lovegrove (2000)
Carnivora	Procyonidae	*Procyon lotor*	5 075	8·920			White & Seymour (2003)
Carnivora	Ursidae	*Melursus ursinus*	66 957	47·064	66 957·0	47·064	McNab (1992)
Carnivora	Viverridae	*Arctictis binturong*	14 280	12·747	14 280·0	12·747	White & Seymour (2003)
Carnivora	Viverridae	*Arctogalidia trivirgata*	2 010	3·085	2 010·0	3·085	White & Seymour (2003)
Carnivora	Viverridae	*Fossa fossana*	2 260	5·090	2 260·0	5·090	Heusner (1991)
Carnivora	Viverridae	*Genetta tigrina*	1 698	4·167	1 699·0	4·189	White & Seymour (2003)
Carnivora	Viverridae	*Genetta tigrina*	1 700	4·210			Heusner (1991)
Carnivora	Viverridae	*Nandinia binotata*	4 270	4·814	4 270·0	5·565	White & Seymour (2003)
Carnivora	Viverridae	*Nandinia binotata*	4 270	6·432			Lovegrove (2000)
Carnivora	Viverridae	*Paradoxurus hermaphroditus*	3 160	7·665	3 282·6	5·534	White & Seymour (2003)
Carnivora	Viverridae	*Paradoxurus hermaphroditus*	3 410	3·995			Lovegrove (2000)
Chiroptera	Emballonuridae	*Peropteryx macrotis*	5	0·065	5·0	0·065	White & Seymour (2003)
Chiroptera	Emballonuridae	*Saccopteryx bilineata*	7·8	0·081	7·8	0·081	Lovegrove (2000)
Chiroptera	Hipposideridae	*Rhinonycteris aurantius*	8·27	0·090	8·3	0·090	Baudinette *et al.* (2000)
Chiroptera	Megadermatidae	*Macroderma gigas*	107·2	0·526	126·0	0·639	Baudinette *et al.* (2000)
Chiroptera	Megadermatidae	*Macroderma gigas*	148	0·776			McNab (1969)
Chiroptera	Molossidae	*Eumops perotis*	56	0·222	56·0	0·222	White & Seymour (2003)
Chiroptera	Molossidae	*Molossus molossus*	15·6	0·126	15·6	0·126	White & Seymour (2003)
Chiroptera	Molossidae	*Nyctinomops laticaudatus*	14	0·062	14·0	0·062	Lovegrove (2000)
Chiroptera	Molossidae	*Tadarida brasiliensis*	10·4	0·120	13·3	0·117	Heusner (1991)
Chiroptera	Molossidae	*Tadarida brasiliensis*	16·9	0·113			White & Seymour (2003)
Chiroptera	Mormoopidae	*Mormoops blainvillii*	8·6	0·045	8·6	0·045	White & Seymour (2003)
Chiroptera	Mormoopidae	*Mormoops megalophylla*	16·5	0·136	16·5	0·136	White & Seymour (2003)
Chiroptera	Mormoopidae	*Pteronotus davyi*	9·4	0·085	9·4	0·085	Lovegrove (2000)
Chiroptera	Mormoopidae	*Pteronotus parnellii*	19·2	0·171	19·2	0·171	Lovegrove (2000)
Chiroptera	Mormoopidae	*Pteronotus personatus*	14	0·128	14·0	0·128	Lovegrove (2000)
Chiroptera	Mormoopidae	*Pteronotus quadridens*	4·9	0·034	4·9	0·034	White & Seymour (2003)
Chiroptera	Natalidae	*Natalus tumidirostris*	5·4	0·046	5·4	0·046	White & Seymour (2003)
Chiroptera	Noctilionidae	*Noctilio albiventris*	27	0·176	27·0	0·176	McNab (1969)
Chiroptera	Noctilionidae	*Noctilio leporinus*	61	0·400	61·0	0·400	McNab (1969)
Chiroptera	Phyllostomidae	*Anoura caudifera*	11·5	0·238	11·5	0·238	McNab (1969)
Chiroptera	Phyllostomidae	*Artibeus concolor*	19·7	0·222	19·7	0·222	McNab (1969)
Chiroptera	Phyllostomidae	*Artibeus fimbriatus*	63·9	0·435	63·9	0·435	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Artibeus jamaicensis*	45·2	0·428	46·1	0·359	McNab (1969)
Chiroptera	Phyllostomidae	*Artibeus jamaicensis*	47	0·300			Heusner (1991)
Chiroptera	Phyllostomidae	*Artibeus lituratus*	70·1	0·602	70·1	0·602	McNab (1969)
Chiroptera	Phyllostomidae	*Carollia perspicillata*	14·9	0·240	14·9	0·240	McNab (1969)
Chiroptera	Phyllostomidae	*Chiroderma doriae*	19·9	0·173	19·9	0·173	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Chrotopterus auritus*	96·1	0·788	96·1	0·788	McNab (1969)
Chiroptera	Phyllostomidae	*Desmodus rotundus*	29·4	0·194	29·4	0·194	McNab (1969)
Chiroptera	Phyllostomidae	*Diaemus youngi*	36·6	0·208	36·6	0·208	McNab (1969)
Chiroptera	Phyllostomidae	*Diphylla ecaudata*	27·8	0·215	27·8	0·215	McNab (1969)
Chiroptera	Phyllostomidae	*Erophylla sezekorni*	16·1	0·099	16·1	0·099	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Glossophaga soricina*	9·6	0·164	9·6	0·164	McNab (1969)
Chiroptera	Phyllostomidae	*Leptonycteris curasoae*	22	0·245	22·0	0·245	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Macrotus californicus*	11·7	0·082	11·7	0·082	Lovegrove (2000)
Chiroptera	Phyllostomidae	*Monophyllus redmani*	8·7	0·062	8·7	0·062	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Phyllostomus discolor*	33·5	0·267	33·5	0·267	McNab (1969)
Chiroptera	Phyllostomidae	*Phyllostomus elongatus*	35·6	0·216	35·6	0·216	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Phyllostomus hastatus*	84·2	0·559	84·2	0·559	McNab (1969)
Chiroptera	Phyllostomidae	*Platyrrhinus lineatus*	21·9	0·250	21·9	0·250	McNab (1969)
Chiroptera	Phyllostomidae	*Rhinophylla fischerae*	9·5	0·091	9·5	0·091	Lovegrove (2000)
Chiroptera	Phyllostomidae	*Rhinophylla pumilio*	9·5	0·104	9·5	0·104	McNab (1969)
Chiroptera	Phyllostomidae	*Sturnira lilium*	21	0·190	21·4	0·237	Heusner (1991)
Chiroptera	Phyllostomidae	*Sturnira lilium*	21·9	0·297			McNab (1969)
Chiroptera	Phyllostomidae	*Sturnira tildae*	20·5	0·223	20·5	0·223	White & Seymour (2003)
Chiroptera	Phyllostomidae	*Tonatia bidens*	27·4	0·307	27·4	0·307	McNab (1969)
Chiroptera	Phyllostomidae	*Uroderma bilobatum*	16·2	0·176	16·2	0·176	McNab (1969)
Chiroptera	Phyllostomidae	*Vampyressa pusilla*	8·8	0·104	8·8	0·104	White & Seymour (2003)
Chiroptera	Pteropodidae	*Cynopterus brachyotis*	37	0·260	37·2	0·262	Heusner (1991)
Chiroptera	Pteropodidae	*Cynopterus brachyotis*	37·4	0·265			White & Seymour (2003)
Chiroptera	Pteropodidae	*Dobsonia minor*	73·7	0·415	80·1	0·504	White & Seymour (2003)
Chiroptera	Pteropodidae	*Dobsonia minor*	87	0·612			Lovegrove (2000)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Chiroptera	Pteropodidae	*Dobsonia moluccensis*	241·4	0·971	312·4	1·411	White & Seymour (2003)
Chiroptera	Pteropodidae	*Dobsonia moluccensis*	404·3	2·052			White & Seymour (2003)
Chiroptera	Pteropodidae	*Dobsonia praedatrix*	179·5	0·795	179·5	0·795	White & Seymour (2003)
Chiroptera	Pteropodidae	*Eonycteris spelaea*	51·6	0·268	51·6	0·268	Lovegrove (2000)
Chiroptera	Pteropodidae	*Macroglossus minimus*	15·9	0·103	15·9	0·103	White & Seymour (2003)
Chiroptera	Pteropodidae	*Megaloglossus woermanni*	12·4	0·121	12·4	0·121	Lovegrove (2000)
Chiroptera	Pteropodidae	*Melonycteris melanops*	53·3	0·242	53·3	0·242	White & Seymour (2003)
Chiroptera	Pteropodidae	*Nyctimene albiventer*	28·2	0·225	29·5	0·185	Lovegrove (2000)
Chiroptera	Pteropodidae	*Nyctimene albiventer*	30·9	0·152			White & Seymour (2003)
Chiroptera	Pteropodidae	*Nyctimene cyclotis*	40·4	0·360	40·4	0·360	White & Seymour (2003)
Chiroptera	Pteropodidae	*Nyctimene major*	13·6	0·114	13·6	0·114	White & Seymour (2003)
Chiroptera	Pteropodidae	*Paranyctimene raptor*	21·3	0·170	22·4	0·152	Heusner (1991)
Chiroptera	Pteropodidae	*Paranyctimene raptor*	23·6	0·137			White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus giganteus*	562·2	1·622	562·2	1·622	White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus hypomelanus*	520·8	1·618	520·8	1·618	White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus poliocephalus*	598	1·768	598·0	1·768	White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus pumilus*	194·2	0·705	194·2	0·705	White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus rodricensis*	254·5	0·753	254·5	0·753	White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus scapulatus*	362	1·353	362·0	1·353	White & Seymour (2003)
Chiroptera	Pteropodidae	*Pteropus vampyrus*	1024·3	4·486	1024·3	4·486	White & Seymour (2003)
Chiroptera	Pteropodidae	*Rousettus aegyptiacus*	146	0·684	146·0	0·684	White & Seymour (2003)
Chiroptera	Pteropodidae	*Rousettus amplexicaudatus*	91·5	0·582	91·5	0·582	White & Seymour (2003)
Chiroptera	Pteropodidae	*Syconycteris australis*	15·9	0·122	16·7	0·152	White & Seymour (2003)
Chiroptera	Pteropodidae	*Syconycteris australis*	17·5	0·188			McNab (1969)
Chiroptera	Rhinolophidae	*Hipposideros galeritus*	8·5	0·050	8·5	0·050	Heusner (1991)
Chiroptera	Vespertilionidae	*Antrozous pallidus*	22	0·104	22·0	0·104	Lovegrove (2000)
Chiroptera	Vespertilionidae	*Chalinolobus gouldii*	17·5	0·141	17·5	0·141	White & Seymour (2003)
Chiroptera	Vespertilionidae	*Eptesicus fuscus*	10·4	0·116	13·3	0·113	White & Seymour (2003)
Chiroptera	Vespertilionidae	*Eptesicus fuscus*	16·9	0·110			Heusner (1991)
Chiroptera	Vespertilionidae	*Histiotus velatus*	11·2	0·088	11·2	0·088	White & Seymour (2003)
Chiroptera	Vespertilionidae	*Miniopterus schreibersi*	10·91	0·145	10·9	0·145	Baudinette *et al.* (2000)
Chiroptera	Vespertilionidae	*Myotis lucifugus*	5·2	0·050	5·8	0·051	White & Seymour (2003)
Chiroptera	Vespertilionidae	*Myotis lucifugus*	6·5	0·052			Lovegrove (2000)
Chiroptera	Vespertilionidae	*Myotis nigricans*	3·7	0·027	3·7	0·027	Lovegrove (2000)
Chiroptera	Vespertilionidae	*Myotis velifer*	11·89	0·040	11·9	0·040	Heusner (1991)
Chiroptera	Vespertilionidae	*Myotis vivesi*	25	0·199	25·0	0·199	Lovegrove (2000)
Chiroptera	Vespertilionidae	*Myotis yumanensis*	5	0·047	5·0	0·047	Lovegrove (2000)
Chiroptera	Vespertilionidae	*Nyctophilus geoffroyi*	8	0·062	8·0	0·062	White & Seymour (2003)
Chiroptera	Vespertilionidae	*Plecotus auritus*	10·25	0·082	10·2	0·082	White & Seymour (2003)
Dasyuromorpha	Caluromyidae	*Caluromys derbianus*	329	1·255	342·7	1·194	White & Seymour (2003)
Dasyuromorpha	Caluromyidae	*Caluromys derbianus*	357	1·135			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Antechinus flavipes*	46·5	0·252	46·5	0·252	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Antechinus stuartii*	22·1	0·190	25·0	0·189	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Antechinus stuartii*	28·2	0·189			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Antechinus swainsonii*	66·9	0·351	66·9	0·351	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Dasycercus byrnei*	89	0·440	100·0	0·439	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Dasycercus byrnei*	91·7	0·400			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Dasycercus byrnei*	103·5	0·456			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Dasycercus byrnei*	118·2	0·462			Lovegrove (2003)
Dasyuromorpha	Dasyuridae	*Dasycercus cristicauda*	86	0·240	91·0	0·260	Lovegrove (2003)
Dasyuromorpha	Dasyuridae	*Dasycercus cristicauda*	88·8	0·260			Heusner (1991)
Dasyuromorpha	Dasyuridae	*Dasycercus cristicauda*	89	0·258			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Dasycercus cristicauda*	101	0·285			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Dasyurus geoffroii*	1 300	2·820	1 326·7	2·991	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Dasyurus geoffroii*	1 354	3·172			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Dasyurus hallucatus*	558	1·356	571·0	1·501	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Dasyurus hallucatus*	584·4	1·663			Lovegrove (2003)
Dasyuromorpha	Dasyuridae	*Dasyurus maculatus*	1 782	3·010	1 782·0	3·142	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Dasyurus maculatus*	1 782	3·281			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Dasyurus viverrinus*	909·9	2·310	945·3	2·260	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Dasyurus viverrinus*	982	2·210			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Ningaui yvonnae*	11·6	0·088	11·6	0·088	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Phascogale tapoatafa*	147	0·664	153·7	0·694	Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Phascogale tapoatafa*	157	0·710			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Phascogale tapoatafa*	157·2	0·710			Lovegrove (2003)
Dasyuromorpha	Dasyuridae	*Planigale gilesi*	8·9	0·071	9·1	0·058	Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Planigale gilesi*	9·1	0·039			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Planigale gilesi*	9·4	0·070			Heusner (1991)
Dasyuromorpha	Dasyuridae	*Planigale ingrami*	7·1	0·063	8·8	0·065	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Planigale ingrami*	10·8	0·067			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Planigale maculata*	8·5	0·060	10·6	0·067	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Planigale maculata*	13·1	0·074			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Planigale tenuirostris*	7·1	0·063	7·1	0·063	White & Seymour (2003)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Dasyuromorpha	Dasyuridae	*Pseudantechinus macdonnellensis*	43·1	0·152	43·1	0·152	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Sarcophilus laniarius*	5 775	7·394	6 126·8	8·664	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Sarcophilus laniarius*	6 500	10·153			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Sminthopsis crassicaudata*	14·1	0·110	16·0	0·121	Heusner (1991)
Dasyuromorpha	Dasyuridae	*Sminthopsis crassicaudata*	15·9	0·114			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Sminthopsis crassicaudata*	16·4	0·140			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Sminthopsis crassicaudata*	17·7	0·123			Lovegrove (2003)
Dasyuromorpha	Dasyuridae	*Sminthopsis laniger*	24·2	0·132	25·8	0·141	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Sminthopsis laniger*	25·8	0·141			White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Sminthopsis laniger*	27·4	0·150			Lovegrove (2003)
Dasyuromorpha	Dasyuridae	*Sminthopsis macroura*	19·35	0·126	20·6	0·128	White & Seymour (2003)
Dasyuromorpha	Dasyuridae	*Sminthopsis macroura*	22	0·131			Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Sminthopsis murina*	12·9	0·114	15·7	0·117	Lovegrove (2000)
Dasyuromorpha	Dasyuridae	*Sminthopsis murina*	19	0·120			White & Seymour (2003)
Dasyuromorpha	Didelphidae	*Chironectes minimus*	935	2·549	940·5	2·793	White & Seymour (2003)
Dasyuromorpha	Didelphidae	*Chironectes minimus*	946	3·061			Lovegrove (2000)
Dasyuromorpha	Didelphidae	*Didelphis marsupialis*	1 165	3·185	1 244·3	3·310	White & Seymour (2003)
Dasyuromorpha	Didelphidae	*Didelphis marsupialis*	1 329	3·440			Heusner (1991)
Dasyuromorpha	Didelphidae	*Didelphis virginiana*	2 488	4·641	2 846·6	5·299	White & Seymour (2003)
Dasyuromorpha	Didelphidae	*Didelphis virginiana*	3 257	6·050			Heusner (1991)
Dasyuromorpha	Didelphidae	*Lutreolina crassicaudata*	812	2·265	812·0	2·265	White & Seymour (2003)
Dasyuromorpha	Didelphidae	*Philander opossum*	751	1·886	751·0	1·886	White & Seymour (2003)
Dasyuromorpha	Marmosidae	*Gracilinanus microtarsus*	13	0·106	13·0	0·106	White & Seymour (2003)
Dasyuromorpha	Marmosidae	*Marmosa robinsoni*	122	0·547	122·0	0·547	White & Seymour (2003)
Dasyuromorpha	Marmosidae	*Metachirus nudicaudatus*	336	1·144	336·0	1·144	White & Seymour (2003)
Dasyuromorpha	Marmosidae	*Monodelphis brevicaudata*	75·5	0·318	91·5	0·366	White & Seymour (2003)
Dasyuromorpha	Marmosidae	*Monodelphis brevicaudata*	111	0·421			Lovegrove (2000)
Dasyuromorpha	Marmosidae	*Monodelphis domestica*	104	0·335	104·0	0·335	White & Seymour (2003)
Dasyuromorpha	Myrmecobiidae	*Myrmecobius fasciatus*	400	0·794	438·2	0·907	White & Seymour (2003)
Dasyuromorpha	Myrmecobiidae	*Myrmecobius fasciatus*	480	1·036			Lovegrove (2003)
Diprotodontia	Acrobatidae	*Acrobates pygmaeus*	14	0·084	14·0	0·084	White & Seymour (2003)
Diprotodontia	Burramyidae	*Burramys parvus*	44·3	0·205	44·3	0·205	White & Seymour (2003)
Diprotodontia	Burramyidae	*Cercartetus lepidus*	12·6	0·105	12·6	0·105	White & Seymour (2003)
Diprotodontia	Burramyidae	*Cercartetus nanus*	60	0·288	64·8	0·311	Lovegrove (2000)
Diprotodontia	Burramyidae	*Cercartetus nanus*	70	0·336			White & Seymour (2003)
Diprotodontia	Macropodidae	*Dendrolagus matschiei*	6 960	7·960	6 960·0	7·960	White & Seymour (2003)
Diprotodontia	Macropodidae	*Lagorchestes conspicillatus*	2 660	4·749	2 660·0	4·749	White & Seymour (2003)
Diprotodontia	Macropodidae	*Macropus eugenii*	4 796	7·780	4 796·0	7·780	Heusner (1991)
Diprotodontia	Macropodidae	*Macropus robustus*	29 300	31·710	29 647·9	33·056	White & Seymour (2003)
Diprotodontia	Macropodidae	*Macropus robustus*	30 000	34·460			Heusner (1991)
Diprotodontia	Macropodidae	*Macropus rufus*	25 000	30·130	28 500·0	31·353	Heusner (1991)
Diprotodontia	Macropodidae	*Macropus rufus*	32 490	32·625			White & Seymour (2003)
Diprotodontia	Macropodidae	*Setonix brachyurus*	2 510	4·520	2 702·3	4·695	Heusner (1991)
Diprotodontia	Macropodidae	*Setonix brachyurus*	2 674	4·654			White & Seymour (2003)
Diprotodontia	Macropodidae	*Setonix brachyurus*	2 940	4·920			Lovegrove (2000)
Diprotodontia	Petauridae	*Gymnobelideus leadbeateri*	166	0·574	166·0	0·574	White & Seymour (2003)
Diprotodontia	Petauridae	*Petaurus breviceps*	127	0·502	129·3	0·517	White & Seymour (2003)
Diprotodontia	Petauridae	*Petaurus breviceps*	128·1	0·500			Heusner (1991)
Diprotodontia	Petauridae	*Petaurus breviceps*	130	0·522			Lovegrove (2000)
Diprotodontia	Petauridae	*Petaurus breviceps*	132·2	0·546			Lovegrove (2003)
Diprotodontia	Phalangeridae	*Spilocuscus maculatus*	4 250	6·164	4 250·0	6·270	Lovegrove (2000)
Diprotodontia	Phalangeridae	*Spilocuscus maculatus*	4 250	6·378			White & Seymour (2003)
Diprotodontia	Phalangeridae	*Trichosurus vulpecula*	1 982	3·538	1 993·5	3·800	Lovegrove (2000)
Diprotodontia	Phalangeridae	*Trichosurus vulpecula*	2 005	4·081			White & Seymour (2003)
Diprotodontia	Phascolarctidae	*Phascolarctos cinereus*	4 700	5·720	4 732·4	5·744	Heusner (1991)
Diprotodontia	Phascolarctidae	*Phascolarctos cinereus*	4 765	5·768			White & Seymour (2003)
Diprotodontia	Potoroidae	*Aepyprymnus rufescens*	2 820	5·978	2 820·0	5·978	White & Seymour (2003)
Diprotodontia	Potoroidae	*Bettongia gaimardi*	1 385	3·578	1 385·0	3·578	White & Seymour (2003)
Diprotodontia	Potoroidae	*Bettongia penicillata*	1 018	3·132	1 018·0	3·132	White & Seymour (2003)
Diprotodontia	Potoroidae	*Potorous tridactylus*	976	2·323	1 045·5	2·556	White & Seymour (2003)
Diprotodontia	Potoroidae	*Potorous tridactylus*	1 120	2·812			Lovegrove (2000)
Diprotodontia	Pseudocheiridae	*Cercartetus concinnus*	18·6	0·125	18·6	0·125	Lovegrove (2000)
Diprotodontia	Pseudocheiridae	*Petauroides volans*	1 140	3·180	1 140·5	3·191	Lovegrove (2000)
Diprotodontia	Pseudocheiridae	*Petauroides volans*	1 141	3·202			White & Seymour (2003)
Diprotodontia	Pseudocheiridae	*Pseudocheirus peregrinus*	828	2·210	859·3	2·270	Heusner (1991)
Diprotodontia	Pseudocheiridae	*Pseudocheirus peregrinus*	835	2·194			Lovegrove (2003)
Diprotodontia	Pseudocheiridae	*Pseudocheirus peregrinus*	861	2·282			White & Seymour (2003)
Diprotodontia	Pseudocheiridae	*Pseudocheirus peregrinus*	916	2·402			White & Seymour (2003)
Diprotodontia	Tarsipedidae	*Tarsipes rostratus*	10	0·162	10·0	0·162	White & Seymour (2003)
Diprotodontia	Vombatidae	*Lasiorhinus latifrons*	25 000	15·341	27 348·2	16·001	Lovegrove (2000)
Diprotodontia	Vombatidae	*Lasiorhinus latifrons*	29 917	16·690			White & Seymour (2003)
Hyracoidea	Procaviidae	*Dendrohyrax dorsalis*	2 210	4·190	2 210·0	4·190	White & Seymour (2003)
Hyracoidea	Procaviidae	*Heterohyrax brucei*	1 287	3·733	1 604·4	3·872	Lovegrove (2000)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Hyracoidea	Procaviidae	*Heterohyrax brucei*	2 000	4·017			White & Seymour (2003)
Hyracoidea	Procaviidae	*Procavia capensis*	2 250	5·021	2 458·0	4·954	White & Seymour (2003)
Hyracoidea	Procaviidae	*Procavia capensis*	2 400	3·682			White & Seymour (2003)
Hyracoidea	Procaviidae	*Procavia capensis*	2 750	6·577			White & Seymour (2003)
Insectivora	Chrysochloridae	*Amblysomus hottentotus*	70	0·473	70·0	0·473	White & Seymour (2003)
Insectivora	Chrysochloridae	*Chrysochloris asiatica*	33	0·220	36·7	0·243	Heusner (1991)
Insectivora	Chrysochloridae	*Chrysochloris asiatica*	34	0·228			Lovegrove (2000)
Insectivora	Chrysochloridae	*Chrysochloris asiatica*	44	0·287			White & Seymour (2003)
Insectivora	Chrysochloridae	*Eremitalpa granti*	20	0·056	22·8	0·069	White & Seymour (2003)
Insectivora	Chrysochloridae	*Eremitalpa granti*	26·1	0·086			Lovegrove (2000)
Insectivora	Erinaceidae	*Atelerix albiventris*	450	0·828	450·0	0·828	White & Seymour (2003)
Insectivora	Erinaceidae	*Echinosorex gymnura*	721·2	2·816	721·2	2·816	White & Seymour (2003)
Insectivora	Erinaceidae	*Erinaceus concolor*	822·7	1·937	822·7	1·937	White & Seymour (2003)
Insectivora	Erinaceidae	*Erinaceus europaeus*	750	1·883	1 213·5	2·434	White & Seymour (2003)
Insectivora	Erinaceidae	*Erinaceus europaeus*	1 191·2	2·632			Lovegrove (2000)
Insectivora	Erinaceidae	*Erinaceus europaeus*	2 000	2·910			Heusner (1991)
Insectivora	Erinaceidae	*Hemiechinus aethiopicus*	450	0·628	451·5	0·630	White & Seymour (2003)
Insectivora	Erinaceidae	*Hemiechinus aethiopicus*	453	0·632			Lovegrove (2000)
Insectivora	Erinaceidae	*Hemiechinus auritus*	397	0·842	398·5	0·845	Lovegrove (2000)
Insectivora	Erinaceidae	*Hemiechinus auritus*	400	0·848			White & Seymour (2003)
Insectivora	Erinaceidae	*Hylomys suillus*	57·8	0·335	57·8	0·335	White & Seymour (2003)
Insectivora	Soricidae	*Blarina brevicauda*	20·4	0·331	20·9	0·344	Lovegrove (2000)
Insectivora	Soricidae	*Blarina brevicauda*	20·5	0·366			White & Seymour (2003)
Insectivora	Soricidae	*Blarina brevicauda*	20·7	0·290			Heusner (1991)
Insectivora	Soricidae	*Blarina brevicauda*	22·1	0·397			Lovegrove (2003)
Insectivora	Soricidae	*Blarina carolinensis*	10·2	0·188	10·2	0·188	White & Seymour (2003)
Insectivora	Soricidae	*Crocidura crossei*	9·5	0·117	9·8	0·121	Lovegrove (2003)
Insectivora	Soricidae	*Crocidura crossei*	10·2	0·125			White & Seymour (2003)
Insectivora	Soricidae	*Crocidura flavescens*	33·2	0·248	33·2	0·248	White & Seymour (2003)
Insectivora	Soricidae	*Crocidura hildegardeae*	10	0·145	10·7	0·156	White & Seymour (2003)
Insectivora	Soricidae	*Crocidura hildegardeae*	11·5	0·167			Lovegrove (2000)
Insectivora	Soricidae	*Crocidura leucodon*	11·7	0·166	11·7	0·166	Lovegrove (2003)
Insectivora	Soricidae	*Crocidura luna*	11·8	0·138	12·3	0·144	White & Seymour (2003)
Insectivora	Soricidae	*Crocidura luna*	12·8	0·150			Lovegrove (2000)
Insectivora	Soricidae	*Crocidura olivieri*	38·3	0·320	38·6	0·323	Lovegrove (2000)
Insectivora	Soricidae	*Crocidura olivieri*	38·9	0·326			White & Seymour (2003)
Insectivora	Soricidae	*Crocidura poensis*	16·9	0·170	17·1	0·172	Lovegrove (2000)
Insectivora	Soricidae	*Crocidura poensis*	17·3	0·173			White & Seymour (2003)
Insectivora	Soricidae	*Crocidura russula*	9·6	0·131	10·8	0·143	Lovegrove (2003)
Insectivora	Soricidae	*Crocidura russula*	10·1	0·166			Lovegrove (2000)
Insectivora	Soricidae	*Crocidura russula*	10·4	0·128			White & Seymour (2003)
Insectivora	Soricidae	*Crocidura russula*	13·7	0·150			Heusner (1991)
Insectivora	Soricidae	*Crocidura suaveolens*	6·5	0·105	6·9	0·112	White & Seymour (2003)
Insectivora	Soricidae	*Crocidura suaveolens*	6·8	0·110			Lovegrove (2003)
Insectivora	Soricidae	*Crocidura suaveolens*	7·5	0·120			Heusner (1991)
Insectivora	Soricidae	*Crocidura viaria*	14·7	0·123	15·0	0·126	White & Seymour (2003)
Insectivora	Soricidae	*Crocidura viaria*	15·3	0·128			Lovegrove (2000)
Insectivora	Soricidae	*Cryptotis parva*	6·2	0·107	6·3	0·164	White & Seymour (2003)
Insectivora	Soricidae	*Cryptotis parva*	6·4	0·250			Lovegrove (2000)
Insectivora	Soricidae	*Neomys anomalus*	13·1	0·373	13·1	0·373	White & Seymour (2003)
Insectivora	Soricidae	*Neomys fodiens*	14·1	0·373	16·0	0·328	Lovegrove (2000)
Insectivora	Soricidae	*Neomys fodiens*	17·1	0·310			Heusner (1991)
Insectivora	Soricidae	*Neomys fodiens*	17·1	0·305			White & Seymour (2003)
Insectivora	Soricidae	*Notiosorex crawfordi*	4	0·074	4·0	0·074	White & Seymour (2003)
Insectivora	Soricidae	*Sorex alpinus*	7·8	0·265	7·8	0·267	Lovegrove (2000)
Insectivora	Soricidae	*Sorex alpinus*	7·9	0·269			White & Seymour (2003)
Insectivora	Soricidae	*Sorex araneus*	8·05	0·336	8·4	0·348	White & Seymour (2003)
Insectivora	Soricidae	*Sorex araneus*	8·7	0·361			Lovegrove (2003)
Insectivora	Soricidae	*Sorex cinereus*	3·5	0·176	5·2	0·238	White & Seymour (2003)
Insectivora	Soricidae	*Sorex cinereus*	5	0·249			Lovegrove (2000)
Insectivora	Soricidae	*Sorex cinereus*	7·9	0·310			Heusner (1991)
Insectivora	Soricidae	*Sorex coronatus*	9·1	0·290	9·1	0·290	White & Seymour (2003)
Insectivora	Soricidae	*Sorex minutus*	3·8	0·182	4·1	0·179	Lovegrove (2003)
Insectivora	Soricidae	*Sorex minutus*	4	0·172			White & Seymour (2003)
Insectivora	Soricidae	*Sorex minutus*	4·2	0·183			Lovegrove (2000)
Insectivora	Soricidae	*Sorex minutus*	4·6	0·180			Heusner (1991)
Insectivora	Soricidae	*Sorex ornatus*	9·7	0·292	9·7	0·292	White & Seymour (2003)
Insectivora	Soricidae	*Sorex vagrans*	5·2	0·157	5·2	0·157	White & Seymour (2003)
Insectivora	Soricidae	*Suncus etruscus*	2·4	0·080	2·4	0·063	White & Seymour (2003)
Insectivora	Soricidae	*Suncus etruscus*	2·5	0·050			Heusner (1991)
Insectivora	Soricidae	*Suncus murinus*	30·2	0·332	39·7	0·403	White & Seymour (2003)
Insectivora	Soricidae	*Suncus murinus*	52·3	0·490			Heusner (1991)
Insectivora	Talpidae	*Condylura cristata*	49	0·615	49·0	0·615	White & Seymour (2003)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Insectivora	Talpidae	*Neurotrichus gibbsii*	11·8	0·259	11·8	0·259	White & Seymour (2003)
Insectivora	Talpidae	*Scalopus aquaticus*	48	0·378	48·0	0·378	White & Seymour (2003)
Insectivora	Talpidae	*Scapanus latimanus*	61	0·425	61·0	0·425	White & Seymour (2003)
Insectivora	Talpidae	*Scapanus orarius*	61·2	0·358	61·2	0·358	White & Seymour (2003)
Insectivora	Talpidae	*Scapanus townsendii*	130·1	0·607	130·1	0·607	Lovegrove (2000)
Insectivora	Tenrecidae	*Echinops telfairi*	116·4	0·750	116·4	0·750	Heusner (1991)
Insectivora	Tenrecidae	*Geogale aurita*	6·9	0·043	6·9	0·043	White & Seymour (2003)
Insectivora	Tenrecidae	*Hemicentetes semispinosus*	101·9	0·404	116·4	0·380	White & Seymour (2003)
Insectivora	Tenrecidae	*Hemicentetes semispinosus*	133	0·358			White & Seymour (2003)
Insectivora	Tenrecidae	*Limnogale mergulus*	77·7	0·312	77·7	0·355	White & Seymour (2003)
Insectivora	Tenrecidae	*Limnogale mergulus*	77·7	0·404			Lovegrove (2000)
Insectivora	Tenrecidae	*Microgale cowani*	12·2	0·179	12·2	0·179	White & Seymour (2003)
Insectivora	Tenrecidae	*Microgale dobsoni*	44·6	0·315	44·6	0·315	White & Seymour (2003)
Insectivora	Tenrecidae	*Microgale talazaci*	44	0·243	44·0	0·243	White & Seymour (2003)
Insectivora	Tenrecidae	*Setifer setosus*	345	0·483	427·6	0·573	Lovegrove (2000)
Insectivora	Tenrecidae	*Setifer setosus*	530	0·680			White & Seymour (2003)
Insectivora	Tenrecidae	*Tenrec ecaudatus*	650	0·729	650·0	0·729	White & Seymour (2003)
Lagomorpha	Leporidae	*Brachylagus idahoensis*	432	2·145	432·0	2·145	Lovegrove (2003)
Lagomorpha	Leporidae	*Lepus alleni*	3 000	9·205	3 200·4	9·220	White & Seymour (2003)
Lagomorpha	Leporidae	*Lepus alleni*	3 250	9·972			Lovegrove (2000)
Lagomorpha	Leporidae	*Lepus alleni*	3 362	8·540			Heusner (1991)
Lagomorpha	Leporidae	*Lepus americanus*	1 380	5·235	1 603·4	6·708	Hart (1971)
Lagomorpha	Leporidae	*Lepus americanus*	1 480	6·605			Hart (1971)
Lagomorpha	Leporidae	*Lepus americanus*	1 562·8	6·975			Lovegrove (2000)
Lagomorpha	Leporidae	*Lepus americanus*	1 581	8·468			White & Seymour (2003)
Lagomorpha	Leporidae	*Lepus americanus*	2 100	6·650			Heusner (1991)
Lagomorpha	Leporidae	*Lepus arcticus*	3 004·4	6·036	3 004·4	6·036	White & Seymour (2003)
Lagomorpha	Leporidae	*Lepus californicus*	2 300	7·314	2 300·0	7·314	White & Seymour (2003)
Lagomorpha	Leporidae	*Lepus timidus*	3 004	6·033	3 014·5	8·443	Lovegrove (2000)
Lagomorpha	Leporidae	*Lepus timidus*	3 025	11·815			White & Seymour (2003)
Lagomorpha	Leporidae	*Lepus townsendii*	2 430	7·051	2 523·2	7·698	White & Seymour (2003)
Lagomorpha	Leporidae	*Lepus townsendii*	2 620	8·404			Lovegrove (2000)
Lagomorpha	Leporidae	*Oryctolagus cuniculus*	2 000	6·360	2167·9	7·395	White & Seymour (2003)
Lagomorpha	Leporidae	*Oryctolagus cuniculus*	2 350	8·600			Heusner (1991)
Lagomorpha	Leporidae	*Sylvilagus audubonii*	672·4	2·443	686·9	2·506	White & Seymour (2003)
Lagomorpha	Leporidae	*Sylvilagus audubonii*	701·7	2·570			Heusner (1991)
Lagomorpha	Ochotonidae	*Ochotona dauurica*	127·7	1·389	127·7	1·389	White & Seymour (2003)
Lagomorpha	Ochotonidae	*Ochotona princeps*	109	0·932	109·0	0·932	White & Seymour (2003)
Macroscelidae	Macroscelididae	*Elephantulus brachyrhynchus*	45·3	0·244	45·3	0·244	White & Seymour (2003)
Macroscelidae	Macroscelididae	*Elephantulus edwardii*	49·8	0·303	49·9	0·303	Lovegrove (2000)
Macroscelidae	Macroscelididae	*Elephantulus edwardii*	50	0·304			White & Seymour (2003)
Macroscelidae	Macroscelididae	*Elephantulus intufi*	46·49	0·290	46·5	0·290	White & Seymour (2003)
Macroscelidae	Macroscelididae	*Elephantulus myurus*	61	0·358	63·0	0·387	Lovegrove (2003)
Macroscelidae	Macroscelididae	*Elephantulus myurus*	62·97	0·370			White & Seymour (2003)
Macroscelidae	Macroscelididae	*Elephantulus myurus*	65·2	0·436			Lovegrove (2000)
Macroscelidae	Macroscelididae	*Elephantulus rozeti*	45·31	0·267	49·0	0·288	White & Seymour (2003)
Macroscelidae	Macroscelididae	*Elephantulus rozeti*	53	0·312			Lovegrove (2003)
Macroscelidae	Macroscelididae	*Elephantulus rufescens*	53	0·317	53·0	0·317	White & Seymour (2003)
Macroscelidae	Macroscelididae	*Macroscelides proboscideus*	39	0·292	39·0	0·292	White & Seymour (2003)
Macroscelidae	Macroscelididae	*Petrodromus tetradactylus*	206·1	1·001	208·0	0·852	Lovegrove (2003)
Macroscelidae	Macroscelididae	*Petrodromus tetradactylus*	208	0·859			Lovegrove (2000)
Macroscelidae	Macroscelididae	*Petrodromus tetradactylus*	210	0·720			Heusner (1991)
Monotremata	Ornithorhynchidae	*Ornithorhynchus anatinus*	693	1·082	1 030·3	1·931	White & Seymour (2003)
Monotremata	Ornithorhynchidae	*Ornithorhynchus anatinus*	1 200	2·500			Heusner (1991)
Monotremata	Ornithorynchidae	*Ornithorhynchus anatinus*	1 315	2·663			Lovegrove (2000)
Monotremata	Tachyglossidae	*Tachyglossus aculeatus*	2 140	1·564	2 909·0	2·327	Lovegrove (2000)
Monotremata	Tachyglossidae	*Tachyglossus aculeatus*	2 725	2·404			White & Seymour (2003)
Monotremata	Tachyglossidae	*Tachyglossus aculeatus*	3 430	2·550			Heusner (1991)
Monotremata	Tachyglossidae	*Tachyglossus aculeatus*	3 580	3·056			Lovegrove (2000)
Monotremata	Tachyglossidae	*Zaglossus bruijni*	10 300	6·778	11 848·6	6·493	White & Seymour (2003)
Monotremata	Tachyglossidae	*Zaglossus bruijni*	13 630	6·220			Heusner (1991)
Notoryctomorphia	Notoryctidae	*Notoryctes caurinus*	34	0·119	34·0	0·119	White & Seymour (2003)
Peramelemorphia	Peramelidae	*Isoodon auratus*	428	0·837	428·0	0·837	White & Seymour (2003)
Peramelemorphia	Peramelidae	*Isoodon macrourus*	1 551	3·202	1 551·0	3·202	White & Seymour (2003)
Peramelemorphia	Peramelidae	*Isoodon obesulus*	717	1·238	717·0	1·238	White & Seymour (2003)
Peramelemorphia	Peramelidae	*Macrotis lagotis*	1 011	1·974	1 245·5	2·400	Lovegrove (2000)
Peramelemorphia	Peramelidae	*Macrotis lagotis*	1 294	2·510			White & Seymour (2003)
Peramelemorphia	Peramelidae	*Macrotis lagotis*	1 477	2·790			Heusner (1991)
Peramelemorphia	Peramelidae	*Perameles gunnii*	837	2·343	837·0	2·343	White & Seymour (2003)
Peramelemorphia	Peramelidae	*Perameles nasuta*	645	1·763	645·0	1·763	White & Seymour (2003)
Peramelemorphia	Peroryctidae	*Echymipera rufescens*	616	1·685	886·6	2·255	White & Seymour (2003)
Peramelemorphia	Peroryctidae	*Echymipera rufescens*	1 276	3·018			White & Seymour (2003)
Peramelemorphia	Peroryctidae	*Perameles gunnii*	695	1·902	695·0	1·902	White & Seymour (2003)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Perissodactyla	Equidae	*Equus asinus*	177 500	164·920	177 500·0	164·920	Heusner (1991)
Pholidota	Manidae	*Manis crassicaudata*	15 910	6·923	15 910·0	6·923	White & Seymour (2003)
Pholidota	Manidae	*Manis javanica*	4 220	6·230	4 220·0	6·230	Heusner (1991)
Pholidota	Manidae	*Manis pentadactyla*	3 637·5	3·727	3 637·5	3·727	White & Seymour (2003)
Pholidota	Manidae	*Manis tetradactyla*	1 430	1·278	1 430·0	1·278	White & Seymour (2003)
Pholidota	Manidae	*Manis tricuspis*	1 365	1·540	1 930·4	2·670	White & Seymour (2003)
Pholidota	Manidae	*Manis tricuspis*	2 730	4·630			Heusner (1991)
Primates	Callitrichidae	*Callithrix jacchus*	190	0·848	190·0	0·848	White & Seymour (2003)
Primates	Callitrichidae	*Callithrix pygmaea*	105	0·550	110·7	0·599	Heusner (1991)
Primates	Callitrichidae	*Callithrix pygmaea*	116·8	0·653			White & Seymour (2003)
Primates	Callitrichidae	*Saguinus geoffroyi*	225	1·305	225·0	1·305	White & Seymour (2003)
Primates	Cebidae	*Alouatta palliata*	4 670	11·464	4 670·0	11·464	White & Seymour (2003)
Primates	Cebidae	*Aotus trivirgatus*	820	2·466	914·5	2·499	White & Seymour (2003)
Primates	Cebidae	*Aotus trivirgatus*	1 020	2·532			Lovegrove (2000)
Primates	Cebidae	*Saimiri sciureus*	800	4·390	836·7	4·429	Heusner (1991)
Primates	Cebidae	*Saimiri sciureus*	875	4·468			White & Seymour (2003)
Primates	Cercopithecidae	*Cercopithecus mitis*	8 500	18·923	8 648·7	19·276	White & Seymour (2003)
Primates	Cercopithecidae	*Cercopithecus mitis*	8 800	19·637			Lovegrove (2000)
Primates	Cercopithecidae	*Colobus guereza*	10 450	16·613	10 623·6	17·037	White & Seymour (2003)
Primates	Cercopithecidae	*Colobus guereza*	10 800	17·472			Lovegrove (2000)
Primates	Cercopithecidae	*Erythrocebus patas*	3 000	5·958	3 000·0	5·958	White & Seymour (2003)
Primates	Cercopithecidae	*Papio hamadryas*	9 500	15·497	12 670·8	21·095	White & Seymour (2003)
Primates	Cercopithecidae	*Papio hamadryas*	16 900	28·713			White & Seymour (2003)
Primates	Cheirogaleidae	*Cheirogaleus medius*	300	1·088	300·0	1·088	White & Seymour (2003)
Primates	Hominidae	*Homo sapiens sapiens*	70 000	82·780	70 000·0	82·780	Heusner (1991)
Primates	Indriidae	*Propithecus verreauxi*	3 350	3·738	3 350·0	3·738	White & Seymour (2003)
Primates	Lemuridae	*Eulemur fulvus*	2 330	4·162	2 374·1	4·239	White & Seymour (2003)
Primates	Lemuridae	*Eulemur fulvus*	2 419	4·318			Lovegrove (2000)
Primates	Lorisidae	*Arctocebus calabarensis*	206	0·731	206·0	0·731	White & Seymour (2003)
Primates	Lorisidae	*Euoticus elegantulus*	261·5	1·205	261·5	1·205	White & Seymour (2003)
Primates	Lorisidae	*Galago moholi*	170	0·285	170·0	0·285	White & Seymour (2003)
Primates	Lorisidae	*Galago senegalensis*	171·5	0·764	171·5	0·764	White & Seymour (2003)
Primates	Lorisidae	*Galagoides demidoff*	61	0·420	62·4	0·372	Heusner (1991)
Primates	Lorisidae	*Galagoides demidoff*	63·8	0·329			White & Seymour (2003)
Primates	Lorisidae	*Loris tardigradus*	284	0·714	284·0	0·714	White & Seymour (2003)
Primates	Lorisidae	*Nycticebus coucang*	953·3	1·292	1 128·6	1·504	Lovegrove (2000)
Primates	Lorisidae	*Nycticebus coucang*	1 160	1·523			White & Seymour (2003)
Primates	Lorisidae	*Nycticebus coucang*	1 300	1·730			Heusner (1991)
Primates	Lorisidae	*Otolemur crassicaudatus*	950	2·298	993·5	2·595	White & Seymour (2003)
Primates	Lorisidae	*Otolemur crassicaudatus*	1 039	2·930			Heusner (1991)
Primates	Lorisidae	*Otolemur garnettii*	1 314	3·927	1 314·0	3·927	White & Seymour (2003)
Primates	Lorisidae	*Perodicticus potto*	932·5	1·940	968·6	1·942	Lovegrove (2000)
Primates	Lorisidae	*Perodicticus potto*	964	1·824			White & Seymour (2003)
Primates	Lorisidae	*Perodicticus potto*	1 011	2·070			Heusner (1991)
Primates	Tarsiidae	*Tarsius spectrum*	173	0·831	173·0	0·831	White & Seymour (2003)
Primates	Tarsiidae	*Tarsius syrichta*	113	0·430	113·0	0·430	White & Seymour (2003)
Proboscidea	Elphantidae	*Elephas maximus*	3 672 000	2336·500	3 672 000·0	2336·500	Heusner (1991)
Rodentia	Agoutidae	*Agouti paca*	9 156	15·323	9 156·0	15·323	White & Seymour (2003)
Rodentia	Aplodontidae	*Aplodontia rufa*	630	1·546	706·8	1·892	White & Seymour (2003)
Rodentia	Aplodontidae	*Aplodontia rufa*	793	2·314			Lovegrove (2000)
Rodentia	Bathyergidae	*Bathyergus janetta*	406	1·201	406·0	1·201	White & Seymour (2003)
Rodentia	Bathyergidae	*Bathyergus suillus*	620	1·695	664·4	1·798	White & Seymour (2003)
Rodentia	Bathyergidae	*Bathyergus suillus*	712	1·907			Lovegrove (2000)
Rodentia	Bathyergidae	*Cryptomys bocagei*	94	0·388	94·0	0·388	White & Seymour (2003)
Rodentia	Bathyergidae	*Cryptomys damarensis*	125	0·397	131·3	0·418	Lovegrove (2000)
Rodentia	Bathyergidae	*Cryptomys damarensis*	138	0·439			White & Seymour (2003)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	60	0·328	78·9	0·350	Lovegrove (2000)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	71	0·380			Heusner (1991)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	75	0·377			White & Seymour (2003)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	77	0·271			Lovegrove (2000)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	79·5	0·310			White & Seymour (2003)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	95	0·360			Lovegrove (2000)
Rodentia	Bathyergidae	*Cryptomys hottentotus*	102	0·455			White & Seymour (2003)
Rodentia	Bathyergidae	*Cryptomys mechowi*	267	0·894	269·5	0·902	White & Seymour (2003)
Rodentia	Bathyergidae	*Cryptomys mechowi*	272	0·910			Lovegrove (2000)
Rodentia	Bathyergidae	*Georychus capensis*	191	0·629	193·0	0·637	Lovegrove (2000)
Rodentia	Bathyergidae	*Georychus capensis*	195	0·645			White & Seymour (2003)
Rodentia	Bathyergidae	*Heliophobius argenteocinereus*	88	0·420	88·5	0·430	Heusner (1991)
Rodentia	Bathyergidae	*Heliophobius argenteocinereus*	89	0·440			Heusner (1991)
Rodentia	Bathyergidae	*Heterocephalus glaber*	32	0·114	35·3	0·128	White & Seymour (2003)
Rodentia	Bathyergidae	*Heterocephalus glaber*	39	0·144			Lovegrove (2000)
Rodentia	Capromyidae	*Capromys pilorides*	2 630	3·375	2 630·0	3·375	White & Seymour (2003)
Rodentia	Capromyidae	*Geocapromys brownii*	2 456	4·110	2 456·0	4·110	White & Seymour (2003)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Capromyidae	*Geocapromys ingrahami*	775	1·483	775·0	1·483	White & Seymour (2003)
Rodentia	Caviidae	*Cavia porcellus*	570	2·226	639·1	2·130	Hart (1971)
Rodentia	Caviidae	*Cavia porcellus*	629	1·930			White & Seymour (2003)
Rodentia	Caviidae	*Cavia porcellus*	728	2·250			Heusner (1991)
Rodentia	Caviidae	*Dolichotis salinicola*	1 613	4·050	1 613·0	4·050	White & Seymour (2003)
Rodentia	Caviidae	*Galea musteloides*	322	1·473	322·0	1·473	White & Seymour (2003)
Rodentia	Caviidae	*Kerodon rupestris*	801	2·011	801·0	2·011	White & Seymour (2003)
Rodentia	Caviidae	*Microcavia niata*	255	0·980	255·0	0·980	White & Seymour (2003)
Rodentia	Chinchillidae	*Chinchilla lanigera*	403	1·574	436·7	1·310	Lovegrove (2000)
Rodentia	Chinchillidae	*Chinchilla lanigera*	426	1·117			White & Seymour (2003)
Rodentia	Chinchillidae	*Chinchilla lanigera*	485	1·280			Heusner (1991)
Rodentia	Chinchillidae	*Lagostomus maximus*	6 784	10·597	6 794·0	10·623	Lovegrove (2000)
Rodentia	Chinchillidae	*Lagostomus maximus*	6 804	10·650			Heusner (1991)
Rodentia	Ctenomyidae	*Ctenomys australis*	340	0·650	340·0	0·650	White & Seymour (2003)
Rodentia	Ctenomyidae	*Ctenomys fulvus*	300	1·054	300·0	1·054	White & Seymour (2003)
Rodentia	Ctenomyidae	*Ctenomys maulinus*	215	1·044	215·0	1·044	White & Seymour (2003)
Rodentia	Ctenomyidae	*Ctenomys peruanus*	490	1·230	490·0	1·230	White & Seymour (2003)
Rodentia	Ctenomyidae	*Ctenomys talarum*	121	0·611	121·0	0·611	White & Seymour (2003)
Rodentia	Dasyproctidae	*Dasyprocta azarae*	3 849	10·521	3 849·0	10·521	White & Seymour (2003)
Rodentia	Dasyproctidae	*Dasyprocta leporina*	2 687	8·694	2 687·0	8·694	White & Seymour (2003)
Rodentia	Dasyproctidae	*Myoprocta acouchy*	914	2·804	914·0	2·804	White & Seymour (2003)
Rodentia	Dipodidae	*Dipus sagitta?*	160	0·676	160·0	0·676	White & Seymour (2003)
Rodentia	Dipodidae	*Jaculus jaculus*	75	0·515	75·0	0·515	White & Seymour (2003)
Rodentia	Dipodidae	*Jaculus orientalis*	139	0·775	139·0	0·775	White & Seymour (2003)
Rodentia	Dipodidae	*Napaeozapus insignis*	21·6	0·220	21·8	0·220	Heusner (1991)
Rodentia	Dipodidae	*Napaeozapus insignis*	22	0·221			White & Seymour (2003)
Rodentia	Dipodidae	*Sicista betulina*	10	0·179	10·0	0·179	White & Seymour (2003)
Rodentia	Dipodidae	*Zapus hudsonius*	23·8	0·199	26·1	0·219	White & Seymour (2003)
Rodentia	Dipodidae	*Zapus hudsonius*	25	0·209			Hart (1971)
Rodentia	Dipodidae	*Zapus hudsonius*	30	0·251			Lovegrove (2000)
Rodentia	Echimyidae	*Proechimys semispinosus*	498	1·750	498·0	1·750	White & Seymour (2003)
Rodentia	Echimyidae	*Thrichomys apereoides*	323	1·153	323·0	1·153	White & Seymour (2003)
Rodentia	Erethizontidae	*Coendou prehensilis*	3 280	5·123	3 280·0	5·123	White & Seymour (2003)
Rodentia	Erethizontidae	*Erethizon dorsatum*	4 290	11·966	6 871·0	13·675	Hart (1971)
Rodentia	Erethizontidae	*Erethizon dorsatum*	6 790	13·760			Heusner (1991)
Rodentia	Erethizontidae	*Erethizon dorsatum*	11 136	15·531			White & Seymour (2003)
Rodentia	Geomyidae	*Geomys bursarius*	197	0·769	197·0	0·769	Bradley & Yousef (1975)
Rodentia	Geomyidae	*Geomys pinetis*	173	0·743	191·5	0·768	White & Seymour (2003)
Rodentia	Geomyidae	*Geomys pinetis*	200	0·792			Lovegrove (2000)
Rodentia	Geomyidae	*Geomys pinetis*	203	0·770			Heusner (1991)
Rodentia	Geomyidae	*Thomomys bottae*	143	0·670	143·0	0·670	White & Seymour (2003)
Rodentia	Geomyidae	*Thomomys talpoides*	82·6	0·550	97·6	0·679	Heusner (1991)
Rodentia	Geomyidae	*Thomomys talpoides*	105·5	0·719			Lovegrove (2000)
Rodentia	Geomyidae	*Thomomys talpoides*	106·8	0·792			White & Seymour (2003)
Rodentia	Geomyidae	*Thomomys umbrinus*	85	0·403	90·0	0·427	White & Seymour (2003)
Rodentia	Geomyidae	*Thomomys umbrinus*	95·3	0·452			Lovegrove (2000)
Rodentia	Heteromyidae	*Chaetodipus baileyi*	29·1	0·192	29·1	0·192	White & Seymour (2003)
Rodentia	Heteromyidae	*Chaetodipus californicus*	22	0·119	22·0	0·119	White & Seymour (2003)
Rodentia	Heteromyidae	*Chaetodipus fallax*	19·6	0·150	19·6	0·150	Hinds & MacMillen (1985)
Rodentia	Heteromyidae	*Chaetodipus formosus*	15·1	0·103	15·1	0·103	Lovegrove (2003)
Rodentia	Heteromyidae	*Chaetodipus hispidus*	32	0·256	35·6	0·266	Lovegrove (2003)
Rodentia	Heteromyidae	*Chaetodipus hispidus*	35·8	0·268			Lovegrove (2000)
Rodentia	Heteromyidae	*Chaetodipus hispidus*	39·5	0·276			White & Seymour (2003)
Rodentia	Heteromyidae	*Chaetodipus intermedius*	14·6	0·087	15·9	0·106	Lovegrove (2000)
Rodentia	Heteromyidae	*Chaetodipus intermedius*	15	0·100			White & Seymour (2003)
Rodentia	Heteromyidae	*Chaetodipus intermedius*	18·3	0·136			Lovegrove (2003)
Rodentia	Heteromyidae	*Chaetodipus penicillatus*	16	0·125	16·0	0·125	White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys agilis*	60·6	0·355	60·6	0·355	White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys deserti*	104·7	0·541	105·8	0·517	Lovegrove (2003)
Rodentia	Heteromyidae	*Dipodomys deserti*	104·9	0·524			Lovegrove (2000)
Rodentia	Heteromyidae	*Dipodomys deserti*	106	0·514			White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys deserti*	107·5	0·490			Heusner (1991)
Rodentia	Heteromyidae	*Dipodomys heermanni*	63·3	0·408	63·3	0·408	White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys merriami*	35	0·234	37·6	0·246	Hart (1971)
Rodentia	Heteromyidae	*Dipodomys merriami*	35·8	0·295			Lovegrove (2003)
Rodentia	Heteromyidae	*Dipodomys merriami*	36·5	0·237			White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys merriami*	37·7	0·248			Lovegrove (2000)
Rodentia	Heteromyidae	*Dipodomys merriami*	38	0·240			Hart (1971)
Rodentia	Heteromyidae	*Dipodomys merriami*	43·4	0·230			Heusner (1991)
Rodentia	Heteromyidae	*Dipodomys microps*	51·5	0·305	54·6	0·335	Lovegrove (2003)
Rodentia	Heteromyidae	*Dipodomys microps*	54·2	0·330			Heusner (1991)
Rodentia	Heteromyidae	*Dipodomys microps*	55·7	0·336			Lovegrove (2000)
Rodentia	Heteromyidae	*Dipodomys microps*	57·2	0·373			White & Seymour (2003)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Heteromyidae	*Dipodomys nitratoides*	37·8	0·257	37·8	0·204	White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys nitratoides*	37·8	0·162			Lovegrove (2003)
Rodentia	Heteromyidae	*Dipodomys ordii*	46·8	0·358	47·8	0·339	White & Seymour (2003)
Rodentia	Heteromyidae	*Dipodomys ordii*	48·8	0·320			Heusner (1991)
Rodentia	Heteromyidae	*Dipodomys panamintinus*	56·9	0·380	60·4	0·397	Heusner (1991)
Rodentia	Heteromyidae	*Dipodomys panamintinus*	64·2	0·414			White & Seymour (2003)
Rodentia	Heteromyidae	*Heteromys anomalus*	69·3	0·561	69·3	0·561	White & Seymour (2003)
Rodentia	Heteromyidae	*Heteromys desmarestianus*	75·8	0·553	75·8	0·553	White & Seymour (2003)
Rodentia	Heteromyidae	*Liomys irroratus*	44·9	0·336	46·5	0·318	Lovegrove (2003)
Rodentia	Heteromyidae	*Liomys irroratus*	48·1	0·301			White & Seymour (2003)
Rodentia	Heteromyidae	*Liomys salvini*	42·7	0·313	43·7	0·281	Lovegrove (2003)
Rodentia	Heteromyidae	*Liomys salvini*	43·8	0·262			White & Seymour (2003)
Rodentia	Heteromyidae	*Liomys salvini*	44·5	0·270			Lovegrove (2000)
Rodentia	Heteromyidae	*Microdipodops megacephalus*	11	0·168	11·0	0·168	White & Seymour (2003)
Rodentia	Heteromyidae	*Microdipodops pallidus*	15·2	0·110	15·2	0·110	Lovegrove (2000)
Rodentia	Heteromyidae	*Perognathus flavus*	8·3	0·097	8·3	0·097	White & Seymour (2003)
Rodentia	Heteromyidae	*Perognathus longimembris*	8·2	0·070	8·5	0·061	Lovegrove (2000)
Rodentia	Heteromyidae	*Perognathus longimembris*	8·9	0·053			White & Seymour (2003)
Rodentia	Heteromyidae	*Perognathus parvus*	19·2	0·160	19·2	0·160	Heusner (1991)
Rodentia	Hydrochaeridae	*Hydrochaeris hydrochaeris*	26 385	36·798	26 385·0	36·798	White & Seymour (2003)
Rodentia	Hystricidae	*Hystrix africaeaustralis*	11 300	13·175	11 300·0	13·175	White & Seymour (2003)
Rodentia	Muridae	*Acomys cahirinus*	42	0·258	42·0	0·258	White & Seymour (2003)
Rodentia	Muridae	*Acomys russatus*	51·1	0·230	55·4	0·240	Heusner (1991)
Rodentia	Muridae	*Acomys russatus*	55·55	0·239			White & Seymour (2003)
Rodentia	Muridae	*Acomys russatus*	60	0·251			Lovegrove (2003)
Rodentia	Muridae	*Acomys spinosissimus*	27·02	0·246	27·0	0·246	White & Seymour (2003)
Rodentia	Muridae	*Acomys subspinosus*	32·25	0·465	32·3	0·465	White & Seymour (2003)
Rodentia	Muridae	*Aethomys namaquensis*	57·3	0·269	62·6	0·292	Lovegrove (2000)
Rodentia	Muridae	*Aethomys namaquensis*	64·2	0·317			White & Seymour (2003)
Rodentia	Muridae	*Aethomys namaquensis*	66·6	0·293			Lovegrove (2003)
Rodentia	Muridae	*Akodon albiventer*	31	0·259	31·0	0·259	White & Seymour (2003)
Rodentia	Muridae	*Akodon azarae*	23·5	0·223	23·7	0·225	Lovegrove (2000)
Rodentia	Muridae	*Akodon azarae*	24	0·228			White & Seymour (2003)
Rodentia	Muridae	*Akodon lanosus*	24	0·254	24·0	0·254	White & Seymour (2003)
Rodentia	Muridae	*Akodon longipilis*	42·3	0·321	42·3	0·321	White & Seymour (2003)
Rodentia	Muridae	*Akodon olivaceus*	27	0·276	27·0	0·276	White & Seymour (2003)
Rodentia	Muridae	*Alticola argentatus*	37·7	0·675	37·7	0·675	White & Seymour (2003)
Rodentia	Muridae	*Apodemus agrarius*	21·2	0·373	21·2	0·373	Lovegrove (2003)
Rodentia	Muridae	*Apodemus flavicollis*	23·4	0·236	28·3	0·365	Lovegrove (2003)
Rodentia	Muridae	*Apodemus flavicollis*	23·9	0·242			White & Seymour (2003)
Rodentia	Muridae	*Apodemus flavicollis*	40·5	0·850			Lovegrove (2000)
Rodentia	Muridae	*Apodemus hermonensis*	20·5	0·279	20·6	0·280	White & Seymour (2003)
Rodentia	Muridae	*Apodemus hermonensis*	20·7	0·282			Lovegrove (2000)
Rodentia	Muridae	*Apodemus mystacinus*	40·4	0·312	41·3	0·351	White & Seymour (2003)
Rodentia	Muridae	*Apodemus mystacinus*	42·3	0·394			Lovegrove (2000)
Rodentia	Muridae	*Apodemus sylvaticus*	22	0·318	23·8	0·264	Lovegrove (2000)
Rodentia	Muridae	*Apodemus sylvaticus*	23·9	0·242			White & Seymour (2003)
Rodentia	Muridae	*Apodemus sylvaticus*	25·7	0·241			Lovegrove (2003)
Rodentia	Muridae	*Arborimus longicaudus*	21·8	0·329	21·8	0·329	White & Seymour (2003)
Rodentia	Muridae	*Arvicola terrestris*	92	0·595	94·7	0·613	White & Seymour (2003)
Rodentia	Muridae	*Arvicola terrestris*	97·5	0·631			Lovegrove (2000)
Rodentia	Muridae	*Auliscomys boliviensis*	76·8	0·617	76·8	0·617	White & Seymour (2003)
Rodentia	Muridae	*Auliscomys micropus*	62·3	0·546	62·3	0·546	White & Seymour (2003)
Rodentia	Muridae	*Baiomys taylori*	7·15	0·095	7·2	0·095	White & Seymour (2003)
Rodentia	Muridae	*Calomys callosus*	48	0·311	49·2	0·371	Lovegrove (2000)
Rodentia	Muridae	*Calomys callosus*	49·5	0·395			Lovegrove (2000)
Rodentia	Muridae	*Calomys callosus*	50·1	0·417			White & Seymour (2003)
Rodentia	Muridae	*Calomys lepidus*	16	0·161	16·0	0·161	Lovegrove (2003)
Rodentia	Muridae	*Calomys musculinus*	16·9	0·154	16·9	0·154	White & Seymour (2003)
Rodentia	Muridae	*Cannomys badius*	344	0·960	344·0	0·960	White & Seymour (2003)
Rodentia	Muridae	*Chionomys nivalis*	32·8	0·452	32·8	0·452	White & Seymour (2003)
Rodentia	Muridae	*Chroeomys andinus*	34·6	0·361	34·7	0·353	White & Seymour (2003)
Rodentia	Muridae	*Chroeomys andinus*	34·9	0·345			Lovegrove (2003)
Rodentia	Muridae	*Clethrionomys californicus*	18·3	0·341	18·3	0·341	Lovegrove (2000)
Rodentia	Muridae	*Clethrionomys gapperi*	22·3	0·275	23·4	0·291	White & Seymour (2003)
Rodentia	Muridae	*Clethrionomys gapperi*	23·3	0·270			Lovegrove (2003)
Rodentia	Muridae	*Clethrionomys gapperi*	24·6	0·332			Lovegrove (2000)
Rodentia	Muridae	*Clethrionomys glareolus*	18	0·311	21·5	0·312	Hart (1971)
Rodentia	Muridae	*Clethrionomys glareolus*	20·5	0·270			Heusner (1991)
Rodentia	Muridae	*Clethrionomys glareolus*	23·4	0·354			White & Seymour (2003)
Rodentia	Muridae	*Clethrionomys glareolus*	24·6	0·320			Lovegrove (2003)
Rodentia	Muridae	*Clethrionomys rufocanus*	27	0·331	27·2	0·321	White & Seymour (2003)
Rodentia	Muridae	*Clethrionomys rufocanus*	27·5	0·310			Heusner (1991)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Muridae	*Clethrionomys rutilus*	28	0·430	28·0	0·430	White & Seymour (2003)
Rodentia	Muridae	*Conilurus penicillatus*	213·2	0·908	213·2	0·908	White & Seymour (2003)
Rodentia	Muridae	*Cricetomys gambianus*	1 521·4	5·703	1 686·7	6·024	Lovegrove (2000)
Rodentia	Muridae	*Cricetomys gambianus*	1 870	6·364			White & Seymour (2003)
Rodentia	Muridae	*Cricetulus migratorius*	30·7	0·245	30·7	0·245	White & Seymour (2003)
Rodentia	Muridae	*Cricetus cricetus*	336·7	1·190	365·3	1·251	Heusner (1991)
Rodentia	Muridae	*Cricetus cricetus*	362	1·293			White & Seymour (2003)
Rodentia	Muridae	*Cricetus cricetus*	400	1·272			Hart (1971)
Rodentia	Muridae	*Desmodillus auricularis*	71·93	0·490	71·9	0·490	White & Seymour (2003)
Rodentia	Muridae	*Dicrostonyx groenlandicus*	47	0·520	56·8	0·459	Heusner (1991)
Rodentia	Muridae	*Dicrostonyx groenlandicus*	59·62	0·551			White & Seymour (2003)
Rodentia	Muridae	*Dicrostonyx groenlandicus*	61	0·391			Hart (1971)
Rodentia	Muridae	*Dicrostonyx groenlandicus*	61	0·395			Hart (1971)
Rodentia	Muridae	*Eligmodontia typus*	17·5	0·167	17·5	0·167	White & Seymour (2003)
Rodentia	Muridae	*Euneomys chinchilloides*	65·4	0·471	65·4	0·471	White & Seymour (2003)
Rodentia	Muridae	*Gerbillurus paeba*	33·9	0·194	33·9	0·194	White & Seymour (2003)
Rodentia	Muridae	*Gerbillurus setzeri*	46·1	0·206	46·1	0·206	White & Seymour (2003)
Rodentia	Muridae	*Gerbillurus tytonis*	29·9	0·177	29·9	0·177	White & Seymour (2003)
Rodentia	Muridae	*Gerbillurus vallinus*	38·8	0·194	38·8	0·194	White & Seymour (2003)
Rodentia	Muridae	*Gerbillus allenbyi*	35·3	0·217	35·3	0·217	Lovegrove (2000)
Rodentia	Muridae	*Gerbillus dasyurus*	27·6	0·163	27·6	0·163	White & Seymour (2003)
Rodentia	Muridae	*Gerbillus gerbillus*	29·7	0·237	29·7	0·237	White & Seymour (2003)
Rodentia	Muridae	*Gerbillus nanus*	28·4	0·124	29·7	0·129	White & Seymour (2003)
Rodentia	Muridae	*Gerbillus nanus*	31	0·135			Lovegrove (2000)
Rodentia	Muridae	*Gerbillus perpallidus*	52·4	0·243	56·3	0·261	White & Seymour (2003)
Rodentia	Muridae	*Gerbillus perpallidus*	60·5	0·280			Lovegrove (2003)
Rodentia	Muridae	*Gerbillus pusillus*	12·6	0·075	12·6	0·075	White & Seymour (2003)
Rodentia	Muridae	*Gerbillus pyramidum*	108·5	0·454	108·5	0·454	White & Seymour (2003)
Rodentia	Muridae	*Golunda ellioti*	56·2	0·339	56·2	0·339	Lovegrove (2003)
Rodentia	Muridae	*Graomys griseoflavus*	69·4	0·469	69·4	0·469	White & Seymour (2003)
Rodentia	Muridae	*Hydromys chrysogaster*	900	2·970	900·0	2·970	Heusner (1991)
Rodentia	Muridae	*Isthmomys pirrensis*	137·9	0·677	137·9	0·677	White & Seymour (2003)
Rodentia	Muridae	*Lasiopodomys brandtii*	40·2	0·428	40·2	0·428	White & Seymour (2003)
Rodentia	Muridae	*Lemmiscus curtatus*	30·3	0·281	30·3	0·281	White & Seymour (2003)
Rodentia	Muridae	*Lemmus lemmus*	80	1·071	80·0	1·071	White & Seymour (2003)
Rodentia	Muridae	*Lemmus sibiricus*	50·2	0·503	60·8	0·667	White & Seymour (2003)
Rodentia	Muridae	*Lemmus sibiricus*	64	0·882			Lovegrove (2000)
Rodentia	Muridae	*Lemmus sibiricus*	70	0·670			Heusner (1991)
Rodentia	Muridae	*Lemniscomys griselda*	47·5	0·321	47·5	0·321	White & Seymour (2003)
Rodentia	Muridae	*Lemniscomys rosalia*	50·53	0·343	50·5	0·343	White & Seymour (2003)
Rodentia	Muridae	*Malacothrix typica*	21·7	0·115	21·7	0·115	White & Seymour (2003)
Rodentia	Muridae	*Mastomys natalensis*	41·49	0·183	41·5	0·183	Lovegrove (2000)
Rodentia	Muridae	*Megadontomys thomasi*	110·8	0·692	110·8	0·692	White & Seymour (2003)
Rodentia	Muridae	*Meriones hurrianae*	69	0·304	70·6	0·301	White & Seymour (2003)
Rodentia	Muridae	*Meriones hurrianae*	72·3	0·298			Lovegrove (2003)
Rodentia	Muridae	*Meriones tristrami*	112	0·550	112·0	0·550	White & Seymour (2003)
Rodentia	Muridae	*Meriones unguiculatus*	58·1	0·690	64·8	0·546	Lovegrove (2003)
Rodentia	Muridae	*Meriones unguiculatus*	67	0·430			White & Seymour (2003)
Rodentia	Muridae	*Meriones unguiculatus*	70	0·547			Hart (1971)
Rodentia	Muridae	*Mesocricetus auratus*	98	0·820	108·2	0·690	White & Seymour (2003)
Rodentia	Muridae	*Mesocricetus auratus*	119·5	0·580			Heusner (1991)
Rodentia	Muridae	*Micromys minutus*	6	0·224	7·6	0·201	Hart (1971)
Rodentia	Muridae	*Micromys minutus*	7·37	0·118			White & Seymour (2003)
Rodentia	Muridae	*Micromys minutus*	8·7	0·240			Heusner (1991)
Rodentia	Muridae	*Micromys minutus*	8·71	0·260			Heusner (1991)
Rodentia	Muridae	*Microtus agrestis*	22·3	0·380	25·0	0·367	Heusner (1991)
Rodentia	Muridae	*Microtus agrestis*	28	0·355			White & Seymour (2003)
Rodentia	Muridae	*Microtus arvalis*	20	0·346	21·9	0·343	White & Seymour (2003)
Rodentia	Muridae	*Microtus arvalis*	23·9	0·340			Heusner (1991)
Rodentia	Muridae	*Microtus breweri*	53·1	0·412	53·1	0·412	White & Seymour (2003)
Rodentia	Muridae	*Microtus californicus*	44	0·380	44·0	0·380	White & Seymour (2003)
Rodentia	Muridae	*Microtus guentheri*	43·8	0·447	43·8	0·447	White & Seymour (2003)
Rodentia	Muridae	*Microtus longicaudus*	28·6	0·377	32·5	0·383	White & Seymour (2003)
Rodentia	Muridae	*Microtus longicaudus*	30·2	0·347			Lovegrove (2003)
Rodentia	Muridae	*Microtus longicaudus*	31·2	0·410			Lovegrove (2000)
Rodentia	Muridae	*Microtus longicaudus*	41·4	0·400			Heusner (1991)
Rodentia	Muridae	*Microtus mexicanus*	28	0·260	28·4	0·261	Heusner (1991)
Rodentia	Muridae	*Microtus mexicanus*	28·8	0·262			White & Seymour (2003)
Rodentia	Muridae	*Microtus montanus*	30·8	0·455	32·9	0·460	Lovegrove (2000)
Rodentia	Muridae	*Microtus montanus*	35·1	0·465			White & Seymour (2003)
Rodentia	Muridae	*Microtus ochrogaster*	46·7	0·441	48·2	0·410	White & Seymour (2003)
Rodentia	Muridae	*Microtus ochrogaster*	47	0·459			Lovegrove (2000)
Rodentia	Muridae	*Microtus ochrogaster*	51	0·340			Heusner (1991)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Muridae	*Microtus oeconomus*	32	0·570	32·8	0·566	Heusner (1991)
Rodentia	Muridae	*Microtus oeconomus*	33·7	0·563			White & Seymour (2003)
Rodentia	Muridae	*Microtus pennsylvanicus*	37·8	0·457	38·2	0·428	Lovegrove (2000)
Rodentia	Muridae	*Microtus pennsylvanicus*	38	0·410			Heusner (1991)
Rodentia	Muridae	*Microtus pennsylvanicus*	38·9	0·419			White & Seymour (2003)
Rodentia	Muridae	*Microtus pinetorum*	23·8	0·312	24·8	0·305	Lovegrove (2003)
Rodentia	Muridae	*Microtus pinetorum*	25	0·280			Heusner (1991)
Rodentia	Muridae	*Microtus pinetorum*	25·5	0·326			White & Seymour (2003)
Rodentia	Muridae	*Microtus richardsoni*	51	0·500	64·5	0·701	Heusner (1991)
Rodentia	Muridae	*Microtus richardsoni*	65·65	0·714			White & Seymour (2003)
Rodentia	Muridae	*Microtus richardsoni*	80	0·964			Lovegrove (2003)
Rodentia	Muridae	*Microtus subterraneus*	17·8	0·276	17·8	0·276	White & Seymour (2003)
Rodentia	Muridae	*Microtus townsendii*	52·2	0·504	52·2	0·504	White & Seymour (2003)
Rodentia	Muridae	*Microtus xanthognathus*	68·5	0·550	68·5	0·550	White & Seymour (2003)
Rodentia	Muridae	*Millardia meltada*	67·4	0·327	67·4	0·327	White & Seymour (2003)
Rodentia	Muridae	*Mus minutoides*	7·92	0·124	8·0	0·129	Lovegrove (2000)
Rodentia	Muridae	*Mus minutoides*	8·06	0·134			White & Seymour (2003)
Rodentia	Muridae	*Mus musculus*	13·2	0·365	18·0	0·271	Lovegrove (2003)
Rodentia	Muridae	*Mus musculus*	17	0·160			Heusner (1991)
Rodentia	Muridae	*Mus musculus*	26	0·340			Heusner (1991)
Rodentia	Muridae	*Mus spretus*	21·8	0·345	21·8	0·345	White & Seymour (2003)
Rodentia	Muridae	*Myopus schisticolor*	26·4	0·522	26·4	0·522	White & Seymour (2003)
Rodentia	Muridae	*Mystromys albicaudatus*	93·78	0·707	93·8	0·707	White & Seymour (2003)
Rodentia	Muridae	*Nannospalax ehrenbergi*	128	0·614	133·8	0·585	Lovegrove (2000)
Rodentia	Muridae	*Nannospalax ehrenbergi*	134	0·568			White & Seymour (2003)
Rodentia	Muridae	*Nannospalax ehrenbergi*	134	0·462			White & Seymour (2003)
Rodentia	Muridae	*Nannospalax ehrenbergi*	135	0·640			White & Seymour (2003)
Rodentia	Muridae	*Nannospalax ehrenbergi*	138	0·662			White & Seymour (2003)
Rodentia	Muridae	*Nannospalax leucodon*	151·9	0·713	183·3	0·760	Lovegrove (2000)
Rodentia	Muridae	*Nannospalax leucodon*	177·9	0·630			Heusner (1991)
Rodentia	Muridae	*Nannospalax leucodon*	201	0·830			White & Seymour (2003)
Rodentia	Muridae	*Nannospalax leucodon*	208	0·893			Hart (1971)
Rodentia	Muridae	*Neofiber alleni*	258·1	1·209	258·1	1·209	White & Seymour (2003)
Rodentia	Muridae	*Neotoma albigula*	172·4	0·720	177·6	0·735	Heusner (1991)
Rodentia	Muridae	*Neotoma albigula*	183	0·750			White & Seymour (2003)
Rodentia	Muridae	*Neotoma cinerea*	205·1	0·941	256·5	1·152	White & Seymour (2003)
Rodentia	Muridae	*Neotoma cinerea*	320·9	1·410			Heusner (1991)
Rodentia	Muridae	*Neotoma fuscipes*	187	0·824	187·0	0·824	White & Seymour (2003)
Rodentia	Muridae	*Neotoma lepida*	98·7	0·413	112·5	0·460	Lovegrove (2003)
Rodentia	Muridae	*Neotoma lepida*	106	0·360			Heusner (1991)
Rodentia	Muridae	*Neotoma lepida*	110	0·485			White & Seymour (2003)
Rodentia	Muridae	*Neotoma lepida*	113·4	0·517			Lovegrove (2000)
Rodentia	Muridae	*Neotoma lepida*	138	0·554			Hart (1971)
Rodentia	Muridae	*Notomys alexis*	32·3	0·252	32·3	0·252	White & Seymour (2003)
Rodentia	Muridae	*Notomys cervinus*	33·2	0·246	33·7	0·239	Lovegrove (2000)
Rodentia	Muridae	*Notomys cervinus*	34·2	0·233			White & Seymour (2003)
Rodentia	Muridae	*Ochrotomys nuttalli*	19·5	0·151	19·5	0·151	White & Seymour (2003)
Rodentia	Muridae	*Oligoryzomys longicaudatus*	28·2	0·285	28·2	0·285	White & Seymour (2003)
Rodentia	Muridae	*Ondatra zibethicus*	842	3·890	976·3	4·363	Heusner (1991)
Rodentia	Muridae	*Ondatra zibethicus*	1 004·6	3·586			White & Seymour (2003)
Rodentia	Muridae	*Ondatra zibethicus*	1 100	5·952			Hart (1971)
Rodentia	Muridae	*Onychomys torridus*	19·1	0·165	19·1	0·165	White & Seymour (2003)
Rodentia	Muridae	*Otomys irroratus*	102	0·474	102·0	0·474	White & Seymour (2003)
Rodentia	Muridae	*Otomys sloggetti*	113·29	0·746	113·3	0·746	White & Seymour (2003)
Rodentia	Muridae	*Otomys unisulcatus*	96	0·595	96·0	0·595	White & Seymour (2003)
Rodentia	Muridae	*Oxymycterus roberti*	83·5	0·508	83·5	0·508	White & Seymour (2003)
Rodentia	Muridae	*Parotomys brantsii*	86·5	0·468	86·5	0·468	White & Seymour (2003)
Rodentia	Muridae	*Peromyscus boylii*	23·2	0·303	23·2	0·303	White & Seymour (2003)
Rodentia	Muridae	*Peromyscus californicus*	45·5	0·261	47·0	0·267	Lovegrove (2003)
Rodentia	Muridae	*Peromyscus californicus*	47·6	0·292			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus californicus*	48	0·250			Heusner (1991)
Rodentia	Muridae	*Peromyscus crinitus*	13·6	0·100	20·5	0·162	Heusner (1991)
Rodentia	Muridae	*Peromyscus crinitus*	15·9	0·140			Lovegrove (2003)
Rodentia	Muridae	*Peromyscus crinitus*	16	0·143			Hart (1971)
Rodentia	Muridae	*Peromyscus crinitus*	20·9	0·173			Lovegrove (2003)
Rodentia	Muridae	*Peromyscus crinitus*	49·6	0·324			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus eremicus*	20	0·179	21·0	0·173	Hart (1971)
Rodentia	Muridae	*Peromyscus eremicus*	20·7	0·150			Heusner (1991)
Rodentia	Muridae	*Peromyscus eremicus*	21·5	0·185			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus eremicus*	22	0·182			Lovegrove (2000)
Rodentia	Muridae	*Peromyscus gossypinus*	21·5	0·206	21·5	0·206	White & Seymour (2003)
Rodentia	Muridae	*Peromyscus leucopus*	20	0·185	22·3	0·213	White & Seymour (2003)
Rodentia	Muridae	*Peromyscus leucopus*	21·4	0·189			Lovegrove (2000)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Muridae	*Peromyscus leucopus*	22·1	0·205			Lovegrove (2003)
Rodentia	Muridae	*Peromyscus leucopus*	22·3	0·190			Heusner (1991)
Rodentia	Muridae	*Peromyscus leucopus*	26	0·319			Hart (1971)
Rodentia	Muridae	*Peromyscus maniculatus*	17	0·170	20·5	0·219	Heusner (1991)
Rodentia	Muridae	*Peromyscus maniculatus*	18·7	0·203			Lovegrove (2000)
Rodentia	Muridae	*Peromyscus maniculatus*	18·93	0·220			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	19	0·212			Hart (1971)
Rodentia	Muridae	*Peromyscus maniculatus*	19	0·223			Hart (1971)
Rodentia	Muridae	*Peromyscus maniculatus*	19·1	0·217			Lovegrove (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	19·53	0·222			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	20·38	0·209			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	22	0·245			Hart (1971)
Rodentia	Muridae	*Peromyscus maniculatus*	22·8	0·206			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	23·19	0·257			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	24·2	0·225			Lovegrove (2003)
Rodentia	Muridae	*Peromyscus maniculatus*	25	0·251			Hart (1971)
Rodentia	Muridae	*Peromyscus megalops*	66	0·515	66·1	0·511	Hart (1971)
Rodentia	Muridae	*Peromyscus megalops*	66·2	0·506			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus oreas*	24·58	0·243	24·6	0·243	White & Seymour (2003)
Rodentia	Muridae	*Peromyscus polionotus*	12	0·120	12·0	0·120	Lovegrove (2003)
Rodentia	Muridae	*Peromyscus sitkensis*	28·3	0·261	28·3	0·261	White & Seymour (2003)
Rodentia	Muridae	*Peromyscus truei*	33	0·256	33·1	0·307	Lovegrove (2000)
Rodentia	Muridae	*Peromyscus truei*	33	0·350			Hart (1971)
Rodentia	Muridae	*Peromyscus truei*	33·2	0·283			White & Seymour (2003)
Rodentia	Muridae	*Peromyscus truei*	33·3	0·349			White & Seymour (2003)
Rodentia	Muridae	*Petromyscus collinus*	20·41	0·115	20·4	0·115	Lovegrove (2003)
Rodentia	Muridae	*Phenacomys intermedius*	21·5	0·375	21·5	0·375	White & Seymour (2003)
Rodentia	Muridae	*Phodopus sungorus*	25·7	0·228	31·3	0·313	White & Seymour (2003)
Rodentia	Muridae	*Phodopus sungorus*	31·4	0·329			Lovegrove (2003)
Rodentia	Muridae	*Phodopus sungorus*	33·2	0·300			Heusner (1991)
Rodentia	Muridae	*Phodopus sungorus*	35·9	0·425			Lovegrove (2000)
Rodentia	Muridae	*Phyllotis darwini*	36	0·253	47·0	0·333	Lovegrove (2000)
Rodentia	Muridae	*Phyllotis darwini*	49	0·367			White & Seymour (2003)
Rodentia	Muridae	*Phyllotis darwini*	59	0·398			White & Seymour (2003)
Rodentia	Muridae	*Phyllotis magister*	62·8	0·385	62·8	0·385	White & Seymour (2003)
Rodentia	Muridae	*Phyllotis xanthopygus*	55	0·316	55·0	0·316	White & Seymour (2003)
Rodentia	Muridae	*Podomys floridanus*	30·8	0·288	30·8	0·288	White & Seymour (2003)
Rodentia	Muridae	*Pseudomys gracilicaudatus*	79·8	0·467	79·8	0·467	White & Seymour (2003)
Rodentia	Muridae	*Pseudomys hermannsburgensis*	12·2	0·130	12·2	0·130	White & Seymour (2003)
Rodentia	Muridae	*Rattus colletti*	165·7	0·686	165·7	0·686	White & Seymour (2003)
Rodentia	Muridae	*Rattus fuscipes*	76	0·471	76·0	0·471	White & Seymour (2003)
Rodentia	Muridae	*Rattus lutreolus*	109	0·353	109·0	0·353	White & Seymour (2003)
Rodentia	Muridae	*Rattus norvegicus*	160	1·339	206·9	1·404	Hart (1971)
Rodentia	Muridae	*Rattus norvegicus*	160	1·169			Hart (1971)
Rodentia	Muridae	*Rattus norvegicus*	170	0·948			Hart (1971)
Rodentia	Muridae	*Rattus norvegicus*	170	0·960			Heusner (1991)
Rodentia	Muridae	*Rattus norvegicus*	225	1·506			Hart (1971)
Rodentia	Muridae	*Rattus norvegicus*	250	2·092			Hart (1971)
Rodentia	Muridae	*Rattus norvegicus*	390	2·393			Hart (1971)
Rodentia	Muridae	*Rattus rattus*	117	0·770	117·0	0·770	Heusner (1991)
Rodentia	Muridae	*Rattus sordidus*	187	0·595	187·0	0·595	White & Seymour (2003)
Rodentia	Muridae	*Rattus villosissimus*	185	0·585	215·3	0·690	Lovegrove (2003)
Rodentia	Muridae	*Rattus villosissimus*	250·6	0·813			White & Seymour (2003)
Rodentia	Muridae	*Reithrodon auritus*	78·7	0·428	78·7	0·428	Lovegrove (2003)
Rodentia	Muridae	*Reithrodontomys megalotis*	9	0·130	9·0	0·130	Heusner (1991)
Rodentia	Muridae	*Rhabdomys pumilio*	39·6	0·179	39·6	0·179	White & Seymour (2003)
Rodentia	Muridae	*Saccostomus campestris*	61·3	0·287	68·1	0·274	White & Seymour (2003)
Rodentia	Muridae	*Saccostomus campestris*	75·7	0·261			Lovegrove (2003)
Rodentia	Muridae	*Scotinomys teguina*	12	0·174	12·0	0·174	White & Seymour (2003)
Rodentia	Muridae	*Scotinomys xerampelinus*	15·2	0·178	15·2	0·178	White & Seymour (2003)
Rodentia	Muridae	*Sekeetamys calurus*	56·9	0·248	63·6	0·274	White & Seymour (2003)
Rodentia	Muridae	*Sekeetamys calurus*	71·2	0·303			Lovegrove (2003)
Rodentia	Muridae	*Sigmodon alleni*	137·8	1·134	137·8	1·134	White & Seymour (2003)
Rodentia	Muridae	*Sigmodon fulviventer*	137·8	1·157	137·8	1·157	White & Seymour (2003)
Rodentia	Muridae	*Sigmodon hispidus*	139·3	1·285	159·6	1·085	White & Seymour (2003)
Rodentia	Muridae	*Sigmodon hispidus*	152·4	0·710			Heusner (1991)
Rodentia	Muridae	*Sigmodon hispidus*	191·6	1·400			Lovegrove (2003)
Rodentia	Muridae	*Sigmodon leucotis*	128·6	1·040	128·6	1·040	White & Seymour (2003)
Rodentia	Muridae	*Sigmodon ochrognathus*	115·1	0·860	115·1	0·860	White & Seymour (2003)
Rodentia	Muridae	*Steatomys pratensis*	37·54	0·105	37·5	0·105	White & Seymour (2003)
Rodentia	Muridae	*Stochomys longicaudatus*	82·33	0·550	83·3	0·547	Heusner (1991)
Rodentia	Muridae	*Stochomys longicaudatus*	84·2	0·544			White & Seymour (2003)
Rodentia	Muridae	*Tachyoryctes splendens*	171	0·811	197·0	0·856	Hart (1971)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Muridae	*Tachyoryctes splendens*	191	0·842			White & Seymour (2003)
Rodentia	Muridae	*Tachyoryctes splendens*	234	0·920			Heusner (1991)
Rodentia	Muridae	*Tatera afra*	106·5	1·016	106·5	1·016	White & Seymour (2003)
Rodentia	Muridae	*Tatera indica*	86·8	0·421	86·9	0·422	Lovegrove (2003)
Rodentia	Muridae	*Tatera indica*	87	0·422			White & Seymour (2003)
Rodentia	Muridae	*Tatera leucogaster*	133·8	0·764	145·2	0·752	Lovegrove (2000)
Rodentia	Muridae	*Tatera leucogaster*	157·62	0·740			White & Seymour (2003)
Rodentia	Muridae	*Thallomys nigricauda*	124·7	0·382	124·7	0·382	Lovegrove (2000)
Rodentia	Muridae	*Thallomys paedulcus*	132·4	0·487	132·4	0·487	White & Seymour (2003)
Rodentia	Muridae	*Uromys caudimaculatus*	812	3·184	812·0	3·184	White & Seymour (2003)
Rodentia	Myoxidae	*Graphiurus murinus*	38·43	0·225	38·4	0·225	Lovegrove (2003)
Rodentia	Myoxidae	*Graphiurus ocularis*	67·8	0·370	67·8	0·370	White & Seymour (2003)
Rodentia	Myoxidae	*Muscardinus avellanarius*	23·5	0·351	23·5	0·351	White & Seymour (2003)
Rodentia	Myoxidae	*Myoxus glis*	152	0·500	174·4	0·664	Heusner (1991)
Rodentia	Myoxidae	*Myoxus glis*	200	0·881			White & Seymour (2003)
Rodentia	Octodontidae	*Aconaemys fuscus*	112	0·675	112·0	0·675	White & Seymour (2003)
Rodentia	Octodontidae	*Octodon bridgesi*	176·1	1·023	176·1	1·023	White & Seymour (2003)
Rodentia	Octodontidae	*Octodon degus*	193	0·949	199·6	0·958	White & Seymour (2003)
Rodentia	Octodontidae	*Octodon degus*	206·4	0·966			Lovegrove (2000)
Rodentia	Octodontidae	*Octodon lunatus*	173·2	0·957	173·2	0·957	White & Seymour (2003)
Rodentia	Octodontidae	*Octodontomys gliroides*	152	0·729	154·1	0·715	White & Seymour (2003)
Rodentia	Octodontidae	*Octodontomys gliroides*	156·3	0·702			Lovegrove (2000)
Rodentia	Octodontidae	*Octomys mimax*	118·6	0·642	118·6	0·642	White & Seymour (2003)
Rodentia	Octodontidae	*Spalacopus cyanus*	109·5	0·520	126·2	0·561	Lovegrove (2000)
Rodentia	Octodontidae	*Spalacopus cyanus*	135	0·596			White & Seymour (2003)
Rodentia	Octodontidae	*Spalacopus cyanus*	136	0·570			Heusner (1991)
Rodentia	Octodontidae	*Tympanoctomys barrerae*	71·4	0·430	71·4	0·430	White & Seymour (2003)
Rodentia	Peditidae	*Pedetes capensis*	2 300	4·427	2 300·0	4·427	White & Seymour (2003)
Rodentia	Sciuridae	*Ammospermophilus leucurus*	75·6	0·439	94·1	0·511	Lovegrove (2003)
Rodentia	Sciuridae	*Ammospermophilus leucurus*	95·7	0·524			White & Seymour (2003)
Rodentia	Sciuridae	*Ammospermophilus leucurus*	96	0·540			Heusner (1991)
Rodentia	Sciuridae	*Ammospermophilus leucurus*	112·8	0·550			Heusner (1991)
Rodentia	Sciuridae	*Cynomys ludovicianus*	1 112·3	2·358	1 112·3	2·358	White & Seymour (2003)
Rodentia	Sciuridae	*Epixerus wilsoni*	460	1·347	460·0	1·347	White & Seymour (2003)
Rodentia	Sciuridae	*Funisciurus anerythrus*	63	0·580	63·0	0·580	Heusner (1991)
Rodentia	Sciuridae	*Funisciurus congicus*	112·3	0·533	112·3	0·533	White & Seymour (2003)
Rodentia	Sciuridae	*Funisciurus isabella*	60	0·570	60·0	0·570	White & Seymour (2003)
Rodentia	Sciuridae	*Funisciurus lemniscatus*	95	0·500	95·0	0·500	Heusner (1991)
Rodentia	Sciuridae	*Funisciurus pyrrhopus*	244	1·011	244·0	1·011	White & Seymour (2003)
Rodentia	Sciuridae	*Glaucomys volans*	62·8	0·370	67·4	0·414	Heusner (1991)
Rodentia	Sciuridae	*Glaucomys volans*	64·25	0·377			White & Seymour (2003)
Rodentia	Sciuridae	*Glaucomys volans*	76	0·509			Lovegrove (2000)
Rodentia	Sciuridae	*Heliosciurus rufobrachium*	230	0·744	230·0	0·744	White & Seymour (2003)
Rodentia	Sciuridae	*Marmota flaviventris*	4 295	8·626	4 295·0	8·626	White & Seymour (2003)
Rodentia	Sciuridae	*Marmota monax*	2 650	3·696	2 650·0	3·696	White & Seymour (2003)
Rodentia	Sciuridae	*Paraxerus cepapi*	223·6	0·811	223·6	0·811	White & Seymour (2003)
Rodentia	Sciuridae	*Paraxerus palliatus*	206	0·977	274·8	1·191	White & Seymour (2003)
Rodentia	Sciuridae	*Paraxerus palliatus*	366·6	1·452			White & Seymour (2003)
Rodentia	Sciuridae	*Sciurus aberti*	624	2·402	624·0	2·402	White & Seymour (2003)
Rodentia	Sciuridae	*Sciurus carolinensis*	440	2·062	440·0	2·062	White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus armatus*	307	1·062	313·2	0·915	Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus armatus*	312·8	0·880			Heusner (1991)
Rodentia	Sciuridae	*Spermophilus armatus*	320	0·821			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus beecheyi*	599·6	1·773	599·6	1·773	White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus beldingi*	288·56	0·800	293·7	0·796	Heusner (1991)
Rodentia	Sciuridae	*Spermophilus beldingi*	289·8	0·889			Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus beldingi*	303	0·710			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus citellus*	240	1·272	240·0	1·272	White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus franklinii*	607	2·190	607·0	2·190	Heusner (1991)
Rodentia	Sciuridae	*Spermophilus lateralis*	217·6	1·317	249·6	0·967	Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus lateralis*	237	0·800			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus lateralis*	270·16	0·740			Heusner (1991)
Rodentia	Sciuridae	*Spermophilus lateralis*	278·7	1·119			Lovegrove (2003)
Rodentia	Sciuridae	*Spermophilus mohavensis*	240	0·629	240·0	0·629	White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus parryii*	650	2·901	650·0	2·901	White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus richardsonii*	252·3	0·901	266·3	0·788	Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus richardsonii*	273·07	0·740			Heusner (1991)
Rodentia	Sciuridae	*Spermophilus richardsonii*	274	0·734			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus saturatus*	252·2	0·900	256·6	0·849	Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus saturatus*	261·15	0·800			Heusner (1991)
Rodentia	Sciuridae	*Spermophilus spilosoma*	157·8	0·500	170·4	0·543	Heusner (1991)
Rodentia	Sciuridae	*Spermophilus spilosoma*	174	0·514			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus spilosoma*	180·3	0·624			Lovegrove (2000)

Appendix 1. *Continued.*

Order	Family	Species	Mass (g)	BMR (W)	Species avg. mass (g)	Species avg. BMR (W)	References
Rodentia	Sciuridae	*Spermophilus tereticaudus*	90·8	0·334	125·1	0·501	Lovegrove (2003)
Rodentia	Sciuridae	*Spermophilus tereticaudus*	129	0·720			Hart (1971)
Rodentia	Sciuridae	*Spermophilus tereticaudus*	167	0·522			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus townsendii*	212·52	0·600	224·0	0·634	Heusner (1991)
Rodentia	Sciuridae	*Spermophilus townsendii*	229	0·587			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus townsendii*	231	0·722			Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus tridecemlineatus*	182	0·579	198·4	0·983	Lovegrove (2000)
Rodentia	Sciuridae	*Spermophilus tridecemlineatus*	205·4	0·783			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus tridecemlineatus*	209	2·099			Hart (1971)
Rodentia	Sciuridae	*Spermophilus undulatus*	500	2·789	698·0	3·601	Hart (1971)
Rodentia	Sciuridae	*Spermophilus undulatus*	680	3·721			White & Seymour (2003)
Rodentia	Sciuridae	*Spermophilus undulatus*	1 000	4·500			Heusner (1991)
Rodentia	Sciuridae	*Tamias alpinus*	39	0·322	39·0	0·322	White & Seymour (2003)
Rodentia	Sciuridae	*Tamias amoenus*	52·7	0·430	55·7	0·500	Heusner (1991)
Rodentia	Sciuridae	*Tamias amoenus*	57·1	0·537			White & Seymour (2003)
Rodentia	Sciuridae	*Tamias amoenus*	57·3	0·540			Lovegrove (2003)
Rodentia	Sciuridae	*Tamias merriami*	75	0·440	76·9	0·459	White & Seymour (2003)
Rodentia	Sciuridae	*Tamias merriami*	78·9	0·480			Heusner (1991)
Rodentia	Sciuridae	*Tamias minimus*	45·8	0·406	49·3	0·349	White & Seymour (2003)
Rodentia	Sciuridae	*Tamias minimus*	53	0·300			Heusner (1991)
Rodentia	Sciuridae	*Tamias palmeri*	69·4	0·631	69·4	0·631	White & Seymour (2003)
Rodentia	Sciuridae	*Tamias striatus*	87·4	0·502	89·6	0·813	White & Seymour (2003)
Rodentia	Sciuridae	*Tamias striatus*	91·8	1·316			Lovegrove (2000)
Rodentia	Sciuridae	*Tamiasciurus hudsonicus*	202	1·803	219·6	1·615	White & Seymour (2003)
Rodentia	Sciuridae	*Tamiasciurus hudsonicus*	224	1·410			Heusner (1991)
Rodentia	Sciuridae	*Tamiasciurus hudsonicus*	225	1·883			Hart (1971)
Rodentia	Sciuridae	*Tamiasciurus hudsonicus*	228·3	1·420			White & Seymour (2003)
Rodentia	Sciuridae	*Xerus inauris*	515·3	1·731	528·5	1·775	Lovegrove (2000)
Rodentia	Sciuridae	*Xerus inauris*	542	1·820			White & Seymour (2003)
Rodentia	Sciuridae	*Xerus princeps*	602	1·897	614·4	1·936	White & Seymour (2003)
Rodentia	Sciuridae	*Xerus princeps*	627	1·976			Lovegrove (2000)
Scandentia	Tupaiidae	*Ptilocercus lowii*	57·5	0·240	57·5	0·240	Heusner (1991)
Scandentia	Tupaiidae	*Tupaia glis*	123	0·522	123·0	0·522	White & Seymour (2003)
Scandentia	Tupaiidae	*Urogale everetti*	260·6	1·250	260·6	1·250	White & Seymour (2003)
Sirenia	Trichechidae	*Trichechus inunguis*	165 223	64·520	167 594·5	55·015	Lovegrove (2000)
Sirenia	Trichechidae	*Trichechus inunguis*	170 000	46·910			Heusner (1991)
Tubulidentata	Orycteropodidae	*Orycteropus afer*	48 000	34·275	48 000·0	34·275	White & Seymour (2003)
Xenarthra	Bradypodidae	*Bradypus variegatus*	3 790	3·827	3 790·0	3·827	White & Seymour (2003)
Xenarthra	Dasypodidae	*Cabassous centralis*	3 810	4·527	4 061·7	4·812	Lovegrove (2000)
Xenarthra	Dasypodidae	*Cabassous centralis*	4 330	5·116			White & Seymour (2003)
Xenarthra	Dasypodidae	*Chaetophractus nationi*	2 150	3·118	2 150·0	3·118	White & Seymour (2003)
Xenarthra	Dasypodidae	*Chaetophractus vellerosus*	1 110	1·707	1 110·0	1·707	White & Seymour (2003)
Xenarthra	Dasypodidae	*Chaetophractus villosus*	4 540	4·508	4 540·0	4·508	White & Seymour (2003)
Xenarthra	Dasypodidae	*Dasypus novemcinctus*	3 320	4·490	3 413·7	4·655	Heusner (1991)
Xenarthra	Dasypodidae	*Dasypus novemcinctus*	3 510	4·825			White & Seymour (2003)
Xenarthra	Dasypodidae	*Euphractus sexcinctus*	8 190	6·901	8 190·0	6·901	White & Seymour (2003)
Xenarthra	Dasypodidae	*Priodontes maximus*	45 190	16·892	45 190·0	16·892	White & Seymour (2003)
Xenarthra	Dasypodidae	*Tolypeutes matacus*	1 160	1·172	1 160·0	1·172	White & Seymour (2003)
Xenarthra	Dasypodidae	*Zaedyus pichiy*	1 740	2·192	1 740·0	2·192	White & Seymour (2003)
Xenarthra	Megalonychidae	*Choloepus hoffmanni*	3 770	3·364	4 005·2	3·891	White & Seymour (2003)
Xenarthra	Megalonychidae	*Choloepus hoffmanni*	4 010	3·892			Lovegrove (2000)
Xenarthra	Megalonychidae	*Choloepus hoffmanni*	4 250	4·500			Heusner (1991)
Xenarthra	Myrmecophagidae	*Cyclopes didactylus*	240	0·636	240·0	0·636	White & Seymour (2003)
Xenarthra	Myrmecophagidae	*Myrmecophaga tridactyla*	30 600	14·543	30 600·0	14·543	White & Seymour (2003)
Xenarthra	Myrmecophagidae	*Tamandua mexicana*	3 500	5·077	3 884·2	5·124	Lovegrove (2000)
Xenarthra	Myrmecophagidae	*Tamandua mexicana*	3 977	5·534			White & Seymour (2003)
Xenarthra	Myrmecophagidae	*Tamandua mexicana*	4 210	4·790			Heusner (1991)
Xenarthra	Myrmecophagidae	*Tamandua tetradactyla*	3 500	5·015	3 500·0	5·015	White & Seymour (2003)

Appendix 2

Binned log(mass (g))	Binned log(BMR (W))	Mass (g)	BMR (W)
0·389 075 625	−1·198 070 708	2·4	0·063
0·568 201 724	−1·571 328 836	3·7	0·027
0·661 431 752	−1·172 116 015	4·6	0·067
0·745 139 266	−0·968 529 764	5·6	0·108
0·864 688 449	−0·985 843 9	7·3	0·103
0·947 565 356	−0·992 687 641	8·9	0·102
1·052 690 015	−0·884 366 833	11·3	0·131
1·148 732 343	−0·914 990 175	14·1	0·122
1·243 318 579	−0·784 506 412	17·5	0·164
1·347 316 514	−0·651 955 766	22·2	0·223
1·454 764 674	−0·612 176 627	28·5	0·244
1·553 081 125	−0·568 248 466	35·7	0·270
1·656 886 834	−0·512 975 406	45·4	0·307
1·760 953 626	−0·436 201 138	57·7	0·366
1·844 213 326	−0·355 015 962	69·9	0·442
1·952 822 747	−0·278 952 613	89·7	0·526
2·055 702 395	−0·232 303 347	113·7	0·586
2·134 807 325	−0·146 755 532	136·4	0·713
2·253 844 347	−0·135 624 546	179·4	0·732
2·348 606 534	−0·029 454 704	223·2	0·934
2·439 805 622	−0·001 765 502	275·3	0·996
2·533 468 277	0·048 604 469	341·6	1·118
2·645 402 525	0·045 198 384	442·0	1·110
2·763 711 627	0·272 260 217	580·4	1·872
2·838 103 042	0·292 155 678	688·8	1·960
2·949 565 843	0·422 545 319	890·4	2·646
3·048 280 513	0·365 582 342	1 117·6	2·321
3·139 330 659	0·463 987 091	1 378·3	2·911
3·237 087 401	0·604 685 242	1 726·2	4·024
3·355 914 424	0·660 023 415	2 269·4	4·571
3·446 405 262	0·727 139 587	2 795·2	5·335
3·551 768 161	0·744 461 524	3 562·6	5·552
3·643 742 43	0·867 574 074	4 402·9	7·372
3·760 687 561	0·852 422 308	5 763·5	7·119
3·859 428 015	1·091 854 638	7 234·8	12·355
3·948 483 677	1·209 779 016	8 881·4	16·210
4·031 997 885	1·187 784 38	10 764·6	15·409
4·120 445 694	1·310 508 378	13 196·1	20·441
4·201 670 18	0·840 297 869	15 910·0	6·923
4·322 096 16	1·593 350 261	20 994·0	39·206
4·448 180 523	1·543 794 697	28 066·0	34·978
4·547 431 967	1·672 475 099	35 272·2	47·041
4·668 141 789	1·381 329 626	46 573·8	24·062
4·742 083 907	1·986 948 644	55 218·4	97·040
4·830 810 77	1·925 241 605	67 734·6	84·186
4·960 322 501	2·026 873 632	91 268·8	106·383
5·030 348 92	2·173 024 349	107 238·1	148·944
5·149 112 499	2·162 811 081	140 965·4	145·483
5·255 606 875	2·106 539 721	180 138·6	127·803
5·526 106 418	2·472 231 3	335 819·9	296·641
5·609 594 409	2·351 755 691	407 000·0	224·779
6·564 902 673	3·368 565 785	3 672 000·0	2 336·500