

## Data quality problems undermine analyses of endotherm upper critical temperatures

### Abstract

In an analysis of avian and mammalian thermal tolerances recently published in this journal, Khaliq *et al.* (2015) reported that endotherm thermal niches are phylogenetically conserved in tropical, but not temperate, regions. However, closer examination of the data upon which this analysis was based reveals that many of the upper critical temperature (UCT) data are not valid. Approximately 55 % and 42 % of avian and mammalian UCT data, respectively, originated from studies in which animals were not exposed to air temperatures high enough to elicit an increase in metabolic rate above minimum levels; the cited UCT values are merely the highest air temperatures at which measurements took place. An additional 18 % and 25 % of avian and mammalian UCT data, respectively, represent values based on just one individual per species and/or measurements at too few air temperatures above the thermoneutral zone (TNZ) to reliably estimate the UCT.

**Keywords:** birds; data inclusion criteria; mammals; thermal tolerance; thermoneutral zone; upper critical limit of thermoneutrality

Several recent studies examining global variation in the thermal tolerances of endotherms have focused on the upper and lower limits of the thermoneutral zone (TNZ), the range of air temperatures over which resting metabolic rate is minimal and increments associated with heat production or active heat dissipation are absent. One such study was recently published in this journal; Khaliq and colleagues partitioned variation in thermal traits of mammals and birds into phylogenetic and environmental (i.e., adaptive) components, and reported phylogenetic niche conservatism in tropical, but not temperate, regions (Khaliq *et al.*, 2015).

Our purpose here is to highlight serious flaws in the data set upon which the conclusions of Khaliq *et al.* (2015) are based. The problems concern the upper critical temperature (UCT), the air temperature representing the upper boundary of the TNZ (also known as the upper critical limit of thermoneutrality). A second variable included in the analysis, TNZ breadth, was calculated as the difference between the UCT and the lower critical temperature, and so the shortcomings of the UCT data set apply equally to the TNZ breadth data.

The fundamental problem with the UCT and TNZ breadth data analysed by Khaliq *et al.* (2015) is that many of these data simply do not exist, as they originate from empirical studies in which metabolic rate was not measured at air temperatures high enough to elicit the increase that defines the UCT. Khaliq *et al.* (2015) included mammalian and avian UCT data as defined in an earlier study (Khaliq *et al.*, 2014); the correct definition of UCT is provided in the Electronic Supplementary Material of the latter paper. However, for many UCT data included in their analyses this definition was not followed.

We examined the original papers cited as the sources of 237 of 255 avian data and 284 of 295 mammalian data provided in Appendix S1 of Khaliq *et al.* (2015). On the basis of visual inspection of the relationship between resting metabolic rate and air temperature, we allocated each datum to one of the following categories (Appendix S1, Supporting Information):

1) Good data – increase in metabolic rate above the TNZ, with a clear inflection point defining the UCT based on data for at least two individuals per species (Figure 1A).

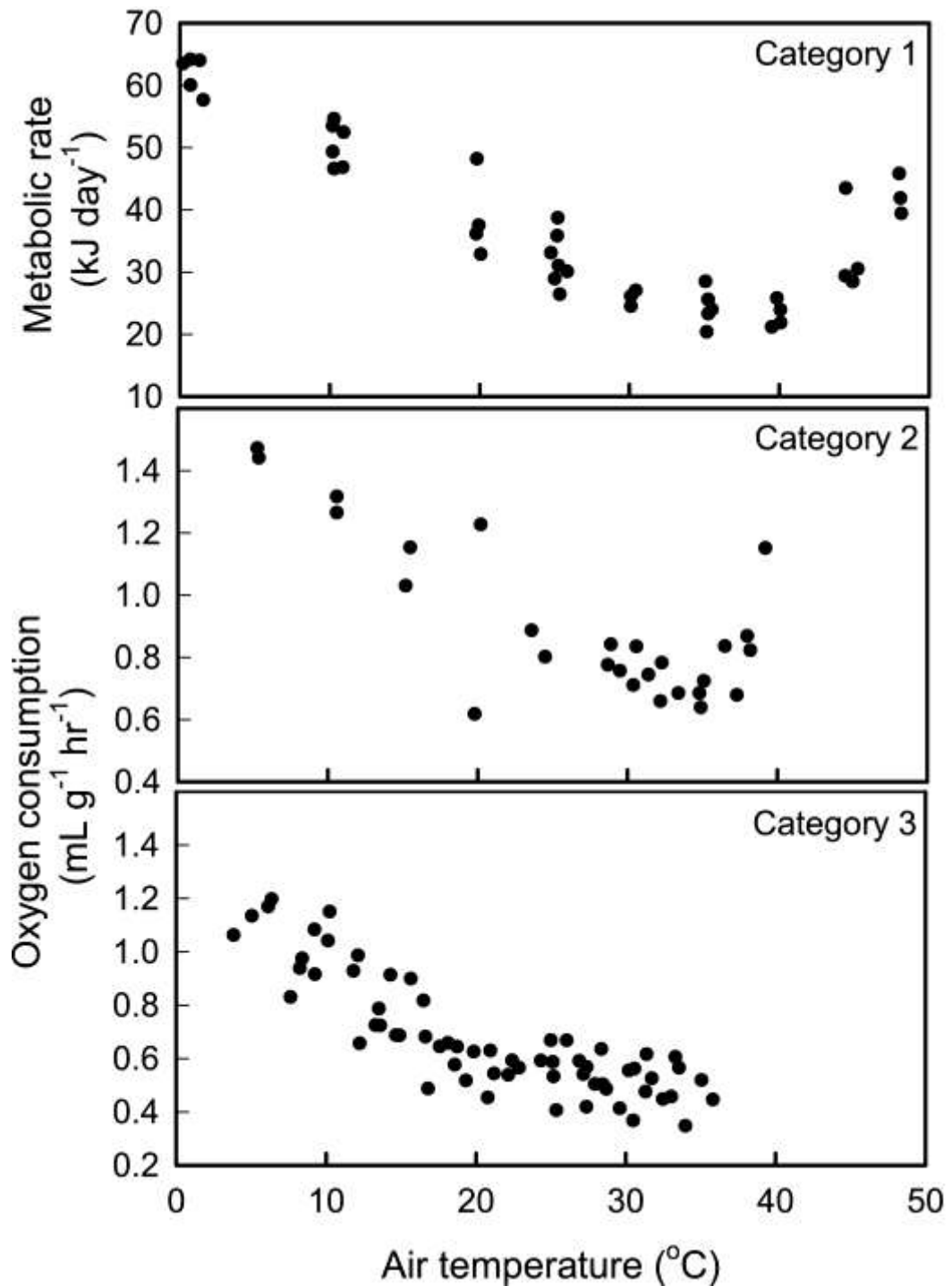
2) Insufficient data – some evidence of an increase in metabolic rate above the TNZ, but based on only a single individual and/or measurements at too few air temperatures to reliably estimate a UCT (Figure 1B). Although it is often possible to fit piecewise regression models to these data sets using software such as the *R* package ‘segmented’ (Muggeo, 2009), inflection points identified in this way are highly sensitive to whether or not sufficient data exist at higher air temperatures to reliably estimate the slope (Figure 2).

3) No UCT – by Khaliq *et al.*’s (2014) definition the data do not exist; metabolic rate was not measured at air temperatures high enough to elicit an increase above thermoneutral levels (Figure 1C).

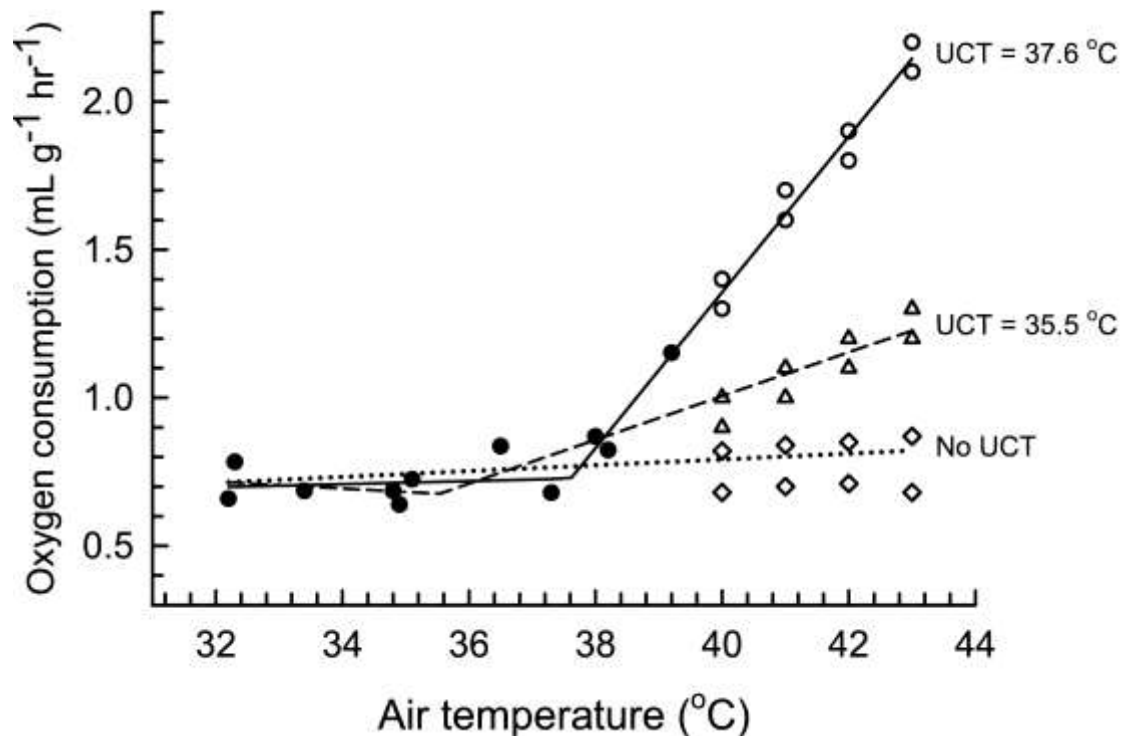
Of the 284 mammalian UCT data we checked, good data (Category 1) accounted for only 33.1 % of the original data set (94 species). A further 25.4 % (72 species) had insufficient data (Category 2), and for the remaining 41.5 % (118 species) the UCT did not exist (Category 3).

Of the 237 avian UCT data we checked, good data (Category 1) accounted for only 27.0 % of the original data set (64 species). A further 18.1 % (43 species) had insufficient data (Category 2), and for the remaining 54.9 % (130 species) the UCT did not exist (Category 3). Approximately one quarter of the avian UCT data are valid, and over half effectively do not exist.

The reasons why the correct UCT definition was not applied by Khaliq *et al.* when compiling the data set are not clear. In at least one instance, unambiguous statements by the authors of an original study that no UCT was reached were apparently overlooked. In their study of the thermal physiology of estrildid finches, Marschall & Prinzinger (1991) clearly indicated that three species (*Estrilda melpoda*, *Padda oryzivora*, and *Taeniopygia guttata*) did not reach a UCT. Nevertheless, Khaliq *et al.* (2015) included UCT values for these three species in their data set. In other instances, original papers admittedly do contain potentially ambiguous phrases such as “Thermoneutrality extended from XX to YY °C” (McNab, 2000, 2001; McNab, 2003), where YY °C was simply the highest air temperature at which metabolic rate was measured. However, even cursory examination of the figures in these papers reveals that no UCT was reached (see Figure 1C for an example of such a data set).



**Figure 1.** Examples of data included by Khaliq *et al.* (2015) illustrating our three categories of upper critical temperature (UCT) data quality. Category 1 (top panel): metabolic rate in Dunn's larks (*Eremalauda dunnii*; data from Tieleman *et al.*, 2002). In this case, metabolic rate is measured at two air temperatures obviously above the thermoneutral zone (TNZ), allowing for accurate estimation of a UCT. Category 2 (middle panel): night-time oxygen consumption in grey-necked wood-rails (*Aramides cajanea*; data from McNab & Ellis, 2006). The increase in metabolic rate above the TNZ involves only a single data point and the UCT can hence not be estimated accurately. Category 3 (bottom panel): night-time oxygen consumption in Nicobar pigeons (*Caloenas nicobarica*; data from McNab, 2000). There is no increase in oxygen consumption associated with a UCT; the value of 37 °C included in the data set analysed by Khaliq *et al.* (2015) is simply the highest air temperature at which oxygen consumption was measured. Data for *E. dunnii*, *A. cajanea* and *C. nicobarica* were extracted from original figures using DigitizeIt software (<http://www.digitizeit.de>) solely for plotting them here.



**Figure 2.** Resting metabolic rate data measured at air temperatures ( $T_a$ ) well above the thermoneutral zone are necessary for reliable estimates of the upper critical temperature (UCT). McNab & Ellis (2006) measured oxygen consumption in grey-necked wood-rails (*Aramides cajanea*) over a  $T_a$  range extending up to *c.* 39 °C (actual data shown as filled circles); these are a subset of the data shown in Fig. 1 (middle panel). The open symbols are hypothetical data that we have added in order to illustrate why data at a range of  $T_a$  above the thermoneutral zone are essential for accurate estimation of the UCT. The three lines are regression models fitted to the data sets (actual data and hypothetical data combined) using the *R* package ‘segmented’. The hypothetical data shown by open circles fall along the line suggested by the single data point that McNab and Ellis collected at  $T_a = 39$  °C; in this instance, the estimated UCT is at  $T_a = 37.6$  °C (solid line), close to the value used by Khaliq *et al.* The hypothetical data shown by open triangles, in contrast, illustrate a situation where the actual slope is shallower than suggested by the single datum at  $T_a = 39$  °C; in this instance, the UCT is nearly 2 °C lower, at  $T_a = 35.5$  °C (dashed line). The third set of hypothetical data, shown by open diamonds, illustrates a situation characteristic of taxa such as caprimulgid birds (e.g. Dawson & Fisher, 1969; O’Connor *et al.*, in press) where RMR remains low even at very high  $T_a$ ; in such instances, no UCT occurs (dotted line).

Overall, just ~30 % of the mammalian and avian UCT data that formed the basis for the analyses by Khaliq *et al.* (2015) can be considered reliable estimates of the upper boundary of the TNZ. In our opinion, these data quality problems fatally undermine these authors’ qualitative and quantitative conclusions about the effects of phylogeny and environment on UCT and TNZ breadth. We recommend the authors repeat these analyses using a more constrained data set to which appropriate data inclusion criteria are rigorously applied.

Andrew E. McKechnie<sup>1,\*</sup>  
 Brittney H. Coe<sup>2</sup>  
 Alexander R. Gerson<sup>3</sup>  
 Blair O. Wolf<sup>2</sup>

<sup>1</sup>DST-NRF Centre of Excellence at the Percy FitzPatrick Institute, Department of Zoology and Entomology, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa

<sup>2</sup>UNM Biology Department, University of New Mexico, MSC03-2020, Albuquerque, NM 87131-0001, USA

<sup>3</sup>Department of Biology, University of Massachusetts, Amherst, MA 01003, USA

\*Address for correspondence

aemckechnie@zoology.up.ac.za

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**Appendix S1.** Body mass and upper critical temperature (UCT) data used by Khaliq et al. (2015), with each datum categorised as 1) good, 2) insufficient data (“Ins. data”) or 3) no UCT, using criteria provided in the text. Data with “-----” listed under Category are those for which we were unable to check the original data set, typically because either we were unable to obtain the original source, or because an incorrect reference was provided by Khaliq et al. (2015). References are those provided in the Supporting Information of Khaliq et al. (2015).

Species	Body Mass (g)	UCT (°C)	References	Category
<b>Birds</b>				
<i>Buteo jamaicensis</i>	1475	34	Wasser, 1986, Hayes & Gessman, 1980	No UCT
<i>Aquila chrysaetos</i>	4320	35	Hayes & Gessman, 1980	No UCT
<i>Buteo buteo</i>	1012	35	Herpel, 2007	-----
<i>Anas castanea</i>	483.3	37	McNab, 2003	No UCT
<i>Anas rhynchotis</i>	508	37	McNab, 2003	No UCT
<i>Aythya novaeseelandiae</i>	488.4	33	McNab, 2003	No UCT
<i>Tadorna variegata</i>	1193.6	33	McNab, 2003	Good
<i>Anas aucklandica</i>	373.1	37	McNab, 2003	No UCT
<i>Anas gracilis</i>	393.7	39	McNab, 2003	No UCT
<i>Hymenolaimus malacorhynchos</i>	717.1	38	McNab, 2003	No UCT
<i>Anas penelope</i>	723	22	Jilg, 2006	-----
<i>Anas rubripes</i>	1263	22	Wooley <i>et al.</i> , 1977	No UCT
<i>Somateria mollissima</i>	1660	25	Richman & Lovvorn, 2011, Hawkins <i>et al.</i> , 2000	No UCT
<i>Clangula hyemalis</i>	490	26	Jenssen & Ekker, 1989	-----
<i>Collocalia vanikorensis</i>	11.6	34	McNab & Bonaccorso, 1995	Good
<i>Collocalia esculenta</i>	6.8	34	McNab & Bonaccorso, 1995	Good

<i>Aegothales cristatus</i>	45.56	35	Doucette & Geiser, 2008	Ins. data
<i>Eurostopodus argus</i>	88	47	Dawson & Fisher, 1969	Good
<i>Caprimulgus macrurus</i>	68.6	36	McNab & Bonaccorso, 1995	No UCT
<i>Eurostopodus mystacalis</i>	162	37	McNab & Bonaccorso, 1995	No UCT
<i>Phalaenoptilus nuttallii</i>	40	44	Bartholomew <i>et al.</i> , 1962	No UCT
<i>Caprimulgus vociferus</i>	46	37	Lane <i>et al.</i> , 2004	Good
<i>Chordeiles minor</i>	72	39	Lasiewski <i>et al.</i> , 1970, Lasiewski & Dawson, 1964	Good
<i>Podargus strigoides</i>	380.3	38	McNab & Bonaccorso, 1995	No UCT
<i>Cephus grylle</i>	342.2	22	Gabrielsen <i>et al.</i> , 1988	No UCT
<i>Alle alle</i>	152.5	20	Gabrielsen <i>et al.</i> , 1991	Good
<i>Uria lomvia</i>	819	18	Bryant & Furness, 1995, Gabrielson <i>et al.</i> , 1987	No UCT
<i>Pluvialis apricaria</i>	151	30	Daan <i>et al.</i> , 1990	-----
<i>Haematopus ostralegus</i>	385.4	30	Heyer, 1995	-----
<i>Rissa tridactyla</i>	365	18	Gabrielson <i>et al.</i> , 1988	No UCT
<i>Calidris alpina</i>	53	35	Heyer, 1995	-----
<i>Calidris minuta</i>	29	35	Heyer, 1995	-----
<i>Sterna fuscata</i>	176.75	35	MacMillen <i>et al.</i> , 1977, Flint & Nagy, 1984	Good
<i>Thinocorus rumicivorus</i>	55.5	38	Ehlers & Morton, 1982	Good
<i>Bubulcus ibis</i>	299.2	40	Ellis, 1980	No UCT
<i>Egretta caerulea</i>	290.3	39	Ellis, 1980	No UCT
<i>Egretta thula</i>	314	40	Ellis, 1980	No UCT
<i>Egretta tricolor</i>	309	41	Ellis, 1980	Ins. data
<i>Colinus colinus</i>	40.2	35	McKechnie & Lovegrove, 2001b	No UCT
<i>Colinus striatus</i>	51	38	McKechnie & Lovegrove, 2001a	No UCT
<i>Urocolius macrourus</i>	51.3	33	Prinzinger, 1988	No UCT

<i>Leucosarcia melanoleuca</i>	468	36	McNab, 2000	No UCT
<i>Hemiphaga novaeseelandiae</i>	435.6	30	McNab, 2000	Good
<i>Geopelia cuneata</i>	39	45	Schleucher, 1991	No UCT
<i>Geophaps plumifera</i>	89	39	Withers & Williams, 1990, Williams <i>et al.</i> , 1995	Good
<i>Drepanoptila holosericea</i>	198	33	Schleucher, 2002	No UCT
<i>Ducula bicolor</i>	453	36	McNab, 2000	No UCT
<i>Ducula pinon</i>	583.8	37	McNab, 2000	No UCT
<i>Ducula pistrinaria</i>	394.2	35	McNab, 2000	No UCT
<i>Ducula radiata</i>	333.6	37	McNab, 2000	No UCT
<i>Ducula rubricera</i>	418.8	36	McNab, 2000	No UCT
<i>Ducula rufigaster</i>	376.7	35	McNab, 2000	No UCT
<i>Ducula zoeae</i>	456.2	32	McNab, 2000	Good
<i>Gymnophaps albertisii</i>	241.6	36	McNab, 2000	Ins. data
<i>Ptilinopus melanospilus</i>	98	35	Schleucher & Withers, 2002, McNab, 2000	Ins. data
<i>Columba vitiensis</i>	467.9	34	McNab, 2000	Ins. data
<i>Caloenas nicobarica</i>	613	37	McNab, 2000	No UCT
<i>Ducula pacifica</i>	333.4	36	McNab, 2000	No UCT
<i>Goura cristata</i>	2313.4	35	McNab, 2000	No UCT
<i>Ptilinopus perlatus</i>	196	32	Schleucher, 2002, McNab, 2000	No UCT
<i>Ptilinopus superbus</i>	120.4	30	Schleucher, 2002, McNab, 2000	No UCT
<i>Columbina inca</i>	41.5	35	MacMillen & Trost, 1967	No UCT
<i>Zenaida macroura</i>	91.4	37.5	Hudson & Brush, 1964	Good
<i>Columba livia</i>	467	36.5	McNab, 2000	Good
<i>Oena capensis</i>	36	40	Schleucher, 2001	No UCT
<i>Dacelo novaeguineae</i>	336	35	Buttemer <i>et al.</i> , 2003	No UCT



<i>Bycanistes bucinator</i>	721	30	Harji, 2003	-----
<i>Aceros plicatus</i>	1965	35	McNab, 2001	No UCT
<i>Phoeniculus purpureus</i>	72.19	35	Boix-Hinzen & Lovegrove, 1998, Williams <i>et al.</i> , 1991	No UCT
<i>Todus mexicanus</i>	6.3	32	Merola-Zwartjes & David, 2000	Good
<i>Guira guira</i>	140	33	Simone, 2003	-----
<i>Falco rupicoloides</i>	214	33	Bush <i>et al.</i> , 2008	Ins. data
<i>Daptrius ater</i>	362	35	Wasser, 1986	Ins. data
<i>Leipoa ocellata</i>	1390	37	Booth, 1989	Good
<i>Callipepla gambelii</i>	125.5	42	Weathers, 1981, Goldstein & Nagy, 1985	Good
<i>Coturnix chinensis</i>	44.9	35	Roberts & Baudinette, 1986, Prinzing <i>et al.</i> , 1993	Ins. data
<i>Coturnix pectoralis</i>	95.8	35	Roberts & Baudinette, 1986	Ins. data
<i>Syrnaticus humiae</i>	398.83	29.2	Ying <i>et al.</i> , 2011	Good
<i>Coturnix japonica</i>	166	36	Prinzing & Hänssler, 1980, Ben-Hamo <i>et al.</i> , 2010	Good
<i>Alectoris chukar</i>	475	39	Marder & Bernstein, 1983	Good
<i>Coturnix coturnix</i>	97	34	Weathers, 1981, Ingrid, 1978	Good
<i>Lagopus leucura</i>	326	38	Johnson, 1968	Good
<i>Lagopus lagopus</i>	658	28	Mortensen & Blix, 1986	No UCT
<i>Lagopus muta</i>	465	22	Mortensen & Blix, 1986	No UCT
<i>Gallinula mortierii</i>	954.4	35	McNab & Ellis, 2006	Ins. data
<i>Gallinula tenebrosa</i>	512.4	36	McNab & Ellis, 2006	No UCT
<i>Porphyrio hochstetteri</i>	2758.3	31	McNab & Ellis, 2006	Ins. data
<i>Porphyrio porphyrio</i>	919.3	38	McNab & Ellis, 2006	No UCT
<i>Gallirallus philippensis</i>	171.7	37	McNab & Ellis, 2006	No UCT
<i>Gallinula ventralis</i>	309.2	40	McNab & Ellis, 2006	No UCT
<i>Gallirallus australis</i>	813.5	38	McNab & Ellis, 2006	No UCT

<i>Porzana cinerea</i>	47.9	37	McNab & Ellis, 2006	Ins. data
<i>Megacrex inepta</i>	856.6	35	McNab & Ellis, 2006	No UCT
<i>Gallirallus owstoni</i>	198.8	38	McNab & Ellis, 2006	Ins. data
<i>Aramides cajanea</i>	374.3	38	McNab & Ellis, 2006	Ins. data
<i>Fulica atra</i>	387	34	Brent <i>et al.</i> , 1985	Good
<i>Mirafra erythrocephala</i>	27.3	35.1	Marschall & Prinzinger, 1991	Good
<i>Alaemon alaudipes</i>	37.7	37.5	Tieleman <i>et al.</i> , 2002	Good
<i>Eremalauda dunni</i>	20.6	41	Tieleman <i>et al.</i> , 2002	Good
<i>Eremophila alpestris</i>	26	35	Trost, 1972	Good
<i>Alauda arvensis</i>	31.7	35.1	Tieleman <i>et al.</i> , 2002	Ins. data
<i>Lullula arborea</i>	25.5	40	Tieleman <i>et al.</i> , 2002	Ins. data
<i>Bombycilla garrulus</i>	64.9	27	Ming <i>et al.</i> , 2005	Ins. data
<i>Cardinalis cardinalis</i>	41	42.6	Hinds & Calder, 1973	Good
<i>Cardinalis sinuatus</i>	32	42.8	Hinds & Calder, 1973	Good
<i>Cnemophilus loriae</i>	78.1	32	McNab, 2005	Ins. data
<i>Coereba flaveola</i>	10	35	Merola-Zwartjes, 1998	Ins. data
<i>Aphelocoma coerulescens</i>	78.72	24	Mann, 1983	Ins. data
<i>Cyanocitta stelleri</i>	99.96	31.8	Mann, 1983	Ins. data
<i>Cyanocitta cristata</i>	80.8	35	Misch, 1960	Ins. data
<i>Pica nuttalli</i>	151.9	33.5	Hayworth & Weathers, 1984	Good
<i>Pica pica</i>	158.9	32.5	Hayworth & Weathers, 1984	Good
<i>Corvus monedula</i>	188	26	Daan <i>et al.</i> , 1990, Prinzinger, 1976	-----
<i>Corvus corone</i>	518	26	Prinzinger, 1976	-----
<i>Corvus corax</i>	1203	31	Schwan & Williams, 1978	No UCT
<i>Phytotoma rara</i>	41.6	30	Rezende <i>et al.</i> , 2001	No UCT

<i>Emberiza citrinella</i>	26.8	33	Wallgren, 1954	No UCT
<i>Emberiza pusilla</i>	11.3	25	Jin-Song <i>et al.</i> , 2001	Good
<i>Emberiza rutila</i>	15.3	32.5	Jin-Song <i>et al.</i> , 2001	Good
<i>Emberiza hortulana</i>	24.3	38	Wallgren, 1954	No UCT
<i>Amphispiza belli</i>	18.6	37	Moldenhauer, 1970	Good
<i>Zonotrichia leucophrys</i>	28.6	37	King, 1964	Good
<i>Emberiza spodocephala</i>	15.1	26	Ming <i>et al.</i> , 2005	Good
<i>Emberiza chrysophrys</i>	15.94	30	Jin-Song <i>et al.</i> , 2005	Good
<i>Lonchura cucullata</i>	10.6	38	Lovegrove & Smith, 2003	No UCT
<i>Taeniopygia guttata</i>	11.7	38	Calder 1964, Marshall & Prinzinger, 1991	No UCT
<i>Amadina fasciata</i>	17.2	38	Marschall & Prinzinger, 1991	Good
<i>Estrilda melpoda</i>	7.5	43	Marshall & Prinzinger, 1991	No UCT
<i>Padda oryzivora</i>	24.9	42	Marshall & Prinzinger, 1991	No UCT
<i>Estrilda troglodytes</i>	6.4	38	Cade <i>et al</i> 1965, Weathers & Nagy, 1984	Good
<i>Lonchura fuscans</i>	9.5	39	Weathers, 1977	Good
<i>Erythrura gouldiae</i>	15.5	38	Burton & Weathers, 2003	Good
<i>Carpodacus mexicanus</i>	20.4	33	Weathers, 1981, Dawson <i>et al.</i> , 1985	No UCT
<i>Carpodacus purpureus</i>	34	35	Salt, 1952	Good
<i>Carpodacus cassinii</i>	27.4	37	Weather <i>et al.</i> , 1980	Good
<i>Loxia curvirostra</i>	29.4	28.5	Dawson & Tordoff, 1964	No UCT
<i>Loxia leucoptera</i>	29.8	22	Dawson & Tordoff, 1964	No UCT
<i>Carduelis pinus</i>	13.8	35	Dawson & Carey, 1976	No UCT
<i>Carduelis tristis</i>	12.8	35	Dawson & Carey, 1976	Ins. data
<i>Carpodacus roseus</i>	22.5	27.5	Jin-Song <i>et al.</i> , 2004	Ins. data
<i>Fringilla montifringilla</i>	21	30	Jin-Song <i>et al.</i> , 2004	Good

<i>Coccothraustes vespertinus</i>	60	34	Dawson & Tordoff, 1959	No UCT
<i>Carduelis flammea</i>	14.7	28	Reinertsen & Haftorn, 1986, Pohl & West, 1973	No UCT
<i>Icterus bullockii</i>	34	35	Rising, 1969	Good
<i>Icterus galbula</i>	34	35	Rising, 1969	Good
<i>Lanius collaris</i>	43.8	35	Soobramoney <i>et al.</i> , 2003	Ins. data
<i>Lanius excubitor</i>	60	36	Ward & Pinshow, 1995, Degen <i>et al.</i> , 1992	Good
<i>Malurus cyaneus</i>	8.2	35	Lill <i>et al.</i> , 2006, Weathers & Stiles, 1989	Good
<i>Manacus vitellinus</i>	15.5	32	Bartholomew <i>et al.</i> , 1983	No UCT
<i>Eremiornis carteri</i>	12.3	39	Ambrose <i>et al.</i> , 1996	Ins. data
<i>Lichmera indistincta</i>	10.1	39	Vittali <i>et al.</i> , 1999, Collins <i>et al.</i> , 1980	No UCT
<i>Lichenostomus virescens</i>	25	39	Collins <i>et al.</i> , 1980	Ins. data
<i>Nectarinia amethystina</i>	10	30	Prinzinger <i>et al.</i> , 1989, Seavy, 2006	No UCT
<i>Nectarinia bifasciata</i>	6.2	27	Prinzinger <i>et al.</i> , 1989, Seavy, 2006	No UCT
<i>Anthreptes collaris</i>	8.3	28	Prinzinger <i>et al.</i> , 1989	No UCT
<i>Nectarinia kilimensis</i>	16.2	32	Prinzinger <i>et al.</i> , 1989	No UCT
<i>Nectarinia venusta</i>	7.6	30	Lübben, 1986, Seavy, 2006	Ins. data
<i>Nectarinia cuprea</i>	7.1	35	Lübben, 1986, Seavy, 2006	No UCT
<i>Aethopyga siparaja</i>	6.8	28	Prinzinger <i>et al.</i> , 1989, Lübben, 1986	No UCT
<i>Nectarinia tacazze</i>	13.5	31	Prinzinger <i>et al.</i> , 1989, Lübben, 1986, Seavy, 2006	No UCT
<i>Anthreptes orientalis</i>	11.8	32	Prinzinger <i>et al.</i> , 1989	No UCT
<i>Nectarinia senegalensis</i>	13.7	35	Seavy, 2006	No UCT
<i>Aethopyga christinae</i>	5.2	32	Prinzinger <i>et al.</i> , 1989	No UCT
<i>Paradisaea raggiana</i>	215.7	33	McNab, 2005	No UCT
<i>Lophorina superba</i>	74.6	32	McNab, 2005	No UCT
<i>Manucodia keraudrenii</i>	170.7	29	McNab, 2005	No UCT

<i>Paradisaea rudolphi</i>	156.1	33	McNab, 2005	No UCT
<i>Epimachus meyeri</i>	202.7	33	McNab, 2005	No UCT
<i>Parotia wahnesi</i>	164.2	30	McNab, 2005	No UCT
<i>Manucodia chalybatus</i>	177.2	30	McNab, 2005	Ins. data
<i>Parotia lawesii</i>	144.9	30	McNab, 2005	No UCT
<i>Astrapia stephaniae</i>	148.2	31	McNab, 2005	No UCT
<i>Cicinnurus regius</i>	54	33	McNab, 2005	No UCT
<i>Cicinnurus magnificus</i>	82.3	33	McNab, 2005	No UCT
<i>Ptiloris magnificus</i>	179.4	31	McNab, 2005	No UCT
<i>Parus atricapillus</i>	10.3	32	Rising & Hudson, 1974	Ins. data
<i>Passer domesticus</i>	23	35	Hudson & Kimzey, 1966	Good
<i>Syrnaticus ellioti</i>	388.25	31.6	Ying <i>et al.</i> , 2011	Good
<i>Pipra mentalis</i>	12.3	32	Bartholomew <i>et al.</i> , 1983	No UCT
<i>Pycnonotus sinensis</i>	25.6	33	Yong-Pu <i>et al.</i> , 2006	-----
<i>Actitis hypoleucos</i>	41.1	33	Heyer, 1995, Tatner & Bryant, 1993	-----
<i>Sitta canadensis</i>	11.2	38	Mugaas & Templeton, 1970	Ins. data
<i>Athene cucularia</i>	146.7	37	Coulombe, 1970	Good
<i>Onychognathus morio</i>	128	30	Chamane & Downs, 2009	No UCT
<i>Acridotheres cristatellus</i>	117.7	32.5	Lin <i>et al.</i> , 2010	-----
<i>Sturnus sericeus</i>	64.9	34.5	Yong-Pu <i>et al.</i> , 2006	-----
<i>Onychognathus tristramii</i>	123	36.5	Dmi'el & Tel-Tzur, 1985	-----
<i>Sturnus vulgaris</i>	75	37	Ricklefs & Williams, 1984	-----
<i>Hylophylax naevioides</i>	16.1	34	Wiersma <i>et al.</i> , 2007, Steiger <i>et al.</i> , 2009	Ins. data
<i>Sporophila corvina</i>	11	39.2	Weathers, 1997	Good
<i>Cyanerpes cyaneus</i>	13.5	35	Wiersma <i>et al.</i> , 2007, Mata, 2010	Ins. data

<i>Thryothorus ludovicianus</i>	14.9	35	Eberhardt, 1994	Ins. data
<i>Zosterops lateralis</i>	11.8	36.5	Maddocks & Gieser, 1997, Weathers & Sttiles, 1989	No UCT
<i>Zosterops erythropleurus</i>	9.16	27.5	Jin-Song <i>et al.</i> , 2005	Good
<i>Anhinga anhinga</i>	1040	40	Hennemann, 1983	No UCT
<i>Phalacrocorax auritus</i>	1330	40	Hennemann, 1983, Enstipp <i>et al.</i> , 2006	No UCT
<i>Trachyphonus darnaudii</i>	36.6	38	McNab, 2001	No UCT
<i>Ramphastos toco</i>	582	34	McNab, 2001	No UCT
<i>Ramphastos dicolorus</i>	328.9	34	McNab, 2001	No UCT
<i>Selenidera maculirostris</i>	130.5	34	McNab, 2001	No UCT
<i>Pteroglossus bailloni</i>	133	34	McNab, 2001	No UCT
<i>Pteroglossus aracari</i>	200.7	35	McNab, 2001	No UCT
<i>Ramphastos tucanus</i>	420.3	35	McNab, 2001	No UCT
<i>Aulacorhynchus sulcatus</i>	131.7	31	McNab, 2001	Ins. data
<i>Aulacorhynchus prasinus</i>	174.7	34	McNab, 2001	No UCT
<i>Podiceps nigricollis</i>	317	38	Ellis & Jehl, 2003	No UCT
<i>Puffinus pacificus</i>	367	34	Whittow <i>et al.</i> , 1987	-----
<i>Fulmarus glacialis</i>	651	22	Gabrielsen <i>et al.</i> , 1988	No UCT
<i>Cacatua roseicapilla</i>	271	33	Dawson & Fisher, 1982, Williams <i>et al.</i> , 1991	Good
<i>Nestor meridionalis</i>	369.3	26	McNab & Salisbury, 1995	No UCT
<i>Nestor notabilis</i>	836.9	28	McNab & Salisbury, 1995	Ins. data
<i>Cyanoramphus unicolor</i>	129.4	35	McNab & Salisbury, 1995	No UCT
<i>Cyanoramphus auriceps</i>	52.9	37	McNab & Salisbury, 1995	No UCT
<i>Cyanoramphus novaezelandiae</i>	56.1	37	McNab & Salisbury, 1995	No UCT
<i>Neophema pulchella</i>	40	32	Prinzinger & Hänssler, 1980, Burton <i>et al.</i> , 2008	Ins. data
<i>Neophema splendida</i>	40.86	29	Burton <i>et al.</i> , 2008	Ins. data

<i>Neophema elegans</i>	42.02	32	Burton <i>et al.</i> , 2008	Ins. data
<i>Melopsittacus undulatus</i>	33.7	41	Weathers & Schoenbaechler, 1976, Buttemer <i>et al.</i> , 1986	Good
<i>Agapornis nigrigenis</i>	41.37	35	Burton <i>et al.</i> , 2008	No UCT
<i>Agapornis roseicollis</i>	53.53	30.5	Burton <i>et al.</i> , 2008	No UCT
<i>Agapornis personatus</i>	46.77	34	Burton <i>et al.</i> , 2008	No UCT
<i>Bolborhynchus lineola</i>	55.7	32	Bucher, 1980	Ins. data
<i>Agapornis fischeri</i>	56.7	34	Burton <i>et al.</i> , 2008	No UCT
<i>Amazona viridigenalis</i>	341	35	Bucher, 1985	No UCT
<i>Myiopsitta monachus</i>	80.4	38.5	Weathers & Caccamise, 1975	Good
<i>Nothoprocta perdicaria</i>	458	28	Withers <i>et al.</i> , 1987	No UCT
<i>Pterocles alchata</i>	242	32.1	Hinsley <i>et al.</i> , 1993	Good
<i>Pterocles orientalis</i>	386.4	35.9	Hinsley <i>et al.</i> , 1993	Good
<i>Aptenodytes patagonicus</i>	11080	10	Froget <i>et al.</i> , 2002	No UCT
<i>Eudiptula minor</i>	1059.3	25	Richman & Lovvorn, 2011	Ins. data
<i>Spheniscus humboldti</i>	3870	30	Drent & Stonehouse, 1971	Ins. data
<i>Otus leucotis</i>	221.1	32	Smit <i>et al.</i> , 2008	Ins. data
<i>Micrathene whitneyi</i>	45	38	Ligon, 1968	Good
<i>Bubo virginianus</i>	1000	32.2	Ganey <i>et al.</i> , 1993	Good
<i>Strix occidentalis</i>	571	25.2	Ganey <i>et al.</i> , 1993, Weathers <i>et al.</i> , 2001	Good
<i>Glaucidium gnoma</i>	52	34	Ligon, 1968	No UCT
<i>Megascops asio</i>	141.5	34	Ligon, 1969	Good
<i>Megascops trichopsis</i>	119	35	Ligon, 1969	No UCT
<i>Aegolius acadicus</i>	118.1	33	Ligon, 1969	Good
<i>Strix aluco</i>	419	35	Bech & Præsteng, 2004	No UCT
<i>Aegolius funereus</i>	130	25	Hohtola, 1994	No UCT

<i>Bubo scandiaca</i>	2026	18.5	Gessaman, 1972	No UCT
<i>Tyto alba</i>	533.2	32.5	Edwards, 1987	Good
<i>Apteryx australis</i>	3137	30	McNab, 1996	No UCT
<i>Apteryx haastii</i>	2529	30	McNab, 1996	No UCT
<i>Apteryx owenii</i>	1377	29	McNab, 1996	No UCT
<i>Patagona gigas</i>	19.1	37	Lasiewski <i>et al.</i> , 1967	No UCT
<i>Eugenes fulgens</i>	6.6	37	Lasiewski & Lasiewski, 1967	No UCT
<i>Archilochus alexandri</i>	3.3	35	Lasiewski, 1963	No UCT
<i>Calypte anna</i>	4.5	37	Lasiewski, 1963	No UCT
<i>Calypte costae</i>	3.2	37	Lasiewski, 1963	No UCT
<i>Selasphorus rufus</i>	3.8	37	Lasiewski, 1963	No UCT
<i>Selasphorus sasin</i>	3.7	36	Lasiewski, 1963	No UCT
<i>Stellula calliope</i>	3	38	Lasiewski, 1963	No UCT
<i>Turnix suscitator</i>	58.1	39	Prinzinger <i>et al.</i> , 1993	No UCT
<b>Mammals</b>				
<i>Setifer setosus</i>	530	33	McNab, 1980	No UCT
<i>Aotus trivirgatus</i>	1020	30	Le-Maho <i>et al.</i> , 1981	Good
<i>Capra hircus</i>	21000	30	Holmes & Moore, 1981; Luiting <i>et al.</i> , 1985	No UCT
<i>Kobus ellipsiprymnus</i>	1.00E+05	37	Taylor <i>et al.</i> , 1969	-----
<i>Madoqua kirkii</i>	4600	35	Maskrey & Hoppe, 1979	No UCT
<i>Philantomba monticola</i>	4400	32	Haim & Skinner, 1991	No UCT
<i>Raphicerus campestris</i>	8500	33	Haim & Skinner, 1991	No UCT
<i>Sus scrofa</i>	48000	22	Huynh <i>et al.</i> , 2005	No UCT
<i>Pecari tajacu</i>	20000	35	Zervanos, 1975	Good



<i>Tragulus javanicus</i>	1618	29	Whittow <i>et al.</i> , 1977	Good
<i>Canis mesomelas</i>	7720	26	Downs <i>et al.</i> , 1991	Ins. data
<i>Canis latrans</i>	10000	26	Golightly & Ohmart, 1983	Good
<i>Vulpes macrotis</i>	1868	33	Golightly & Ohmart, 1983	Good
<i>Cerdocyon thous</i>	5444	37	Henneman <i>et al.</i> , 1983	No UCT
<i>Canis lupus</i>	18066.67	32.5	Irving <i>et al.</i> , 1995	No UCT
<i>Vulpes vulpes</i>	5010	30	Irving <i>et al.</i> , 1995	No UCT
<i>Vulpes zerda</i>	1106	32	Noll-Banholzer, 1979	Good
<i>Fossa fossana</i>	2260	34	McNab, 1995	Ins. data
<i>Leptailurus serval</i>	10100	30	Downs <i>et al.</i> , 1991	No UCT
<i>Galerella sanguinea</i>	540	31	Kamau <i>et al.</i> , 1979	Ins. data
<i>Suricata suricatta</i>	850	33	Müller & Lojewski, 1986	Good
<i>Spilogale putorius</i>	624	36	Knudsen & Kilgore, 1990	Good
<i>Eira barbara</i>	2950	35	McNab, 1995	No UCT
<i>Martes americana</i>	1038	35	Worthen & Kilgore, 1981	No UCT
<i>Nasua nasua</i>	4000	33	Chevillard-Hugot <i>et al.</i> , 1979	Good
<i>Nasua narica</i>	5554	35	Chevillard-Hugot <i>et al.</i> , 1979	-----
<i>Potos flavus</i>	2400	30	Müller <i>et al.</i> , 1983	Good
<i>Ailurus fulgens</i>	5740	36	McNab, 1988	Ins. data
<i>Genetta tigrina</i>	1732	35	Willard <i>et al.</i> , 1980	No UCT
<i>Nandinia binotata</i>	4270	34	McNab, 1995	Ins. data
<i>Arctictis binturong</i>	14280	36	McNab, 1995	No UCT
<i>Arctogalidia trivirgata</i>	2010	38	McNab, 1995	No UCT
<i>Paradoxurus hermaphroditus</i>	3160	36	McNab, 1995	No UCT
<i>Saccopteryx bilineata</i>	8.2	35	Genoud & Bonaccorso, 1986	Ins. data

<i>Peropteryx macrotis</i>	5.1	37	Genoud <i>et al.</i> , 1990	No UCT
<i>Rhinonictoris aurantia</i>	8.27	37.5	Baudinette <i>et al.</i> , 2000	Ins. data
<i>Hipposideros maggietaaylorae</i>	18.2	34	Bonaccorso & McNab, 2003	No UCT
<i>Hipposideros diadema</i>	37.2	34	Bonaccorso & McNab, 2003	No UCT
<i>Hipposideros galeritus</i>	8.5	32	McNab, 1989	Ins. data
<i>Macroderma gigas</i>	107	35	Baudinette <i>et al.</i> , 2000, Leitner & Nelson, 1966	Good
<i>Molossus molossus</i>	15.6	36	McNab, 1969	Ins. data
<i>Tadarida brasiliensis</i>	16.9	32.7	Soriano <i>et al.</i> , 2002	Good
<i>Mormoops megalophylla</i>	16.5	39.5	Bonaccorso <i>et al.</i> , 1992	No UCT
<i>Pteronotus davyi</i>	9.4	43	Bonaccorso <i>et al.</i> , 1992	No UCT
<i>Pteronotus parnellii</i>	19.2	40.5	Bonaccorso <i>et al.</i> , 1992	No UCT
<i>Pteronotus personatus</i>	14	38.5	Bonaccorso <i>et al.</i> , 1992	No UCT
<i>Chrotopterus auritus</i>	96.1	34	McNab, 1969	No UCT
<i>Pteronotus quadridens</i>	4.9	38	Rodríguez-Durán, 1995	Good
<i>Mormoops blainvillei</i>	8.6	36	Rodríguez-Durán, 1995	No UCT
<i>Natalus tumidirostris</i>	5.4	35	Genoud <i>et al.</i> , 1990	Ins. data
<i>Diaemus youngi</i>	36.6	30	McNab, 1969	No UCT
<i>Desmodus rotundus</i>	29.4	37.5	McNab, 1969	No UCT
<i>Noctilio albiventris</i>	27	38	McNab, 1969	No UCT
<i>Noctilio leporinus</i>	61	38	McNab, 1969	Good
<i>Glossophaga longirostris</i>	13.5	36	Arends <i>et al.</i> , 1995	No UCT
<i>Leptonycteris yerbabuenae</i>	44	38	Arends <i>et al.</i> , 1995	No UCT
<i>Leptonycteris curasoae</i>	24	35	Arends <i>et al.</i> , 1995	No UCT
<i>Glossophaga soricina</i>	9.6	35.2	Cruz-Neto & Abe, 1997	Good
<i>Phyllostomus elongatus</i>	35.6	36	McNab, 1969	No UCT

<i>Rhinophylla pumilio</i>	9.5	35	McNab, 1969	Ins. data
<i>Uroderma bilobatum</i>	16.2	35	McNab, 1969	No UCT
<i>Tonatia bidens</i>	27.4	35	McNab, 1969	Ins. data
<i>Artibeus concolor</i>	19.7	38	McNab, 1969	No UCT
<i>Phyllostomus hastatus</i>	84.2	35	McNab, 1969	Good
<i>Artibeus lituratus</i>	70.1	36	McNab, 1969	Good
<i>Phyllostomus discolor</i>	33.5	37	McNab, 1969	Good
<i>Carollia perspicillata</i>	14.9	35	McNab, 1969	Good
<i>Artibeus jamaicensis</i>	45.2	35	McNab, 1969	Good
<i>Sturnira lilium</i>	21.9	35.5	McNab, 1969	No UCT
<i>Diphylla ecaudata</i>	27.8	30	McNab, 1969	Good
<i>Anoura caudifer</i>	11.5	35	McNab, 1969	Ins. data
<i>Choeroniscus periosus</i>	15	37.7	McNab, 1969	-----
<i>Monophyllus redmani</i>	8.7	35	Rodríguez-Durán, 1995	No UCT
<i>Erophylla bombifrons</i>	16.1	33	Rodríguez-Durán, 1995	No UCT
<i>Anoura latidens</i>	13.6	36.2	Soriano <i>et al.</i> , 2002	No UCT
<i>Sturnira erythromos</i>	15.9	32.5	Soriano <i>et al.</i> , 2002	Good
<i>Macroglossus minimus</i>	16.3	33	Bartels <i>et al.</i> , 1998	No UCT
<i>Pteropus scapulatus</i>	440	35	Bartholomew <i>et al.</i> , 1964	Good
<i>Pteropus poliocephalus</i>	825	35	Bartholomew <i>et al.</i> , 1964	No UCT
<i>Dobsonia minor</i>	73.7	35	Bartholomew <i>et al.</i> , 1970	No UCT
<i>Melonycteris melanops</i>	53.3	33	Bonaccorso & McNab, 1997	No UCT
<i>Syconycteris australis</i>	17.8	33	Geiser <i>et al.</i> , 1996	No UCT
<i>Eonycteris spelaea</i>	51.6	32.5	McNab, 1989	Ins. data
<i>Cynopterus brachyotis</i>	37.4	37	McNab, 1989	Good

<i>Pteropus rodricensis</i>	254.5	35.5	McNab & Bonaccorso, 2001	No UCT
<i>Dobsonia praedatrix</i>	179.5	33	McNab & Bonaccorso, 2001	Ins. data
<i>Dobsonia anderseni</i>	241.4	34	McNab & Bonaccorso, 2001	No UCT
<i>Nyctimene albiventer</i>	30.9	34	McNab & Bonaccorso, 2001	Ins. data
<i>Histiotus velatus</i>	11.2	31	McNab, 1969	Ins. data
<i>Miniopterus schreibersii</i>	10.91	37.5	Baudinette <i>et al.</i> , 2000	Good
<i>Lasiurus cinereus</i>	27.5	34	Cryan & Wolf, 2003	Good
<i>Myotis thysanodes</i>	6	36.5	O'Farrell & Studier, 1970	No UCT
<i>Nyctophilus gouldi</i>	10	32.5	Geiser & Brigham, 2000	No UCT
<i>Nyctophilus geoffroyi</i>	7	33.2	Geiser & Brigham, 2000	No UCT
<i>Chalinolobus gouldii</i>	17.5	40	Hosken & Withers, 1997	No UCT
<i>Myotis keaysi</i>	5	33.4	Machado & Soriano, 2007	No UCT
<i>Myotis oxyotus</i>	4.8	32.5	Machado & Soriano, 2007	Ins. data
<i>Myotis lucifugus</i>	9.5	34.5	Machado & Soriano, 2007	-----
<i>Vespadelus vulturnus</i>	4	33.3	Willis <i>et al.</i> , 2005	Good
<i>Chaetophractus nationi</i>	2150	35	McNab, 1980	Ins. data
<i>Chaetophractus vellerosus</i>	1110	35	McNab, 1980	Ins. data
<i>Dasypus novemcinctus</i>	3320	38	McNab, 1980	No UCT
<i>Euphractus sexcinctus</i>	8190	37	McNab, 1980	No UCT
<i>Tolypeutes matacus</i>	1160	36	McNab, 1980	No UCT
<i>Zaedyus pichiy</i>	1740	35	McNab, 1980	No UCT
<i>Dasycercus cristicauda</i>	86	37	Kennedy & Macfarlane, 1971	Good
<i>Ningauai yvonnae</i>	11.6	35	Geiser & Baudinette, 1988	No UCT
<i>Planigale gilesi</i>	9.4	33	Geiser & Baudinette, 1988	No UCT
<i>Planigale maculata</i>	13.1	35	Morton & Lee, 1978	No UCT

<i>Sminthopsis crassicaudata</i>	19	38	Geiser & Baudinette, 1988	-----
<i>Sminthopsis macroura</i>	24.8	34	Song <i>et al.</i> , 1995	No UCT
<i>Caluromys derbianus</i>	357	35	McNab, 1978	Ins. data
<i>Chironectes minimus</i>	946	34	McNab, 1978	No UCT
<i>Didelphis marsupialis</i>	1329	36	McNab, 1978	No UCT
<i>Didelphis virginiana</i>	3257	34	McNab, 1978	Ins. data
<i>Lutreolina crassicaudata</i>	812	35	McNab, 1978	No UCT
<i>Marmosa lepida</i>	106	35	Nelson & Yousaf, 1979	Good
<i>Marmosa robinsoni</i>	122	36	McNab, 1978	Ins. data
<i>Metachirus nudicaudatus</i>	336	36	McNab, 1978	No UCT
<i>Monodelphis brevicaudata</i>	111	36	McNab, 1978	No UCT
<i>Philander opossum</i>	751	36	McNab, 1978	Ins. data
<i>Thylamys elegans</i>	40.2	35	Bozinovic <i>et al.</i> , 2005	Good
<i>Acrobates pygmaeus</i>	14	35.1	Fleming, 1985	Ins. data
<i>Cercartetus lepidus</i>	12	33	Geiser, 1987	Good
<i>Cercartetus concinnus</i>	18.6	30	Geiser, 1987	No UCT
<i>Lagorchestes conspicillatus</i>	2660	35	Dawson & Bennett, 1978	Good
<i>Macropus giganteus</i>	26200	35	Dawson & Hulbert, 1970; Dawson <i>et al.</i> , 2000	Ins. data
<i>Macropus rufus</i>	32490	35	Dawson & Hulbert, 1970; Dawson <i>et al.</i> , 2000	Ins. data
<i>Setonix brachyurus</i>	2674	32.5	Kinnear & Shield, 1975	Good
<i>Dendrolagus matschiei</i>	6960	37	McNab, 1988	Ins. data
<i>Petaurus breviceps</i>	128.1	31	Fleming, 1980; Dawson & Hulbert, 1970	Good
<i>Phalanger carmelitae</i>	1389.7	32.5	McNab, 2008	No UCT
<i>Spilocuscus maculatus</i>	4250	35.4	Dawson & Degabriele, 1973	No UCT
<i>Phalanger sericeus</i>	1353.2	30	McNab, 2008	No UCT

<i>Phascolarctos cinereus</i>	4765	26	Degabriele & Dawson, 1979	Good
<i>Potorous tridactylus</i>	1120	30	Nicol, 1976	Ins. data
<i>Bettongia gaimardi</i>	1700	20	Rose, 1997	Good
<i>Cercartetus nanus</i>	70	35	Bartholomew & MacMillen, 1961	Good
<i>Pseudocheirus peregrinus</i>	872	32.5	Kinnear & Shield, 1975	Good
<i>Cercopithecus mitis</i>	8500	28	Müller <i>et al.</i> , 1983	Good
<i>Petauroides volans</i>	1141	25	Rübsamen <i>et al.</i> , 1984	Good
<i>Tarsipes rostratus</i>	10	34	Withers <i>et al.</i> , 1990	No UCT
<i>Lasiorhinus latifrons</i>	25000	39	Wells, 1978	Good
<i>Atelerix albiventris</i>	450	35	McNab, 1980	No UCT
<i>Erinaceus concolor</i>	822.7	31.5	Krol, 1994	Good
<i>Crocidura russula</i>	10.4	35	Sparti, 1990	Good
<i>Crocidura suaveolens</i>	6.5	35	Sparti, 1990	Good
<i>Heterohyrax brucei</i>	2000	35	Bartholomew & Rainey, 1971	No UCT
<i>Procavia capensis</i>	2400	35	Rübsamen <i>et al.</i> , 1979	Good
<i>Brachylagus idahoensis</i>	432	25.5	Katzner <i>et al.</i> , 1997	Good
<i>Lepus alleni</i>	3362	35	Dawson & Schmidt-Nielsen, 1966	Good
<i>Sylvilagus audubonii</i>	672.4	40	Hinds, 1973	Good
<i>Elephantulus edwardii</i>	49.8	36	Leon <i>et al.</i> , 1983	Good
<i>Macroselides proboscideus</i>	45	38	Roxburg & Perrin, 1994	No UCT
<i>Zaglossus bruijni</i>	10300	33	McNab, 1984	No UCT
<i>Isodon obesulus</i>	1020	35	Larcombe, 2002	No UCT
<i>Macrotis lagotis</i>	1011	35	Kinnear & Shield, 1975	Good
<i>Tamandua tetradactyla</i>	3500	35	McNab, 1984	No UCT
<i>Callithrix pygmaea</i>	153	34	Genoud <i>et al.</i> , 1997	No UCT

<i>Saimiri sciureus</i>	850	35	Stitt & Hardy, 1971; Malinow & Wagner, 1966	Ins. data
<i>Colobus guereza</i>	10500	28	Müller <i>et al.</i> , 1983	Good
<i>Macaca fuscata</i>	9550	35	Nakayama <i>et al.</i> , 1971	No UCT
<i>Microcebus murinus</i>	105	28	Aujard <i>et al.</i> , 1998	No UCT
<i>Eulemur fulvus</i>	2330	40	Daniel, 1984	No UCT
<i>Perodicticus potto</i>	1090	29	Hildwein & Goffart, 1975	Ins. data
<i>Nycticebus coucang</i>	1300	33	Müller, 1979	Good
<i>Nycticebus pygmaeus</i>	388	35	Xiao <i>et al.</i> , 2010	Ins. data
<i>Tarsius syrichta</i>	125	35	McNab & Wright, 1987	Ins. data
<i>Aplodontia rufa</i>	630	35	McNab, 1979	No UCT
<i>Cryptomys hottentotus</i>	102	32	Bennett <i>et al.</i> , 1994	Ins. data
<i>Cryptomys bocagei</i>	94	32.5	Bennett <i>et al.</i> , 1994	Ins. data
<i>Cryptomys mehowi</i>	267	30	Bennett <i>et al.</i> , 1994	Ins. data
<i>Cryptomys damarensis</i>	124	31	Lovegrove, 1986	Good
<i>Georychus capensis</i>	192.6	34	Lovegrove, 1987	Good
<i>Heterocephalus glaber</i>	39.2	37	McNab, 1966	Ins. data
<i>Dolichotis salinicola</i>	1613	37	Arends & McNab, 2001	Ins. data
<i>Kerodon rupestris</i>	801	36	Arends & McNab, 2001	No UCT
<i>Hydrochoerus hydrochaeris</i>	26400	33	Arends & McNab, 2001	No UCT
<i>Microtus guentheri</i>	51.3	34	Banin <i>et al.</i> , 1990, Haim & Izhaki, 1995	No UCT
<i>Microtus californicus</i>	44	40	Bell <i>et al.</i> , 1986	Good
<i>Microtus longicaudus</i>	26.9	33.5	Bell <i>et al.</i> , 1986	Good
<i>Phyllotis darwini</i>	59	34	Bozinovic & Rosenmann, 1988	Good
<i>Loxodontomys micropus</i>	62.3	33	Bozinovic & Rosenmann, 1988	Ins. data
<i>Peromyscus maniculatus</i>	17	37	Brower & Cade, 1966	Ins. data

<i>Megadontomys thomasi</i>	111	35	Buffenstein & Jarvis, 1985	Good
<i>Myodes gapperi</i>	20.8	34	Deavers & Hudson, 1981	Ins. data
<i>Peromyscus leucopus</i>	21.2	34.5	Deavers & Hudson, 1981	Ins. data
<i>Isthmomys pirrensis</i>	140.4	34	Hill, 1975	No UCT
<i>Microtus arvalis</i>	24	30	Jansky, 1959	-----
<i>Ochrotomys nuttalli</i>	19.5	36	Layne & Dolan, 1975	Ins. data
<i>Peromyscus gossypinus</i>	21.5	35.3	Layne & Dolan, 1975	-----
<i>Neotoma lepida</i>	106	35	McNab, 1966	-----
<i>Oxymycterus roberti</i>	83.5	34	McNab, 1984	No UCT
<i>Neofiber alleni</i>	258.1	34	McNab, 1992	Ins. data
<i>Ondatra zibethicus</i>	1004.6	30	McNab, 1992	Ins. data
<i>Microtus pinetorum</i>	23.8	35	McNab, 1992	Ins. data
<i>Lemmiscus curtatus</i>	30.3	33	McNab, 1998	-----
<i>Microtus richardsoni</i>	51.3	33.5	McNab., 1998	-----
<i>Peromyscus californicus</i>	49.6	34.5	McNab & Morrison, 1963	Good
<i>Peromyscus truei</i>	33	33	McNab & Morrison, 1963	Good
<i>Peromyscus crinitus</i>	20.9	35	McNab & Morrison, 1963	Good
<i>Peromyscus eremicus</i>	21.5	36.5	McNab & Morrison, 1963	Ins. data
<i>Microtus montanus</i>	51.2	31	Packard, 1968	No UCT
<i>Reithrodontomys megalotis</i>	7.6	35	Pearson, 1960	No UCT
<i>Myopus schisticolor</i>	26.4	24	Saarela & Hissa, 1993	No UCT
<i>Cricetulus barabensis</i>	31.4	30	Song & Wang, 2003	Ins. data
<i>Graomys griseoflavus</i>	69.4	34	Caviedes-Vidal <i>et al.</i> , 1987	No UCT
<i>Phodopus sungorus</i>	24	35	Weiner & Heldmaier, 1987	No UCT
<i>Onychomys torridus</i>	19.1	35	Whitford & Conley, 1971	Good



<i>Microtus pennsylvanicus</i>	38.9	29	Wiegert, 1961	Ins. data
<i>Microtus ochrogaster</i>	47.4	34	Wunder <i>et al.</i> , 1977	No UCT
<i>Ctenomys talarum</i>	116	30	Busch, 1989	No UCT
<i>Priodontes maximus</i>	45190	34	McNab, 1980	No UCT
<i>Cabassous centralis</i>	3810	32.5	McNab, 1980	Good
<i>Dasyprocta azarae</i>	3849	35	Arends & McNab, 2001	No UCT
<i>Myoprocta acouchy</i>	914	30	Arends & McNab, 2001	Ins. data
<i>Dasyprocta leporina</i>	2687	34	Arends & McNab, 2001	No UCT
<i>Napaeozapus insignis</i>	20.9	34	Brower & Cade, 1966	Ins. data
<i>Jaculus jaculus</i>	74.5	35	Hooper & Hilali, 1972	Good
<i>Jaculus orientalis</i>	139.1	33	Hooper & Hilali, 1972	Good
<i>Thrichomys apereoides</i>	323	35	Arends & McNab, 2001	No UCT
<i>Erethizon dorsatum</i>	7710	20	Irving <i>et al.</i> , 1995	No UCT
<i>Geomys bursarius</i>	197	33	Bradley & Yousaf, 1975	No UCT
<i>Thomomys umbrinus</i>	85	35	Bradley <i>et al.</i> , 1974	Good
<i>Thomomys talpoides</i>	106	32	Bradley <i>et al.</i> , 1974	Good
<i>Geomys pinetis</i>	202	35	McNab, 1966	Ins. data
<i>Thomomys bottae</i>	143	30	Vleck, 1979	Good
<i>Chaetodipus intermedius</i>	15.2	36	Bradley <i>et al.</i> , 1975	Good
<i>Dipodomys microps</i>	57.2	32	Breyen <i>et al.</i> , 1973	Good
<i>Chaetodipus penicillatus</i>	16	37	Brower & Cade, 1966	No UCT
<i>Dipodomys merriami</i>	34.7	35	Dawson, 1955	No UCT
<i>Dipodomys panamintinus</i>	64.2	34	Dawson, 1955	No UCT
<i>Liomys salvini</i>	43.8	34	Hudson & Rummel, 1966	No UCT
<i>Liomys irroratus</i>	48.1	34	Hudson & Rummel, 1966	No UCT

<i>Heteromys anomalus</i>	69.3	33	McNab, 1979	No UCT
<i>Dipodomys deserti</i>	106	35	McNab, 1979	Ins. data
<i>Chaetodipus hispidus</i>	35.8	33.5	Wang & Hudson, 1970	Ins. data
<i>Hystrix africaeaustralis</i>	10700	27	Haim <i>et al.</i> , 1990	Good
<i>Abrothrix longipilis</i>	42.3	32	Bozinovic & Rosenmann, 1988	Good
<i>Abrothrix andinus</i>	34.6	34	Bozinovic & Rosenmann, 1988	Good
<i>Auliscomys boliviensis</i>	76.8	31	Bozinovic & Rosenmann, 1988	No UCT
<i>Micaelamys namaquensis</i>	64.2	34.49	Buffenstein, 1984	Good
<i>Gerbillurus paeba</i>	33.9	35.1	Buffenstein, 1984	Good
<i>Gerbillus pusillus</i>	12.6	38	Buffenstein & Jarvis, 1985	Good
<i>Mus musculus</i>	46	33	Buffenstein & Jarvis, 1985	Ins. data
<i>Rattus fuscipes</i>	76	32.9	Collins, 1973	Ins. data
<i>Rattus villosissimus</i>	250.6	35	Collins & Brdshaw, 1973	Good
<i>Akodon azarae</i>	23.5	32	Dalby & Heath, 1976	Ins. data
<i>Gerbillurus setzeri</i>	46.1	34.8	Dempster <i>et al.</i> , 1998	Good
<i>Gerbillurus vallinus</i>	38.8	35	Dempster <i>et al.</i> , 1999	Good
<i>Gerbillurus tytonis</i>	29.9	34.9	Downs & Perrin, 1990	Good
<i>Mystromys albicaudatus</i>	93.78	30	Downs & Perrin, 1995	Good
<i>Gerbillus andersoni</i>	35.8	35	Haim, 1984	No UCT
<i>Gerbillus nanus</i>	28.2	34	Haim, 1984	Ins. data
<i>Dipodillus dasyurus</i>	27.6	35	Haim, 1987	----
<i>Otomys irroratus</i>	111.6	28	Haim & Fairall, 1987	Good
<i>Apodemus mystacinus</i>	42.3	32	Haim <i>et al.</i> , 1993	No UCT
<i>Mus macedonicus</i>	14.5	33	Haim <i>et al.</i> , 1999	Ins. data
<i>Baiomys taylori</i>	7.3	36	Hudson, 1965	No UCT

<i>Apodemus agrarius</i>	24.4	27.5	Liu <i>et al.</i> , 2004	Good
<i>Apodemus speciosus</i>	28.5	30	Liu <i>et al.</i> , 2004	Good
<i>Thallomys paedulcus</i>	124.7	35.89	Lovegrove <i>et al.</i> , 1991	Good
<i>Notomys cervinus</i>	34.2	34	MacMillen & Lee, 1970	Good
<i>Notomys alexis</i>	32.3	34	MacMillen & Lee, 1970	Good
<i>Pseudomys hermannsburgensis</i>	12.2	36	MacMillen <i>et al.</i> , 1972	Ins. data
<i>Cannomys badius</i>	344	34.5	McNab, 1979	Good
<i>Gerbillus pyramidum</i>	53	31	Robinson, 1959	-----
<i>Meriones unguiculatus</i>	61	40	Robinson, 1959	No UCT
<i>Aepyprymnus rufescens</i>	2820	33	Rübsamen <i>et al.</i> , 1984	-----
<i>Acomys cahirinus</i>	42	32.5	Shkolnik & Borut, 1969	No UCT
<i>Saccostomus campestris</i>	61.3	32	Haim <i>et al.</i> , 1991	No UCT
<i>Steatomys pratensis</i>	37.5	32	Perrin & Richardson, 2005	Ins. data
<i>Octodon degus</i>	206	35	Arends & McNab, 2001	Ins. data
<i>Octodontomys gliroides</i>	152	35	Arends & McNab, 2001	Ins. data
<i>Spalacopus cyanus</i>	185	34	Contreras, 1986; McNab, 1979	Ins. data
<i>Pedetes capensis</i>	2300	33	Müller <i>et al.</i> , 1979	Ins. data
<i>Spermophilus beecheyi</i>	599.6	30	Baudinette, 1972	Good
<i>Ammospermophilus leucurus</i>	96	34	Dawson, 1955	Good
<i>Tamiasciurus hudsonicus</i>	231	27	Pauls, 1981	No UCT
<i>Cynomys ludovicianus</i>	1112.3	35	Reinking <i>et al.</i> , 1977	Good
<i>Spermophilus lateralis</i>	257	30	Tattersall & Milsom, 2003	No UCT
<i>Tamias striatus</i>	92.2	32	Wang & Hudson, 1971	Good
<i>Tamias minimus</i>	50.6	34	Willems & Armitage, 1975	Good
<i>Tamias merriami</i>	75	35	Wunder, 1970	Ins. data

<i>Tachyoryctes splendens</i>	191	35	McNab, 1966	No UCT
<i>Spalax leucodon</i>	207.7	34	McNab, 1966	No UCT
<i>Tupaia belangeri</i>	186	35	Zhang <i>et al.</i> , 2012	Good
<i>Tupaia glis</i>	123	37	Bradley & Hudson, 1974	No UCT
<i>Blarina brevicauda</i>	20.5	33	Deavers & Hudson, 1981; Neal & Lustik, 1973	Ins. data
<i>Neomys anomalus</i>	13.4	30	Gebczynska & Gebczynski, 1965	Ins. data
<i>Neomys fodiens</i>	14.2	30	Gebczynska & Gebczynski, 1965	Ins. data
<i>Notiosorex crawfordi</i>	4	36	Lindstedt, 1980	No UCT
<i>Sorex minutus</i>	4.45	30	McDevitt & Andrews, 1995	No UCT
<i>Sorex cinereus</i>	3.5	30	Morrison <i>et al.</i> , 1959	Ins. data
<i>Neurotrichus gibbsii</i>	11.8	32	Campbell & Hochachka, 2000	Ins. data
<i>Condylura cristata</i>	49	33	Campbell <i>et al.</i> , 1999	No UCT
<i>Scalopus aquaticus</i>	48	33	McNab, 1979	Ins. data

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