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ABSTRACT

Body size, as summarized especially by mass, is one of the simplest yet most significant aspects of an animal's adaptation and life history. Extant Cercopithecidae (Old World monkeys) present a range of mass from ca. 1–50 kg, and extinct species have been suggested to have weighed as much as 100 kg. The development of reliable methods for determining body size in extinct taxa is an important prerequisite to more detailed paleobiological analyses. Here we develop a series of equations to be used in such estimation as well as a protocol for the selection of the "best" such equations.

Data were analyzed for 35 variables from the postcranium, dentition, and cranium in about 1500 individual cercopithecids (roughly half extant and half fossil). Bivariate relationships between each of the variables and mass were determined (using ordinary least squares regression) in a subset of taxa to obtain prediction equations. These equations were then tested on a smaller subset of taxa which had not been included in the previous step, in order to determine prediction accuracy, as judged by Mean Prediction Error. A final set of prediction equations was then developed for the highest-ranked variables in each of seven taxon-sex subgroups. The scaling of these variables with mass was examined in extant taxa using reduced major axis regression.

We compared prediction accuracy in variables from the postcranium, skull, and dentition. Postcranial and dental variables yielded somewhat more accurate estimates than did cranial variables. In addition, we explored the relationships among correlation coefficients, mean prediction error, regression model choice, and scaling patterns with respect to estimation. We determined that 20% on either side of a point estimate of mass is an acceptable range of "answers", given the normal variation in mass in extant Old World monkey populations, the quality of our data, and the statistical methods used for estimation (bivariate OLS regression). Any greater claimed "precision" for a fossil mass estimate is an injustice to the estimation routine as well as to the reader.

The prediction equations were finally applied to over 90 fossil taxa, using postcranial, dental, and cranial specimens from both sexes. As suggested previously, males of the largest population studied (*Theropithecus* from Olorgesailie, Kenya) may have averaged 85 kg, with some isolated teeth indicating a mass of 95 kg. Other taxa, such as *Papio* (*Dinopithecus*) *ingens* from Swartkrans (South Africa), were estimated to have had a far lower mass than predicted by other workers.

The resulting mass estimates were used to examine sexual dimorphism, body size evolution, and energetics in extinct cercopithecids. In *Theropithecus,* for example, mass increased rather steadily through time, as noted previously by many workers. However, although the Olorgesailie population had an average (mixed-sex) mass of ca. 62 kg, roughly contemporaneous populations from Tighenif and Hopefield averaged only 43 kg. This might have resulted from a late lineage split in this clade or factors relating to energetics.

INTRODUCTION

It is by now a truism that body size is an important biological characteristic of any organism. Numerous authors have discussed the ways in which size can affect the adaptations and lifeways of primate species (e.g., Kay, 1975; Clutton-Brock and Harvey, 1977 [and related papers]; Fleagle, 1978, 1985, 1988; Jungers, 1985) and those of other animals (e.g., Peters, 1983; Calder, 1984; Schmidt-Nielsen, 1984; Damuth and MacFadden, 1990). Some statistical analyses attempt to partial out its effects in order to concentrate on the study of "shape", while other studies seek to understand the allometric effects of evolutionary changes in size.

Body mass is an important summary measure of body size as it can be determined (and compared) in groups of widely varying body design. Additionally, analyses of functional morphology as well as of many physiological and life history variables depend upon a reliable knowledge of body mass. Although there is a formal distinction between mass and weight (the former is an inherent property of matter, while the latter results from the interaction of mass with local gravitational forces), near the earth's surface (and thus for all biological purposes) they are identical; we will here use body mass for this property, in part because it is the more universal concept (see also Smith and Jungers, 1997).

The estimation of body mass in fossil (and lesser-known modern) taxa has been the subject of numerous books and papers (e.g., for nonhuman primates: Aiello, 1981; Gingerich et al., 1982; Conroy, 1987; Jungers, 1987; Damuth and MacFadden, 1990; Dagosto and Terranova, 1992; Rafferty et al., 1995). The majority of these contributions have examined size in a range of primate taxa, utilizing dental, cranial, and/or postcranial data to infer mass. In most cases, authors spread their taxonomic nets wide, including modern and extinct taxa from all or a large portion of the order Primates. These broad surveys provided large samples and a great range of size in which to examine relationships among the variables used. They also tended to dilute the reliability of the proposed mass predictions, given that different taxa may not behave identically in terms of morphological response to increasing mass. Conroy (1987), for example, found that equations used to predict masses for animals included in his prosimian, monkey, or ape grades differed from each other and from those derived from all primates. Moreover, the sources of data in these and related studies varied widely. Body mass was often cited from "the literature", that is published sources of species mean masses chosen almost ad hoc. Measurements were either culled from "the literature" (e.g., Swindler, 1976, for teeth) or provided by the authors. In few cases were the masses and measurements from the same individuals. In this paper, we attempt to recognize and control some of these potential sources of error by concentrating on a restricted primate group, the Cercopithecidae, and using only carefully screened raw data.

Living cercopithecids present a range of body masses from *Miopithecus* at about 1 kg to nearly 50 kg in the largest *Mandrillus*. This 50:1 range is somewhat more than in Hominoidea (where the smallest *Hylobates* may be about 5 kg and the largest *Gorilla* 175 kg, for a 35:1 range). The cercopithecid range is not as great as in all primates (*Microcebus* to *Gorilla* range of 30–175,000 g, ca. 6000:1), Strepsirhini (from *Microcebus* to the largest *Propithecus* at ca. 7000 g, for a 230:1 range over seven families), or even platyrrhines (*Cebuella* at 120 g, *Alouatta* at 10,000+ g, >80:1). The smallest known extinct cercopithecids were probably larger than *Miopithecus,* but the largest fossil *Theropithecus* has been estimated to have had a mass as high as 100 kg.

No previous work has looked closely at mass estimates for Old World monkeys, but one paper by Dunbar (1992) used the body masses of a variety of extinct papionin species provided by Fleagle (1988: 402) to evaluate their ecological adaptations. He argued from energetics that the mass estimated for *Dinopithecus ingens* (77 kg) was so high as to require that this species must have had a diet similar in some ways to that of *Theropithecus.* Dunbar recognized the arguments of Delson (1975; Szalay and Delson, 1979) that the dentition (especially the incisors) of *Dinopithecus* was of the *Papio* or *Macaca* type, and unlike *Theropithecus,* but only by applying a model derived from *Theropithecus* could *Dinopithecus* group sizes be estimated as high enough for survival. Dunbar further estimated that another South African species, *Gorgopithecus major* (using Fleagle's mass of 41 kg), would have been restricted to group sizes under 15 individuals. The estimated masses further struck ED as too high, especially in light of the resultant inference. Moreover, Fleagle (1988) gave no indication of the methods used to estimate mass. (It is noteworthy that the 1998 second edition of this work partly clarified some of this question and incorporated some of the results obtained below; other estimates remained as in 1988, and in our discussion we will refer to that earlier work.) Dunbar's analysis provided much of the original impetus for our collaborative investigation.

Another catalyst for this work was the series of papers through the 1980s that attempted to infer the body mass of *Oreopithecus bambolii,* previously considered by ED to be a divergent member of Cercopithecoidea. Schultz (1960) first estimated the mass of the male individual represented by the crushed 1958 skeleton as 40 kg or more. Aiello

(1981) used humeral length as a predictor of body mass in fossil anthropoids, obtaining 48.6 kg for *Oreopithecus,* although the humerus of that species was probably relatively elongated and that of the 1958 skeleton was badly squeezed and probably further lengthened by plastic deformation. Gingerich et al. (1982) obtained an estimate of about 15 kg, based on upper and lower first molar areas, while Conroy (1987) produced estimates of 17–18 kg from lower first molar area only, with slight variation due to different "grade" equations. Szalay and Langdon (1987) argued that the overall size of the 1958 skeleton was comparable to that of a living female orangutan, thus about 37 kg, while Sarmiento (1987) preferred 35 kg. Jungers (1987) reported a series of joint surface analyses and produced the most widely accepted value, 32 kg. This work implied that the teeth of *Oreopithecus bambolii* were probably quite small for its mass (microdonty), while its humerus might well have been long. Such inferences about the relative proportions of different anatomical regions can only be attempted when all available data about fossil species are evaluated together, in light of estimation equations derived from variables of the several regions.

In the present paper, therefore, we undertake a variety of mass-related analyses on a large dataset of cercopithecid cranial, dental, and postcranial measurements and masses. Regressions of body mass on different measurements in selected subsets of Old World monkeys produce a great many equations for mass prediction, and these are then evaluated, both within and across anatomical regions and taxa. A series of tests is undertaken to determine the accuracy and consistency of these estimates and to select the most reliable predictor variables. The "best" equations are then used to produce a range of estimates for extinct cercopithecid species, and these values are assessed for paleobiological implications. Such an approach is more complex but surely more reliable than the use of "point" predictions based on the use of single estimators (e.g., ln m1 area). Following the American Museum of Natural History publications guidelines, upper molars are indicated as M1–3, while lowers are denoted m1–3.

Institutional Abbreviations

AIUG	Anatomisches Institut, Universität Göttingen, Germany
AIUZ	Anthropologisches Institut, Universität Zürich Switzerland
AMNH	American Museum of Natural History, Mammalogy, New York
ANSP	Academy of Natural Sciences, Philadelphia
BM(NH)	British Museum (Natural History), London, Zoology (Mammals)
BNHS	Bombay Natural History Society, India
FDCG	Forestry Designing Centre of Guangxi, Nanning, China
Fleagle	Research collection of Dr. John G. Fleagle, SUNY-Stony Brook
FMNH	Field Museum of Natural History, Chicago, Mammals (F indicates field number)
FSM	Florida State Museum, Gainesville
Haddow	Haddow Collection, Royal College of Surgeons, London
IEBR	Institute of Ecology and Biological Resources, Hanoi, Vietnam
IRSN-B	Institut Royale des Sciences Naturelle, Brussels
IZCAS	Institute of Zoology, Chinese Academy of Sciences, Beijing
Jolly	Research collection of Dr. Clifford J. Jolly, New York University
KIZ	Kunming Institute of Zoology, Academia Sinica, China
KNM-OM	National Museums of Kenya, Nairobi, Osteology
McGraw	Research collection of Dr. Scott McGraw, Dept. Anthropology, The Ohio State University, Mansfield
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Mass.
MNHN-P	Muséum National d'Histoire Naturelle, Paris, Oiseaux et Mammifères
MRAC-T	Musée Royale de l'Afrique Centrale, Tervuren, Belgium
NMNH	National Museum of Natural History, Smithsonian Institution, Washington, D.C., Vertebrate Zoology (Mammals)
PCM	Powell-Cotton Museum, Birchington, U.K.

SAF	Senckenbergische Anatomie, Frankfurt, Starck Collection.
Sarmiento	Research collection of Dr. Esteban Sarmiento, American Museum of Natural History, Mammalogy
SCIEA	South China Institute of Endangered Animals, Guangzhou
SICONBREC	Simian Conservation, Breeding and Research Center, Inc., Tanay, Luzon, Philippines
SIZ	Shaanxi Institute of Zoology, Xian, China
Susman	Research collection of Dr. Randall Susman, SUNY-Stony Brook
UHVZ	University of Hanoi, Vietnam, Zoology (also ZMVNU)
UT-A	University of Texas, Austin, Anthropology, Bramblett Collection
ZIUH	Zoologisches Institut, Universität Hamburg, Germany
ZMNH	Zhejiang Museum of Natural History, Hangzhou, China
ZRC	Zoological Reference Collection, Department of Zoology, National University of Singapore
ZSI	Zoological Society of India, Calcutta

MATERIALS

The data for this study were derived from three inter-related datasets: postcranial dimensions, craniodental dimensions, and body masses.

POSTCRANIA

The postcranial data include six measurements selected for their relationship to the probable weight-bearing role of the element, comparability with previous studies, and availability in the authors' databases. For both humerus and femur, functional length (HL, head to capitulum; FL, proximal surface of head to medial condyle) and midshaft diameters (transverse and anteroposterior) were analyzed. Humeral midshaft diameters (HTR and HAP) were taken either at the measured midpoint of length or just distal to the distal end of the median (deltoid) crest or keel; these two points were very close, and the resulting values of HAP and HTR were effectively equivalent. For the femur, measurements (FTR and FAP) were taken either at the measured or estimated midpoint of length. These measurements are illustrated by Jolly (1972).

Three hundred three individuals were sampled for postcrania, 269 modern (201 with associated masses as recorded on museum labels) and 34 extinct. Of the modern group, 192 individuals were measured by WLJ (or his students), all with mass; 34 by NJ, 6 with mass; and 43 by ED (or his students), 3 with mass. All of the fossil specimens were measured by ED, except that values for one Olduvai individual were provided by M. G. Leakey, and those for several Kanjera and Olorgesailie specimens were taken from Jolly (1972). The detailed taxonomic distribution of this sample is presented in table 1. (The classification mostly follows Strasser and Delson, 1987, but *Mandrillus* and *Lophocebus* are recognized at genus rank.) When possible, specimens were analyzed at the subspecies level, in order to closely relate them to the most appropriate mass values. Most of the *Cercopithecus* and *Macaca* specimens, however, were identified to species. On the other hand, within *Papio hamadryas,* special care was taken to group only those populations that could be assigned reliable masses. Thus, not only were the main subspecies distinguished (see, e.g., Jolly, 1993), but *within P. h. anubis,* two subdivisions were recognized: the Ugandan and northern Kenyan populations, as well as those somewhat further west, have male masses about 20% greater than the peripheral populations in southern Kenya (previously known as *P. anubis neumanni*), western Ethiopia and West Africa (e.g., Ghana, previously *P. a. choras*). This approach makes sense methodologically, as our ultimate goal is to estimate the mean mass of fossil "populations" (or taxa), *not* individuals.

In brief, 16 colobine and 21 cercopithecine taxa (of whatever rank) are represented by specimens with associated body mass, while an additional eight colobine and four cercopithecine taxa lack masses. Four extinct colobines and 10 fossil cercopithecines are also included. Sex is estimated for the fossils either through association with sexed craniodental remains (see below), or when two sizes of bone are known for a given taxon.

TABLE 1
Taxa Forming the Postcranial Dataset: Sex, Availability of Associated Body Mass, and Number of Specimens

	With mass		Without mass	
Taxon	Males	Females	Males	Females
Colobus guereza occidentalis			1	1
Colobus guereza matschiei	5	10		
Colobus guereza dodingae	1			
Colobus guereza guereza	1			
Colobus polykomos polykomos		1		
Colobus angolensis palliatus	2	1		
Procolobus verus	4 (2 H)	1		
Procolobus badius oustaleti			2	
Procolobus badius ?tephrosceles	1			
Nasalis (Nasalis) larvatus	4	5	3	1
Nasalis (Simias) concolor				1
Pygathrix (Pygathrix) nemaeus	2		1	1
Pygathrix (Rhinopithecus) roxellana			5	8
Pygathrix (Rhinopithecus) bieti			8	5
Pygathrix (Rhinopithecus) brelichi			3	
Presbytis thomasi			1	1
Presbytis rubicunda	3	2		
Presbytis hosei		1		
Presbytis frontata	1			
Presbytis melalophos ?siamensis	2	3		
Semnopithecus entellus subsp. indet.				2
Semnopithecus entellus schistacea	1			
Semnopithecus entellus thersites			1	
Semnopithecus (Trachypithecus) johnii			1	1
Semnopithecus (Trachypithecus) obscura subsp.				1
Semnopithecus (Trachypithecus) obscura obscura	5	5		
Semnopithecus (Trachypithecus) cristata ultima	6	6		
Semnopithecus (Trachypithecus) cristata cristata	1			
Semnopithecus (Trachypithecus) phayrei	1	1		
†*Paracolobus chemeroni*			1	
†*Cercopithecoides*? cf. *williamsi*			1	
†*Mesopithecus pentelicus*			2 (1 H, 1 F)	5 (4 H, 1 F)
†*Dolichopithecus ruscinensis*			5 (2 H, 3 F)	2 (1 H, 1 F)
Allenopithecus nigroviridis	2			
Erythrocebus patas		1		
Cercopithecus aethiops pygerythrus	3	5		
Cercopithecus aethiops centralis	1	1		
Cercopithecus aethiops subsp. indet.			2	
Cercopithecus mitis	7	6		
Cercopithecus ascanius	5	1		
Cercopithecus neglectus	2	3		
Cercopithecus cephus	3	2		
Macaca sylvanus sylvanus			3	2 (1 F)
†*Macaca sylvanus* cf. *sylvanus* Ain Mefta			1? (H)	
†*Macaca sylvanus ?pliocena* Zlaty Kun			1? (H)	
Macaca nemestrina nemestrina	1	4		
Macaca nemestrina leonina	1	2		
Macaca assamensis	3			
Macaca arctoides	2	1		
Macaca fascicularis	10	8		
Macaca mulatta	2			

TABLE 1
Continued

	With mass		Without mass	
Taxon	Males	Females	Males	Females
Macaca fuscata			1	
†*Paradolichopithecus arvernensis*			2?? (1 H, 1 F)	
Cercocebus torquatus subsp. indet.				2
Lophocebus albigena	4	2		
†*Parapapio* cf. *jonesi* Hadar			2?? (1 H, 1 F)	
Papio hamadryas hamadryas	4		1	
Papio hamadryas cynocephalus	2			
Papio hamadryas cynocephalus Darajani sample	12	10		
Papio hamadryas anubis	2			
Papio hamadryas anubis "neumanni"	2	5		
Papio hamadryas ursinus	2	2	1	
Mandrillus sphinx	1		2	1
Theropithecus gelada		1	3	2 (1 F)
†*Theropithecus* cf. *darti* Hadar			1? (H)	1? (H)
†*Theropithecus oswaldi oswaldi* Kanjera			1 (H, cast), 1 (F: J)	3 (1 H, cast; 2F: J)
†*Theropithecus oswaldi oswaldi* Olduvai FLK I			1? (H)	
†*Theropithecus oswaldi leakeyi*? Olduvai MCK II			1	
†*Theropithecus oswaldi leakeyi* Olorgesailie			1 (F: J)	2 (1 H; 1 F: J)

?, probable male or female; ??, possible male or female; H, humeral measurements only; F, femoral measurements only; J, measurements from Jolly (1972); †, extinct taxon/population.

CRANIODENTAL DATA

The original dental and cranial dataset includes eight measurements of the skull and 15 of the cheek teeth; additionally, one cranial and five dental areas were calculated. These variables were selected on the basis of previous use by other authors and, for the cranial set, relatively good correlations with mass based on the results of Dechow (1983) and Aiello and Wood (1994). The cranial measures used (with their definitions) are: NAIN (nasion-inion), GLIN (glabella-inion), NABA (nasion-basion), GLBA (glabella-basion), PORB (minimum diameter across the postorbital constriction), BIOR (maximum biorbital width, at the level of the frontozygomatic sutures), ORBH (maximum orbit height, away from the superomedial notch), and ORBW (maximum orbit width); the last two are taken within the orbit. These measurements are illustrated by Freedman (1957) and the landmarks defined by White (2000). An approximation of orbital area, ORBA, was calculated as the product of ORBH and ORBW.

Dental dimensions were taken on M1–2 and m1–3; the first and second molars are usually suggested to be the least variable teeth, while m3s are readily recognized as isolated elements. For each of the molars, two widths were taken, across the anterior (mesial) and posterior (distal) loph(id) near the cervix where width is greatest and generally unaffected by wear; these measures are abbreviated by the tooth identifier (e.g., M1, m3) and AW or PW, respectively. Length (L) is always the maximum mesiodistal diameter; it is reduced by wear as the cercopithecid molar slopes from the mesial and distal shelves toward the cervix, but these changes are probably not significant. Thus, the set of dental measurements are: M1AW, M1PW, M1L, M2AW, M2PW, M2L, m1AW, m1PW, m1L, m2AW, m2PW, m2L, m3AW, m3PW, and m3L. These measurements are illustrated by Freedman (1957). Approximations of molar areas were calculated as the product of L $\times$ 0.5(AW+PW); this takes into account the bipartite morphology of the cercopithecid molar. We calculated M1AR, M2AR, m1AR, m2AR, and m3AR. Twelve hundred twenty-six individuals were sampled for at least one craniodental measurement, 473 modern and 753 fossil. Of the modern specimens, 79 "baboons" were measured by PCD (Dechow, 1980, 1983), 130 individuals of *Papio hamadryas ursinus* by William Eisenhart (see Eisenhart, 1974; original data deposited with ED), 75 colobines by NJ (Jablonski and Pan, 1995; only GLIN, PORB and BIOR were taken on the crania), and the remaining 189 individuals by ED (or his students). Eisenhart measured 192 fossils (all from South Africa, mainly Sterkfontein and Makapan, including *Cercopithecoides, Parapapio, Papio,* and *Theropithecus*). Measurements of five individuals of *Theropithecus* from Ahl al Oughlam were taken from Alemseged and Geraads (1998). ED measured the remaining 556 fossils, including a few casts of selected taxa.

In addition, several published sets of mean measurements on various "baboons" were included. Bramblett (1967) provided measures of a population (roughly 20 to 25 of each sex) of *Papio hamadryas cynocephalus* from the Darajani region of Kenya, part of which was also measured by WLJ for the postcranial dataset; the average male and female mass values of WLJ's subset were considered to be associated with Bramblett's craniodental measurements. Because our sample of *Theropithecus gelada* was small, we included mean measurements published by Eck and Jablonski (1987) on a few additional individuals. In order to include measurements on certain fossil monkeys, some mean craniodental values were used here also. Freedman (1957) listed dental dimensions for a sample of *Papio hamadryas robinsoni* from Swartkrans. Selected values for *Theropithecus oswaldi leakeyi* individuals from Olorgesailie and *T. o. oswaldi* from Kanjera were published by Jolly (1972), and composite sex-specific means were derived from this source, while M. G. Leakey (1993) published maximum (male) values for Olorgesailie as well as male means for this taxon from Olduvai and Kapthurin. Finally, *Theropithecus brumpti* sex-specific means from the Turkana Basin were derived from Eck and Jablonski (1987) and M. G. Leakey (1993).

In general, our measurements were taken with a Helios or DigiCal dial or digital caliper with needle points, although PCD's cranial measures were derived from Cartesian coordinate data taken with a diagraph. The detailed taxonomic distribution of this sample is presented in table 2. Taxa were generally separated at the subspecies level as discussed for the postcranial sample. Fossils were sexed on the basis of associated canines or lower third premolars when possible, or by overall size if sufficient "sexed" individuals of that taxon were known to distinguish between sexes. A sliding scale of certainty was applied (certain, probable, possible, unknown sex). For two taxa (*Paracolobus* from Turkana and Laetoli), sexable fossils were rare, and thus several of the largest or smallest individuals were categorized as possible males or females solely because they had the largest or smallest teeth in the sample, in order to provide a range of mass estimates.

After analysis of the fossil mass predictions, 136 fossils were removed from the sample based on distribution of sexed individuals. For example, if a population included four dental specimens (but no crania) sexed as female, then any dental specimens sexed less certainly as female, or of unknown sex, were removed (and not included in table 2) because they did not add more precise information. However, a possibly female (or even unsexed) cranial specimen would have been retained as it provided different information.

A total of eight colobine and 10 cercopithecine taxa are represented by individuals of known mass (and usually additional "massless" specimens as well), while 12 colobine and 14 cercopithecine taxa have no directly associated masses. Of the extinct samples, 24 are colobine, 59 cercopithecine and 3 victoriapithecine.

Compiled Mass Data

A careful survey was made of three types of sources for cercopithecid body masses in order to provide sample means for our craniodental dataset. Much of the result (table 4)is clearly ad hoc and incomplete, but this was nonetheless the most believable dataset that could readily be compiled for the taxa *under study here*. After our analysis was well under way, Smith and Jungers (1997) pub-

TABLE 2
Taxa Forming the Craniodental Dataset: Sex, Body Part, Availability of Associated Body Mass, and Number of Specimens

	With mass		Without mass		
Taxon	Males	Females	Males	Females	Sex?
Colobus guereza occidentalis			2 CD, 3 D	2 CD, 5 D	
Procolobus verus			1 CD	1 CD	
Procolobus badius oustaleti			2 CD, 3 D	1 CD, 1 D	
Procolobus badius ?tephrosceles			2 D	1 D	
†*Microcolobus tugenensis*			1 D		
†Colobine sp. "A"			2 D		
†Colobine cf. sp. "A" Aramis			8 D	2 D	
†*Colobus? flandrini*					4 D
†*Libypithecus markgrafi*			1 CD		
†*Rhinocolobus turkanaensis* Omo & Hadar			1? CD, 4/1? D	2 CD, 2 D	
†*Paracolobus chemeroni*			1 CD		
†*Paracolobus mutiwa*			1/2?? (U) D	1? D	
†*Paracolobus*? sp. Laetoli			1/2?? (U) D	3/2? D	
†*Cercopithecoides williamsi* Makapan/Sterkfontein/Bolts			2 CD, 1 C, 7 D	2 CD, 5 D	
†*Cercopithecoides williamsi* Leba				2? D	
†*Cercopithecoides williamsi* Swartkrans Mbr?			1 D		
†*Cercopithecoides* cf. *williamsi* Kromdraai B				1 CD, 3 D	
†*Cercopithecoides*? cf. *williamsi* Koobi Fora			1 CD		
†*Cercopithecoides kimeui* Koobi Fora				2? CD	
†*Cercopithecoides kimeui* Olduvai					1 CD
Nasalis (Nasalis) larvatus		1	1 CD, 9 C	1 CD, 4 C	
Nasalis (Simias) concolor	3	3	2 C	2 C	
Pygathrix (Pygathrix) nemaeus	2	1	2 C	1 C	
Pygathrix (Rhinopithecus) roxellana			8 CD, 2 D	14 CD, 5 D	
†*Pygathrix (Rhinopithecus)* cf. *roxellana* Honan				1? CD	
†*Pygathrix (Rhinopithecus) lantianensis* Gongwangling			2 D		
Pygathrix (Rhinopithecus) bieti		1	7 CD, 2 D	8 CD, 1 D	
Pygathrix (Rhinopithecus) brelichi			2 CD	1 CD	
Pygathrix (Rhinopithecus) avunculus			2 CD	2 CD	
Presbytis thomasi			1 CD	1 CD	
Presbytis potenziani			1 CD, 1 C, 4 D	5 D	
Semnopithecus entellus schistacea (including *S. e. ajax*)	2	3			
Semnopithecus entellus thersites	2				
Semnopithecus entellus subsp. indet.			1 CD	1 C, 1 D	
Semnopithecus (Trachypithecus) johnii			1 CD	1 CD	
Semnopithecus (Trachypithecus) obscura obscura	3	3			
Semnopithecus (Trachypithecus) cristata ultima?			4 D	6 D	
Semnopithecus (Trachypithecus) pileata shortridgei			1 CD, 4 D	1 D	
†*Semnopithecus? sivalensis*					5 D
†?*Semnopithecus* sp. Yushe					1 D
†*Mesopithecus pentelicus* Pikermi and most other locs.			2 CD, 1 C (av), 42 D	2 CD, 1 C (av), 25 D	
†*Mesopithecus pentelicus* Macedonia & Maragha			13 D	3 D	
†*Mesopithecus monspessulanus*			4 D	2 D	
†*Dolichopithecus ruscinensis* Perpignan			6 D	1 CD (av), 9 D	
†*Dolichopithecus? eohanuman* Shamar				2 D	
Miopithecus talapoin				2 CD	
Erythrocebus patas			1 C, 1 D		
Cercopithecus aethiops pygerythrus			6 D		1 D
Cercopithecus aethiops subsp. indet.			1 D		
Macaca sylvanus sylvanus			2 CD, 6 D	3 CD, 2 D	

TABLE 2
Continued

Taxon	With mass		Without mass		
	Males	Females	Males	Females	Sex?
†*Macaca sylvanus ?pliocena* various Europe			5 D		
†*Macaca sylvanus ?pliocena* 'Ubeidiya				1 D	
†*Macaca sylvanus ?florentina*			6 D	1 D	
†*Macaca sylvanus ?prisca*			2 D		
†*Macaca majori*			1 CD, 6 D	2 D	
†*Macaca libyca*				2 D	
†*Macaca*? sp. Menacer					11 D
Macaca nemestrina nemestrina				1 D	
Macaca nemestrina leonina			1 CD		
Macaca nigra			1 D	1 CD	
Macaca thibetana			3 CD, 1? D	1/1? CD, 2 D	
Macaca assamensis				1 D	
Macaca arctoides			1 D		
†*Macaca anderssoni* Mien Chih			1 CD		
†*Macaca anderssoni* ("*robusta*") Zhoukoudian			1? CD	3 D	
†*Macaca palaeindica*					2 D
Macaca fascicularis				1 D	
†*Paradolichopithecus arvernensis* Senèze				1 CD	
†*Paradolichopithecus arvernensis* Graunceanu			2 CD, 3 D	2 D	
†*Paradolichopithecus* cf. *arvernensis* Cova Bonica			1 D		
†*Paradolichopithecus sushkini*			1 CD, 1 D	1 CD	
†*Procynocephalus wimani*				2 D	
†*Procynocephalus subhimalayanus*			1? D	2 D	
†*Procynocephalus* cf. *wimani* Dongcun					2 D
†*Procynocephalus*? (or *Macaca*) sp. Yushe					2 D
Cercocebus torquatus subspecies indet.			1 CD, 2 D	2 D	
Lophocebus albigena			1 CD	1 D	
†*Cercocebus*? or *Parapapio jonesi* Makapan					3 D
†*Cercocebus*? or *Parapapio jonesi* Kromdraai A					2 D
†*Cercocebus*? or *Parapapio jonesi* Taung					1 D
†*Parapapio jonesi* Sterkfontein			9 D	19 D	
†*Parapapio* cf. *jonesi* Makapan			1 CD, 4 D	1 CD, 5 D	
†*Parapapio* cf. *jonesi* Hadar			1 CD	1 D	
†*Parapapio broomi* Makapan			3 CD, 2 C, 11 D	1 CD, 19 D	
†*Parapapio broomi* Sterkfontein			19 D	28 D	
†*Parapapio broomi* or *whitei* Bolts Farm Pit 23			1 CD		
†*Parapapio whitei* Makapan			2 CD, 5 D		
†*Parapapio whitei* Sterkfontein				2 D	
†*Parapapio antiquus*			1 CD	1 CD, 1 C, 3 D	
†*Parapapio*? *ado* Laetoli			4 D	9 D	
†*Parapapio*? *ado* Kanapoi			1 D		
†?*Parapapio* sp. Aramis				5 D	
Papio hamadryas hamadryas	8		2 CD	2 CD	
Papio hamadryas hamadryas/anubis hybrid	1				
Papio hamadryas kindae	2	1	7 CD	7 CD, 3 D	
Papio hamadryas cynocephalus	21	2	1 CD	2 CD	
Papio hamadryas cynocephalus Darajani sample	1 (av)	1 (av)			
Papio hamadryas cynocephalus/anubis hybrid	6				
Papio hamadryas anubis	5	1	1 CD	1 CD	
Papio hamadryas anubis "*neumanni*"	27	12	1 CD	1 D	
Papio hamadryas ursinus	3		2 CD, 70 D	1 CD, 63 D	

TABLE 2
Continued

Taxon	With mass: Males	With mass: Females	Without mass: Males	Without mass: Females	Sex?
†*Papio hamadryas robinsoni* Sterkfontein & Bolt's Farm			3/1? D	3 CD, 11/1?/1?? D	
†*Papio hamadryas robinsoni* Swartkrans Mbr 1			1 D (av): F	1 D (av): F	
†*Papio* [?*hama.*] *angusticeps* Kromdraai A			2 CD	3 CD, 4 D	
†*Papio izodi* Taung			1/1?? CD, 2/1? C, 1 D	2/1? CD, 3 C, 3 D	
†*Papio* cf. *izodi* Sterkfontein				1 D	
†*Papio* (*Dinopithecus*) *ingens* Schurweburg/Swartkrans			1? C, 5 D	1? C, 6 D	
†*Papio* (*Dinopithecus*) cf. *quadratirostris* Leba			1?? C, 1 D	1? C, 3? D	
†*Papio* (*Dinopithecus*) cf. *quadratirostris* Omo			1 CD, 5 D	2 CD, 1 D	
Mandrillus sphinx	1		1 CD, 2 D	1 CD	
†*Gorgopithecus major*			1 CD, 2 D	1 CD, 2? D	
Theropithecus gelada	1	4	1 CD (av), 1 C, 2 D	1 CD (av), 2 C	
†*Theropithecus darti* Makapan			6 D	1 CD, 6 D	
†*Theropithecus* cf. *darti* Hadar			9 D	1 CD, 10 D	
†*Theropithecus oswaldi oswaldi* Kanjera			1 CD (cast)	1 CD, 3 D (cast, av)	
†*Theropithecus oswaldi oswaldi* Swartkrans			2 D	1 CD, 1 D	
†*Theropithecus oswaldi oswaldi* Koobi Fora			1CD (cast)	1 C	
†*Theropithecus oswaldi oswaldi* Olduvai Bed I				1 D: J	
†*Theropithecus oswaldi leakeyi* Tighenif			1/1?? D	14 D	
†*Theropithecus oswaldi leakeyi* Thomas Quarry 3			1 D		
†*Theropithecus oswaldi leakeyi*? Olduvai MCK II			1 D (cast)		
†*Theropithecus oswaldi leakeyi* Olduvai Masek & Kapthurin			1 D (av)		
†*Theropithecus oswaldi leakeyi* Hopefield			2 D	2 C, 1 D	
†*Theropithecus oswaldi leakeyi* Olorgesailie			1 D (av), 1 D (max)	1 D (av)	
†*Theropithecus oswaldi leakeyi* Bodo			1 CD		
†*Theropithecus oswaldi delsoni* Mirzapur					1 D
†*Theropithecus oswaldi delsoni*? Cueva Victoria					1 D
†*Theropithecus "atlanticus"* Ain Jourdel					1 D
†*Theropithecus "atlanticus"* Ahl al Oughlam					5 D
†*Theropithecus*? *baringensis* Chemeron			1 CD, 1? D		
†*Theropithecus brumpti* Turkana Basin			2 CD (cast), 1 (av)	1 CD (av)	
†*Theropithecus* sp. indet. Lothagam					1 D
†*Victoriapithecus macinnesi* Maboko			1 CD: BB		21 D
†*Prohylobates tandyi* Wadi Moghara				1 D	
†*Prohylobates simonsi* Gebel Zelten					1 D

Specimens without associated mass are itemized by measurements taken (CD, cranial and dental; C, cranial only; D, dental only) and by certainty of sex (?, probable male or female; ??, possible male or female). Sex?, number of specimens of uncertain sex (all without associated mass); (U), large or small teeth tentatively sexed solely on size, as discussed in text (*Paracolobus* taxa only); (av) or (max), a set of "average" and "maximum" measurements for that sex and region (original data for *Mesopithecus* and *Dolichopithecus*; published values as detailed for other species); F, measurements from Freedman (1957); J, measurements from Jolly (1972); BB, data on *Victoriapithecus* cranium provided by B. Benefit; †, extinct taxon/population.

lished a compilation of sex-specific body masses for most modern primates, and additional mass data became available from published and unpublished sources, but they are not used in our estimation procedures nor included in table 4 below. All the individual mass values available to us are provided in appendix table I so that future workers may

TABLE 3
Mean Associated Mass for Taxa Studied Here (if no compiled mass given in table 4)

	Mass (g)	
Taxon	Male (N)	Female (N)
Colobus guereza matschiei	10462 (5)	8043 (10)
Colobus guereza dodingae	10454 (1)	
Colobus guereza guereza	9750 (1)	
Colobus polykomos polykomos		6818 (1)
Colobus angolensis palliatus	9660 (2)	9100 (1)
Presbytis rubicunda	5682 (3)	6137 (2)
Presbytis hosei		5568 (1)
Presbytis frontata	5568 (1)	
Semnopithecus (*Trachypithecus*) *phayrei*	7045 (1)	7045 (1)
Allenopithecus nigroviridis	5500 (2)	
Cercopithecus mitis	7976 (7)	3891 (6)
Cercopithecus ascanius	5451 (4)	2478 (1)
Cercopithecus neglectus	6895 (2)	4248 (3)
Cercopithecus cephus	3800 (3)	2667 (3)
Macaca fuscata	14475 (1)	
Macaca mulatta mulatta	6200 (1)	
Macaca mulatta villosa	12727 (1)	

See note to table 4.

have access to the data we compiled. Updated taxon-mean masses (and ranges) by sex based upon all of these data are presented in appendix table II.

In addition to values for all specimens measured here with which masses were associated (see table 3), body masses were compiled from several other sets of museum records: a printed list of (almost) all cercopithecids with mass at the USNM (checked for probable juveniles with low masses, which were generally removed to be conservative), provided courtesy of Dr. Richard W. Thorington, Jr.; a partial listing of values for selected taxa at the BM(NH), courtesy of Dr. Peter Andrews and Haviva Goldman (who also measured many baboons); a list of specimens collected in East Africa by Dr. A. J. Haddow and now mainly in the Royal College of Surgeons (see references in Napier, 1985), courtesy of Dr. Terry Harrison; and values from a variety of museums provided courtesy of Dr. John F. Oates (colobines) and Dr. Elizabeth Strasser. Few cercopithecids have been carefully revised recently, but the work of J. Fooden on macaques is an exemplary exception. All of his published reviews were checked for lists of masses that generally included museum catalog numbers, and he provided several clarifications about individual specimens and species, as well as complete data on several species. The reviews of selected colobines by D. Brandon-Jones were treated likewise. Additional unpublished masses of various taxa were provided by Drs. Clifford J. Jolly and Jane Phillips-Conroy, Meave G. Leakey, Wolfgang Scheffrahn, Michael I. Siegel, and Mary Willis, mostly after our estimation equations were completed. The above are considered primary sources.

Secondary sources utilized included both regional and species compilations and original reports from field collectors of various types. Here, it was required that the author had actually seen and/or weighed the specimens involved, as far as could be inferred from the text. (Details are provided in appendix table I.) In all cases (and also for the museum catalog data), geographical source was used to determine the correct (sub)specific identification, following Napier (1981, 1985), as far as possible. No broad or tertiary compilations (e.g., Clutton-Brock and Harvey, 1977 [and related papers—see Smith and Jungers, 1997, for a critique]; or Fleagle, 1988) were used, as there is no way to tell if these sources duplicate each other or the preceding sources, or if they are accurate. A recent compilation of mammalian body mass data (Silva and Downing, 1995) is a case in point: Not only was their selection of cercopithecid values limited (missing several relevant sources in the very set of journals they examined), but often the same masses were repeated in the tabulations under different authors or combinations of authors, although even a cursory check showed that these were identical.

One species of some importance to our work, *Mandrillus sphinx*, is listed in table 4 with only roughly estimated male mean mass. This taxon is especially important because it appears to be the heaviest known extant cercopithecid. Only one acceptable value for a male specimen could be located, however, and thus a male mean is not provided. The history of the search for these data may be instructive. As discussed by Dechow (1983), Malbrant and Maclatchy (1949) provided apparently original values

TABLE 4
Taxa Included in This Study with Compiled Mean Body Mass Data, as Used in Regression Model Development

Taxon	Mass (g) Male (N)	Mass (g) Female (N)
Colobus guereza occidentalis	9022 (48)	7508 (46)
Procolobus verus	4404 (30)	4023 (21)
Procolobus badius oustaleti	12500 (1)	8250 (2)
Procolobus badius tephrosceles	9520 (5)	
Procolobus badius—average (subspecies unknown)	8692 (19)	7171 (37)
Nasalis (Nasalis) larvatus	19503 (22)	9767 (21)
Nasalis (Simias) concolor	9167 (3)	6813 (3)
Pygathrix nemaeus	10910 (2)	8064 (1)
Pygathrix (Rhinopithecus) roxellana	18418 (6)	12300 (3)
Pygathrix (Rhinopithecus) bieti	21500 (2)	12000 (2)
Pygathrix (Rhinopithecus) brelichi	14500 (2)	
Presbytis thomasi	6780 (3)	6790 (4)
Presbytis potenziani	6153 (7)	6420 (2)
Semnopithecus (S.) entellus thersites	11438 (14)	6922 (11)
Semnopithecus (S.) entellus schistacea (incl. *S. e. ajax*)	21184 (3)	15271 (3)
Semnopithecus (S.) entellus—average (ssp. unknown)	17018	11516
Semnopithecus (Trachypithecus) johnii	11724 (8)	11203 (3)
Semnopithecus (Trachypithecus) obscura obscura	7958 (14)	7110 (9)
Semnopithecus (Trachypithecus) obscura—average	8376	6852
Semnopithecus (Trachypithecus) cristata ultima	6492 (16)	5699 (27)
Semnopithecus (Trachypithecus) pileata shortridgei	13182 (2)	9545 (1)
Cercopithecus aethiops pygerythrus group	5252 (22)	3533 (27)
Cercopithecus aethiops—average (subsp. unknown)	5136	3604
Miopithecus talapoin	1396 (9)	1135 (10)
Erythrocebus patas	8817 (6)	4980 (5)
Macaca sylvanus sylvanus (see text and table 8)		
Macaca nemestrina nemestrina	11227 (10)	6364 (17)
Macaca nemestrina leonina	7783 (7)	4929 (7)
Macaca nigra	7481 (4)	4690 (3)
Macaca thibetana	17676 (34)	14100 (28)
Macaca assamensis	11308 (12)	6851 (7)
Macaca arctoides	11722 (9)	7805 (4)
Macaca fascicularis	4938 (26)	3065 (22)
Cercocebus torquatus var. subspp.	11019 (8)	6400 (3)
Lophocebus albigena	8092 (25)	5557 (59)
Papio hamadryas hamadryas	21768 (11)	11750 (1)
Papio hamadryas kindae	16020 (5)	9830 (5)
Papio hamadryas anubis/hamadryas hybrid	20000 (1)	
Papio hamadryas anubis/cynocephalus hybrid	22793 (6)	
Papio hamadryas cynocephalus	23470 (19)	12657 (13)
Papio hamadryas cynocephalus Darajani sample	23312 (13)	12250 (10)
Papio hamadryas anubis (large only)	32345 (10)	15839 (4)
Papio hamadryas anubis ("*neumanni*" and other small)	23501 (31)	14458 (16)
Papio hamadryas ursinus	29858 (35)	14856 (36)
Mandrillus sphinx (see text and table 8)		12750 (4)
Theropithecus gelada	18375 (2)	11920 (5)

Appendix table 2 presents an updated version of these figures, including mass values obtained during the course of this project, as documented in appendix table 1.

for males of 11.3, 13.2, 21, 24, 27, 28, 30, and 39 kg. At least the lowest four are probably from juveniles. Napier and Napier (1967) cited a male mass of 19.5 kg, but this has no original source and is probably also subadult, so it is not included here (although it was by Dechow). Secondary sources have further confused this situation: Jolly (1972: 74) cited the "mean" value from Malbrant and Maclatchy (1949) as 39 kg, which is in fact their maximum (Jolly [personal commun.] indicates that he intentionally used the highest available value given the possibility of continued growth in this species, but neglected to state this in his paper); Hill (1970) mentioned all of the Malbrant and Maclatchy (1949) values, but only listed the heaviest two in a footnote as they came from a different area: Strasser (1989) missed those two and thus arrived at a male mean "from Hill" of only 20.7 kg; Gautier-Hion (1975) cited a male mean (of two specimens) from Malbrant and Maclatchy (1949) as 25 kg—that number was presumably obtained from the original data by averaging just the largest and smallest published values. Napier (1981) reported a male value of 17.3 kg, but H. Goldman determined in London that this specimen was a partly dissected zoo animal. On the other hand, Goldman did locate records from the Powell-Cotton Museum of a male weighing 45 kg and a female 17 kg. Malbrant and Maclatchy gave female masses of 11, 11, and 12 kg; Smith and Jungers (1997) later listed two additional Powell-Cotton females at 10 and 12 kg. The large male specimen was located and measured for us by R. Wunderlich; at least one of the AMNH specimens studied here has postcranial (but not dental) dimensions greater than that of the 45 kg individual. Popp (1983) also reported male masses of 50 and 52 kg, for captive individuals. After our calculations had been completed, we obtained recent papers by Wickings and Dixon (1992a, 1992b) which provide data on individuals studied in semi-free-ranging conditions (a large enclosure) in Gabon. They reported five adult male masses between 30 and 37 kg (not counting one individual lacking a limb) and three adult female masses of 12, 12, and 14 kg. All of this suggests that mandrills are probably the heaviest of all living cercopithecids, that noncaptive adult male masses may range from at least 28 to as much as 45 kg (if this is a correct mass and not perhaps a misprint for 35) and that sexual dimorphism in body mass may approach 3:1! Clearly, life-history parameters of wild mandrills are well worth further study.

Finally, *Macaca sylvanus* is especially interesting because a number of European Plio-Pleistocene populations have been suggested by ED to be subspecies of the living species, and therefore a number of modern specimens were measured for comparison. However, few museum specimens with mass are known (a situation confirmed in litt. by Dr. J. Fooden): Two males in the USNM are listed at 8.6 and 10 kg, while four females are tagged at 8.2, 9, 9.8, and 10 kg. The means (9.3 and 9.2 kg, respectively) appeared too close given the significant observed difference in skull (and postcranial) size. Thus, this species was treated as of unknown mass, as discussed above for mandrills. After our estimation equations had been calculated, however, Dr. W. Scheffrahn (AIUZ) generously provided a large series of body masses taken on wild *M. sylvanus* in Algeria; these are reported in appendix table I and used to test the predictions of our estimation equations. The means are 14.53 kg for males and 10.14 kg for females.

STATISTICAL METHODS

Mass Estimation

We use bivariate ordinary least squares (OLS) regression to estimate body mass in fossil and extant cercopithecid samples, because prediction of a unique y-variable (taxon-mean body mass) from a given x-variable (skeletal or dental measurement) is the goal of this study. Additionally, we wish to be able to compare the results obtained here with those from previous studies that employed this method of estimation model construction (e.g., Gingerich et al., 1982; Conroy, 1987). We rely on OLS line fitting in order to facilitate direct contrasts and because OLS models were developed in order to predict one value (here, body mass) from another (skeletal dimension; see also Smith, 1994). We do not expect that body mass or skeletal dimensions are measured without error (an assumption of OLS models), but consider the error introduced from this source of variation to be randomly distributed and small relative to the total range of the data.

Natural logarithm-transformed data are used in the construction of linear estimation models. The resulting log-unit estimate must be detransformed in order to obtain mass estimates in grams. This transformation from arithmetic units (grams) to the natural logarithm and then back to grams introduces a systematic bias, and thus a correction factor must be applied to the detransformed estimate. Smith (1993) has shown that when correction factors are less than approximately 10%, several different correction factors (Quasi-Maximum Likelihood Estimator, Smearing Estimate, Ratio Estimate) consistently converge. As none of the equations preferred below have correction factors greater than 15%, and the majority are below 5%, we expect that our results would be substantially similar, no matter which of these methods of log-bias correction is employed. [If one compares the results of this study to those from previous analyses (e.g., Gingerich et al., 1982; Conroy, 1987), as we do below, it is important to recall that the application of a correction factor increases the previously published, uncorrected estimates; the actual corrections for the cited works are given by Smith, 1993.]

We use the Quasi-Maximum Likelihood Estimator (QMLE = exp [MSE/2], where MSE is the mean square error of the regression) as a log-bias correction factor applied to the estimate after transformation from logarithmic to arithmetic units (Sprugel, 1983; see also Dagosto and Terranova, 1992; Smith, 1993). Application of this correction factor always increases the mass estimated, and because detransformation characteristically underestimates the arithmetic value, it is reasonable to apply a correction that will increase the mass estimate. An assumption of correcting transformation bias with QMLE is that the residuals are normally distributed; heteroscedastic residual patterning will result in large values of the QMLE.

Most cercopithecid species (especially the larger-sized taxa) present a strong sexual dimorphism in body mass (see table 4) and also in most of the cranial and postcranial dimensions studied here. This is less true for the cheek tooth dimensions. (The highly dimorphic canine and lower third premolar measures are not included in this study.) Moreover, there are several fairly consistent patterns of difference between the two modern subfamilies in limb construction and molar morphology. For example, colobines have longer femora than cercopithecines of the same mass. Nearly all of the fossils studied here can be identified to subfamily, and the majority also to sex, so a four-way division of the modern (predictor) sample is warranted. But we also present and analyze results for each subfamily and for the whole sample undivided by sex, in order to deal with unsexed specimens and with victoriapithecine species that do not (of course) belong to either living subfamily. There are thus seven "subfamily/sex subsets" of the data.

Because the postcranial dataset is largely composed of individuals with associated mass, we have the unique opportunity to examine model performance in terms of both accuracy and consistency. A similar examination is possible for the craniodental sample, but with less control, due to the greater use of compiled masses. Accuracy (i.e., is the estimate correct?) is examined, in part, with a percent difference statistic (after Smith, 1985). Consistency (i.e., how the estimates cluster) is gauged by inspection of the standard error of the estimate. Both of these features of an estimation model are important to document, as a model producing consistent estimates need not produce accurate ones. It is obvious that accuracy can only be examined with associated-mass samples. We tested for these features of estimation models using sex-specific "taxon-mean" samples (at the population, subspecies, or species level).

Choice of Comparative Samples for Estimating Fossil Masses

As one main goal of this study is to reliably estimate the mean sex-specific body mass of cercopithecid fossil samples, it is most reasonable to use estimation models based on the best comparative data available. The *most suitable* dataset for establishing the relationship between body mass and skeletal measures is the associated-mass sample. It is only in this dataset that we can examine prediction accuracy. However, this sample does not contain all species of Old World monkey for which we have skeletal samples. As a result, the *most complete* dataset includes nonassociated masses and skeletal measures. Here we introduce unknown error by incorporating extra, nonassociated masses but we better sample the diversity of extant forms. Importantly, using the compiled estimates of mass as the target for the prediction model closely resembles the methods used, and assumptions made, in estimating fossil sample mass. Since the compiled mean masses include all masses in the known-mass sample as well as many museum catalog listings and well-documented published reports, it seems likely that these mass values are reasonable.

ESTIMATION MODEL CONSTRUCTION AND EVALUATION

Development and testing of models involved a two-step process. First, a set of preliminary models was constructed based on a portion of the available modern data for a given variable, and these models were tested using the remainder of the modern sample. For each subfamily/sex subset, the models were evaluated to determine which variables yield the most accurate and consistent estimates for associated-mass subsamples as detailed below. Then a second set of estimation equations was constructed, using the entire available dataset for all variables. In the further evaluations and analysis, only estimates derived from those "most accurate predictor" variables are utilized. The "sample mass" used in the final prediction models is composed of associated masses for those individuals possessing such values, averaged with compiled taxon/sex mean masses for individuals lacking associated mass. The resulting value may differ somewhat between postcranial and craniodental samples, depending upon differences between associated and compiled masses.

Postcranial Sample

For each subfamily/sex subset, the associated-mass taxon-mean sample was divided into two subsamples (see table 5). The larger subsample of taxa was used to construct an estimation model which was then evaluated for accuracy and consistency using the "test" subsample held out of the construction of the model (following Smith, 1985).

Craniodental Sample

Here, taxon and sex-specific compiled mean masses were used in the construction of the estimation models. Estimation performance was assessed using a "test" sample of individuals with associated body masses (taxa listed in table 5; these individuals were not included in estimation model construction). In this way we examined both the accuracy and consistency of the estimation models. Due to sample limitations, we are restricted to using GLIN, PORB, and BIOR among cranial variables for estimating mass within colobines.

For both the craniodental and postcranial data, we also examined the pattern of estimates derived from equations based on the entire sample (individuals both with and without associated mass), but divided post hoc by subfamily and sex. Sample mass (as described above) was employed here. Comparisons of the most inclusive models with the more restricted subfamily models are used to examine phylogenetic differences in patterns of association between body mass and skeletal or dental measures.

Identifying Reliable Estimators

For the most part, reliable estimators are identified by examining patterns of mass estimation in the test samples. The performance of estimation models is examined using several criteria. We rely primarily on mean prediction errors (MPE) to assess the accuracy of estimating mass with each measurement. Reliable estimator variables should yield low MPEs. MPE is calculated for each variable as the mean of the absolute values of prediction errors (PE) summed over all taxa, where

$$PE = \frac{\text{actual mass} - \text{estimated mass}}{\text{estimated mass}} \times 100$$

We further examined the performance of each variable by determining the proportion of taxa estimated to within 20% of their known mass. Variation in mass seasonally

TABLE 5
"Test" Sample: Taxa Excluded from Preliminary Model Construction and Used to Examine Estimation Accuracy and Consistency

	Variables	
	Cranial, dental	Postcranial
Colobinae		
Colobus guereza matschiei		M, F
Procolobus verus		M
Nasalis (Nasalis) larvatus	F	M, F
Nasalis (Simias) concolor	M, F	
Pygathrix (Pygathrix) nemaeus	M, F	M
Pygathrix (Rhinopithecus) bieti	F	
Presbytis hosei		F
Semnopithecus entellus schistacea (incl. *S. e. ajax*)	M, F	
Semnopithecus entellus thersites	M	
Semnopithecus (Trachypithecus) obscura	M, F	M, F
Cercopithecinae		
Cercopithecus aethiops pygerythrus		F
Cercopithecus aethiops centralis		M
Cercopithecus mitis		M
Cercopithecus cephus		M, F
Macaca nemestrina leonina		F
Macaca fascicularis		M, F
Lophocebus albigena		M, F
Papio hamadryas hamadryas	M	
Papio hamadryas hamadryas/anubis hybrid	M	
Papio hamadryas kindae	M, F	
Papio hamadryas cynocephalus	M, F	M, F
Papio hamadryas cynocephalus Darajani sample		M, F
Papio hamadryas cynocephalus/anubis hybrid	M	
Papio hamadryas anubis	M, F	M
Papio hamadryas anubis "neumanii"	M, F	
Papio hamadryas ursinus	M	M, F
Theropithecus gelada	M, F	
Mandrillus sphinx	M	M

M or F, sex of individuals removed to test sample.

and over the life span can be substantial, creating difficulty in ascribing great importance to a single value summarizing a taxon (e.g., a mean). The variation in known weights for several cercopithecid taxa examined here ranges from 5% to approximately 20% of the mean; additional data on large samples of *Papio hamadryas hamadryas* and *P. h. anubis* (courtesy of Drs. C. J. Jolly and Jane Phillips-Conroy) demonstrate that mass varies approximately ±15% around the mean in these taxa. As such, we expect a reliable estimator to be characterized by a large percentage of all taxa being estimated to within 20% of their actual masses. (It should be clear that the specific value used to bound a range of estimates must be determined with respect to the group under study.) Finally, we examined the coefficient of determination (R^2), because a reliable predictor variable should be significantly correlated with mass. We assume that a similar pattern of correlation exists between mass and the estimator variable among fossil populations as well.

Table 6 contains the set of estimator variables for each taxon/sex sample, ranked by MPE. In addition, the proportion of taxa estimated to within 20% of actual mass and the coefficient of determination are also listed. We use this ranking of variables in our estimates of the masses of extinct cercopithecids

TABLE 6

Ranking of Estimator Variables in Preliminary Models, in Order of MPE as Assessed on Test Subsamples

All Cercopithecidae				Colobinae All				Colobinae Male				Colobinae Female			
	MPE	20%	R^2		MPE	20%	R^2		MPE	20%	R^2		MPE	20%	R^2
FTR	**9.82**	**0.91**	**0.83**	**FTR**	**7.03**	**0.88**	**0.78**	**FTR**	**4.97**	**1.00**	**0.72**	**HAP**	**7.17**	**1.00**	**0.57**
NABA	**11.12**	**0.86**	**0.52**	**HL**	**10.53**	**0.75**	**0.74**	**HL**	**8.69**	**0.75**	**0.71**	**M2PW**	**8.04**	**0.83**	**0.78**
HLEN	**11.12**	**0.83**	**0.86**	**FAP**	**11.41**	**0.88**	**0.82**	**FAP**	**12.48**	**0.75**	**0.81**	**FAP**	**8.11**	**1.00**	**0.79**
FAP	**13.04**	**0.87**	**0.87**	**M1L**	**11.46**	**0.83**	**0.69**	**m3AR**	**12.85**	**0.60**	**0.79**	**M1PW**	**8.34**	**1.00**	**0.75**
GLBA	**13.25**	**0.79**	**0.53**	**HTR**	**11.51**	**0.88**	**0.84**	**M2AR**	**13.13**	**0.80**	**0.82**	**m3AW**	**8.92**	**1.00**	**0.68**
NAIN	**13.42**	**0.79**	**0.55**	**M1AR**	**12.14**	**0.91**	**0.69**	**M1PW**	**13.34**	**0.60**	**0.50**	**M2AW**	**8.97**	**0.83**	**0.78**
m1L	**14.24**	**0.76**	**0.70**	HAP	12.69	0.75	0.78	**M2PW**	**13.75**	**0.80**	**0.75**	**m2AW**	**9.57**	**0.83**	**0.79**
HAP	**14.49**	**0.83**	**0.81**	**m3PW**	**13.79**	**0.82**	**0.50**	**M1L**	**14.12**	**1.00**	**0.79**	**HL**	**9.59**	**1.00**	**0.67**
m1AR	**16.60**	**0.55**	**0.70**	**M2PW**	**14.39**	**0.64**	**0.68**	**FL**	**14.12**	**0.75**	**0.63**	**M1AR**	**9.60**	**0.83**	**0.79**
m3AR	**16.61**	**0.65**	**0.71**	**m1L**	**15.08**	**0.67**	**0.67**	**m2AW**	**14.37**	**0.80**	**0.53**	m2AR	10.15	0.83	0.74
m2AR	**16.64**	**0.55**	**0.65**	**m1AR**	**15.10**	**0.73**	**0.69**	M1AR	14.58	0.80	0.72	**FTR**	**10.17**	**0.75**	**0.94**
m3AW	**16.73**	**0.60**	**0.62**	FL	15.24	0.75	0.71	m1AR	15.45	0.80	0.67	m1AR	10.83	0.83	0.78
m2AW	**16.82**	**0.56**	**0.59**	m3AR	16.07	0.55	0.68	HTR	15.52	0.75	0.85	M2AR	11.14	0.83	0.73
m3PW	17.06	0.60	0.71	m1AW	16.18	0.55	0.54	m3AW	15.59	0.80	0.56	m3PW	11.47	0.83	0.57
m2L	17.16	0.65	0.64	m3AW	16.26	0.64	0.53	m3PW	15.95	0.60	0.57	m1AW	11.59	0.83	0.76
M2AR	17.35	0.60	0.63	m2AW	16.33	0.67	0.79	M2L	15.98	0.80	0.87	M1AW	11.73	0.67	0.78
M1PW	17.40	0.70	0.69	m2L	16.42	0.77	0.68	m2AR	16.15	0.80	0.73	m2PW	12.53	0.67	0.79
m3L	17.91	0.65	0.73	M1PW	16.45	0.64	0.54	m3L	16.62	0.60	0.87	m3AR	13.67	0.83	0.73
M2PW	17.95	0.70	0.63	M2L	16.75	0.69	0.70	m1AW	17.06	0.80	0.39	HTR	15.07	0.75	0.68
M2AW	18.06	0.64	0.62	M2AW	17.16	0.67	0.64	m2L	17.09	0.65	0.78	M1L	15.73	0.57	0.72
M1AR	18.27	0.68	0.68	M1AW	18.05	0.55	0.59	HAP	17.35	0.50	0.78	m1L	16.00	0.57	0.70
M1L	18.29	0.50	0.66	m3L	18.35	0.62	0.75	M2AW	17.52	0.60	0.63	m3L	16.47	0.71	0.74
FL	18.79	0.70	0.70	m2PW	18.86	0.45	0.67	m1PW	19.35	0.60	0.54	FL	16.68	0.75	0.83
M2L	19.08	0.62	0.62	m1PW	19.91	0.64	0.66	PORB	19.39	0.60	0.47	m2L	16.97	0.60	0.68
m1AW	19.59	0.55	0.65	**PORB**	**21.09**	**0.50**	**0.37**	m2PW	20.47	0.60	0.58	M2L	18.50	0.29	0.63
HTR	20.03	0.61	0.76	M2AR	27.76	0.83	0.72	m1L	22.99	0.60	0.72	m1PW	19.14	0.67	0.83
M1AW	20.22	0.55	0.64	m2AR	27.82	0.67	0.69	M1AW	23.09	0.56	0.84	PORB	23.61	0.43	0.39
m1PW	20.97	0.45	0.71	GLIN	57.57	0.17	0.71	GLIN	36.52	0.60	0.78	BIOR	31.56	0.57	0.02
m2PW	21.49	0.50	0.69	BIOR	115.27	0.25	0.42	BIOR	73.38	0.20	0.49	GLIN	65.94	0.14	0.58
ORBW	21.61	0.55	0.41	GLBA	—	—	0.47	GLBA	—	—	0.54	GLBA	—	—	0.29
PORB	24.15	0.43	0.43	NAIN	—	—	0.54	NAIN	—	—	0.65	NAIN	—	—	0.49
ORBAR	28.80	0.45	0.32	NABA	—	—	0.42	NABA	—	—	0.50	NABA	—	—	0.26
GLIN	38.73	0.43	0.54	ORBW	—	—	0.33	ORBW	—	—	0.54	ORBW	—	—	0.14
ORBH	41.58	0.45	0.31	ORBH	—	—	0.28	ORBH	—	—	0.30	ORBH	—	—	0.26
BIOR	60.69	0.10	0.62	ORBAR	—	—	0.22	ORBAR	—	—	0.35	ORBAR	—	—	0.11

Continued on facing page

as well as several extant taxa. In order to include variables from all three anatomical regions, we decided to use only the top-ranked third of variables from each in prediction calculations. Thus, 3 of 9 cranial variables and 6 of 20 dental variables were analyzed in more detail. Because postcranial variables have often been shown (or assumed) to produce "better" mass predictions (Hylander, 1985; Jungers, 1987, 1988; Ruff et al., 1989; Damuth and MacFadden, 1990; Dagosto and Terranova, 1992), we analyzed the top *two*-thirds, thus four of six. In fact, of our seven taxon/sex groups, three of the four top-ranked variables were postcranial in four groups (all cercopithecids, all cercopithecines, all colobines, and male colobines), while two were postcranial for colobine and cercopithecine females; in general, the remaining highest-ranked variables were dental, except in all cercopithecids where it was cranial. In male cercopithecines, however, the top two variables were cranial and the next six dental; only the third cranial variable

TABLE 6
Continued

Cercopithecinae											
All				Male				Female			
	MPE	20%	R^2		MPE	20%	R^2		MPE	20%	R^2
FTR	**9.35**	**0.80**	**0.85**	**NABA**	**10.00**	**0.78**	**0.47**	**HL**	**4.63**	**0.86**	**0.93**
HL	**10.23**	**0.87**	**0.90**	**GLBA**	**10.03**	**0.89**	**0.58**	**FTR**	**6.11**	**1.00**	**0.86**
FAP	**11.00**	**0.87**	**0.91**	**m1L**	**10.44**	**0.80**	**0.90**	**m2PW**	**6.15**	**1.00**	**0.87**
m1L	**12.32**	**0.67**	**0.87**	**m2AW**	**11.82**	**0.89**	**0.82**	**M1AR**	**7.78**	**1.00**	**0.89**
HAP	**13.70**	**0.87**	**0.85**	**M2AW**	**12.79**	**0.89**	**0.84**	**m3PW**	**8.22**	**1.00**	**0.91**
m1AR	**14.68**	**0.78**	**0.85**	**M2L**	**12.93**	**0.89**	**0.87**	GLBA	9.91	1.00	0.43
M1AR	**14.93**	**0.75**	**0.86**	**M2AR**	**13.17**	**0.80**	**0.88**	**HAP**	**10.18**	**0.71**	**0.84**
m3AW	**15.86**	**0.56**	**0.85**	**m2AR**	**13.31**	**0.80**	**0.87**	**NABA**	**12.60**	**0.80**	**0.51**
M1L	**15.91**	**0.63**	**0.83**	M1AR	13.58	0.80	0.88	**m3AR**	**13.07**	**0.75**	**0.91**
M1PW	**16.43**	**0.67**	**0.86**	**HL**	**14.11**	**0.75**	**0.88**	**m3AW**	**13.37**	**0.75**	**0.91**
M1AW	17.10	0.56	0.84	m3L	14.91	0.78	0.84	ORBW	13.74	0.80	0.29
FL	17.39	0.60	0.87	M2PW	15.06	0.80	0.83	**m2AR**	**13.93**	**0.75**	**0.89**
HTR	18.15	0.67	0.79	M1PW	15.13	1.00	0.89	**HTR**	**14.03**	**0.71**	**0.77**
m3AR	18.91	0.78	0.85	m3AW	15.84	0.80	0.82	m1AW	14.17	0.50	0.86
M2PW	18.98	0.56	0.83	M1AW	15.97	0.60	0.86	m2L	14.64	0.80	0.89
m3PW	19.05	0.44	0.86	m3AR	15.98	0.80	0.85	FAP	14.94	0.71	0.85
m1PW	19.18	0.78	0.80	**FAP**	**16.32**	**0.63**	**0.97**	M1PW	15.52	0.75	0.89
m2PW	19.98	0.56	0.84	M1L	16.35	0.80	0.85	m1PW	16.08	1.00	0.83
m2L	20.05	0.62	0.84	m1AR	16.74	0.60	0.87	ORBAR	16.82	0.80	0.16
m1AW	20.23	0.56	0.80	m2L	17.47	0.60	0.88	M1AW	17.68	0.75	0.88
M2L	21.05	0.62	0.83	m2PW	18.36	0.60	0.82	FL	17.68	0.57	0.84
ORBW	**21.07**	**0.55**	**0.32**	ORBW	18.45	0.50	0.24	M1L	18.16	0.67	0.88
m3L	21.95	0.54	0.84	**HAP**	**18.77**	**0.50**	**0.87**	NAIN	18.67	0.60	0.63
m2AW	23.21	0.62	0.82	**FL**	**19.12**	**0.63**	**0.86**	m1AR	18.79	0.75	0.89
M2AW	23.71	0.60	0.63	m3PW	20.00	0.60	0.83	m3L	18.99	0.40	0.91
PORB	**28.31**	**0.45**	**0.45**	FTR	20.57	0.38	0.81	m2AW	19.65	0.80	0.86
GLBA	**28.50**	**0.50**	**0.60**	**NAIN**	**20.76**	**0.56**	**0.80**	**PORB**	**21.02**	**0.80**	**0.56**
NABA	29.31	0.43	0.60	PORB	20.89	0.33	0.18	GLIN	21.07	0.67	0.57
GLIN	29.71	0.50	0.69	HTR	20.92	0.63	0.73	M2L	21.52	0.60	0.89
NAIN	32.63	0.36	0.73	ORBAR	22.18	0.33	0.19	m1L	22.93	0.75	0.90
ORBH	33.72	0.36	0.31	m1AW	23.40	0.40	0.78	M2AR	27.51	0.50	0.89
ORBAR	39.18	0.00	0.25	m1PW	23.72	0.40	0.84	ORBH	28.74	0.60	0.36
M2AR	55.76	0.38	0.85	ORBH	25.87	0.33	0.12	M2AW	30.24	0.60	0.89
m2AR	59.80	0.46	0.85	GLIN	36.93	0.30	0.76	M2PW	31.08	0.25	0.88
BIOR	64.02	0.22	0.67	BIOR	47.24	0.20	0.14	BIOR	54.59	0.25	0.80

MPE, mean prediction error of estimate (value over 29% resulted in rejection of variable); 20%, frequency of estimated values within 20% of known (associated or compiled) mass. HLEN, HAP, HTR, FLEN, FAP, and FTR, humerus (H) or femur (F) length, anteroposterior midshaft diameter, and transverse midshaft diameter. Abbreviations for cranial and dental measurements are explained in the text.

Values in **bold** used in later analyses. Underlined values would have been used if the final-model equations were not rejected (see below—these were replaced when possible). Insufficient data were available to permit the calculation of MPE or 20% values for the final six variables for all three colobine subsets, but the final-model equations for these variables were rejected in any case.

was ranked lower than five postcranial variables.

Using the most complete data, a set of "final" models was calculated, to be used in prediction of mass for fossil taxa. The full set of equation parameters is presented in table 7, with variables selected above as "best predictors" highlighted. Of the 245 equations we have calculated (35 variables over 7 taxon/sex subsets), a number have associated p-values greater than 0.05. Normally, a p-value of 0.05 corresponds to a 95% confidence level, but as the number of simultaneous tests or comparisons goes up, the effective confidence level drops sharply. Rice (1989) has suggested a modified Bon-

TABLE 7
Model Parameters for the Final Estimation Models

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
				Postcranial Models			
Humerus length							
N	84	42	23	19	42	24	18
Slope	**2.728**	**2.456**	**2.536**	**2.074**	**2.832**	**2.779**	**2.744**
Y-Int	**−4.689**	**−3.295**	**−3.666**	**−1.427**	**−5.237**	**−4.935**	**−4.844**
R^2	**0.880**	**0.774**	**0.813**	**0.654**	**0.925**	**0.910**	**0.921**
SEE	**0.215**	**0.217**	**0.222**	**0.205**	**0.208**	**0.219**	**0.194**
MSE	**0.038**	**0.039**	**0.040**	**0.035**	**0.036**	**0.039**	**0.032**
QMLE	**1.019**	**1.019**	**1.020**	**1.018**	**1.018**	**1.020**	**1.016**
MPE	**14.737**	**14.605**	**14.407**	**13.395**	**14.174**	**13.866**	**12.643**
20%	**0.750**	**0.714**	**0.739**	**0.737**	**0.738**	**0.708**	**0.778**
Humerus AP							
N	84	42	23	19	42	24	18
Slope	**2.195**	2.160	2.163	**2.191**	**2.246**	**2.142**	**2.197**
Y-Int	**3.903**	4.064	4.053	**3.998**	**3.706**	**4.013**	**3.744**
R^2	**0.832**	0.783	0.788	**0.692**	**0.877**	**0.844**	**0.896**
SEE	**0.259**	0.212	0.237	**0.192**	**0.274**	**0.298**	**0.225**
MSE	**0.053**	0.037	0.045	**0.031**	**0.059**	**0.068**	**0.041**
QMLE	**1.027**	1.019	1.023	**1.016**	**1.030**	**1.035**	**1.021**
MPE	**16.800**	15.512	16.290	**14.588**	**15.949**	**15.552**	**14.885**
20%	**0.643**	0.786	0.783	**0.789**	**0.619**	**0.625**	**0.556**
Humerus TR							
N	84	42	23	19	42	24	18
Slope	2.573	**2.439**	2.425	2.598	2.708	2.771	**2.546**
Y-Int	2.958	**3.361**	3.385	3.009	2.549	2.409	**2.900**
R^2	0.783	**0.851**	0.859	0.782	0.795	0.759	**0.755**
SEE	0.299	**0.173**	0.190	0.159	0.366	0.383	**0.366**
MSE	0.069	**0.025**	0.030	0.022	0.098	0.105	**0.097**
QMLE	1.035	**1.013**	1.015	1.011	1.050	1.054	**1.050**
MPE	19.532	**12.512**	13.635	11.163	24.064	23.873	**23.338**
20%	0.631	**0.786**	0.783	0.789	0.571	0.583	**0.611**
Femur length							
N	81	40	23	17	41	23	18
Slope	2.852	3.181	**3.312**	2.592	3.043	**2.961**	3.008
Y-Int	−5.855	−7.707	**−8.379**	−4.653	−6.729	**−6.269**	−6.588
R^2	0.790	0.704	**0.700**	0.597	0.883	**0.856**	0.880
SEE	0.297	0.256	**0.289**	0.211	0.266	**0.291**	0.244
MSE	0.068	0.052	**0.065**	0.037	0.056	**0.065**	0.048
QMLE	1.034	1.026	**1.033**	1.019	1.028	**1.033**	1.024
MPE	20.993	16.927	**17.968**	13.626	17.302	**16.767**	17.044
20%	0.556	0.625	**0.609**	0.647	0.585	**0.565**	0.667
Femur AP							
N	83	41	23	18	42	24	18
Slope	**2.792**	**2.532**	**2.750**	**2.174**	**2.918**	**2.868**	2.921
Y-Int	**2.229**	**2.844**	**2.289**	**3.716**	**1.947**	**2.085**	1.924
R^2	**0.876**	**0.776**	**0.807**	**0.651**	**0.918**	**0.909**	0.893
SEE	**0.220**	**0.218**	**0.225**	**0.213**	**0.218**	**0.220**	0.228
MSE	**0.040**	**0.039**	**0.041**	**0.037**	**0.039**	**0.040**	0.042
QMLE	**1.020**	**1.020**	**1.021**	**1.019**	**1.020**	**1.020**	1.021
MPE	**15.417**	**15.784**	**14.215**	**16.165**	**13.458**	**11.140**	15.734
20%	**0.711**	**0.707**	**0.739**	**0.667**	**0.738**	**0.750**	0.667

TABLE 7
Continued

	All Cercopithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
Femur TR							
N	83	41	23	18	42	24	18
Slope	**2.694**	**2.481**	**2.469**	**2.338**	**2.785**	2.774	**2.770**
Y-Int	**2.464**	**2.984**	**3.038**	**3.294**	**2.248**	2.279	**2.276**
R^2	**0.875**	**0.819**	**0.788**	**0.862**	**0.897**	0.848	**0.923**
SEE	**0.221**	**0.194**	**0.237**	**0.129**	**0.247**	0.294	**0.190**
MSE	**0.040**	**0.032**	**0.045**	**0.015**	**0.049**	0.067	**0.031**
QMLE	**1.020**	**1.016**	**1.023**	**1.007**	**1.025**	1.034	**1.015**
MPE	**14.753**	**13.550**	**16.139**	**9.525**	**14.167**	16.602	**11.271**
20%	**0.711**	**0.756**	**0.739**	**0.944**	**0.690**	0.583	**0.833**
Dental Models							
m1AW							
N	64	33	17	16	31	17	14
Slope	2.089	2.678	2.682	2.349	2.455	2.151	2.444
Y-Int	5.592	4.798	4.899	5.219	4.731	5.445	4.583
R^2	0.643	0.589	0.482	0.776	0.811	0.773	0.863
SEE	0.363	0.271	0.312	0.169	0.336	0.296	0.311
p-Value	0.000	0.000	0.002	0.000	0.000	0.000	0.000
MSE	0.132	0.074	0.097	0.028	0.113	0.088	0.097
QMLE	1.068	1.038	1.050	1.014	1.058	1.045	1.050
MPE	26.676	20.240	22.740	12.760	24.413	21.466	16.760
20%	0.453	0.576	0.353	0.875	0.548	0.412	0.643
m1PW							
N	64	33	17	16	31	17	14
Slope	2.175	2.833	2.904	2.431	2.353	2.134	2.286
Y-Int	5.366	4.395	4.360	4.972	4.878	5.443	4.821
R^2	0.700	0.669	0.579	0.810	0.812	0.820	0.839
SEE	0.333	0.244	0.281	0.155	0.336	0.264	0.338
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.111	0.059	0.079	0.024	0.113	0.070	0.114
QMLE	1.057	1.030	1.040	1.012	1.058	1.036	1.059
MPE	24.513	19.658	20.404	13.703	24.686	18.833	21.548
20%	0.484	0.545	0.529	0.813	0.419	0.588	0.714
m1L							
N	65	33	17	16	32	17	15
Slope	**2.455**	**2.965**	3.157	2.437	**2.940**	**2.743**	2.840
Y-Int	**4.325**	**3.540**	3.261	4.440	**3.118**	**3.659**	3.185
R^2	**0.713**	**0.694**	0.690	0.739	**0.891**	**0.913**	0.905
SEE	**0.323**	**0.234**	0.241	0.182	**0.251**	**0.184**	0.252
p-Value	**0.000**	**0.000**	0.000	0.000	**0.000**	**0.000**	0.000
MSE	**0.104**	**0.055**	0.058	0.033	**0.063**	**0.034**	0.064
QMLE	**1.053**	**1.028**	1.029	1.017	**1.032**	**1.017**	1.033
MPE	**23.908**	**19.026**	19.371	13.609	**19.187**	**13.436**	18.593
20%	**0.569**	**0.606**	0.529	0.750	**0.563**	**0.706**	0.600
m1AR							
N	64	33	17	16	31	17	14
Slope	**1.168**	**1.531**	1.629	1.276	**1.346**	1.243	1.297
Y-Int	**4.841**	**3.719**	3.449	4.528	**3.948**	4.496	3.974
R^2	**0.708**	**0.709**	0.668	0.806	**0.864**	0.878	0.889
SEE	**0.328**	**0.228**	0.249	0.157	**0.285**	0.218	0.280

TABLE 7
Continued

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
m1AR (*continued*)							
p-Value	**0.000**	**0.000**	0.000	0.000	**0.000**	0.000	0.000
MSE	**0.108**	**0.052**	0.062	0.025	**0.081**	0.047	0.078
QMLE	**1.055**	**1.026**	1.031	1.013	**1.041**	1.024	1.040
MPE	**41.158**	**72.488**	29.651	82.436	**20.851**	15.834	18.005
20%	**0.469**	**0.545**	0.588	0.688	**0.452**	0.647	0.643
m2AW							
N	68	33	17	16	35	19	16
Slope	**1.838**	2.442	2.578	2.060	2.562	2.398	2.429
Y-Int	**5.694**	4.832	4.677	5.408	3.987	4.484	4.074
R^2	**0.596**	0.662	0.579	0.809	0.823	0.825	0.868
SEE	**0.383**	0.246	0.281	0.156	0.313	0.252	0.290
p-Value	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
MSE	**0.147**	0.061	0.079	0.024	0.098	0.063	0.084
QMLE	**1.076**	1.031	1.040	1.012	1.050	1.032	1.043
MPE	**27.202**	19.459	20.690	12.185	24.376	17.072	18.943
20%	**0.412**	0.667	0.471	0.813	0.457	0.632	0.688
m2PW							
N	65	33	17	16	32	17	15
Slope	2.141	2.694	2.683	2.355	2.549	2.433	2.410
Y-Int	5.128	4.308	4.413	4.823	4.112	4.483	4.235
R^2	0.677	0.679	0.600	0.793	0.842	0.820	0.880
SEE	0.343	0.240	0.274	0.162	0.302	0.264	0.283
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.118	0.057	0.075	0.026	0.091	0.070	0.080
QMLE	1.061	1.029	1.038	1.013	1.047	1.036	1.041
MPE	26.358	19.423	22.068	13.381	23.729	19.403	18.970
20%	0.446	0.545	0.412	0.750	0.500	0.647	0.733
m2L							
N	68	33	17	16	35	19	16
Slope	1.890	2.432	2.858	1.873	2.448	2.315	2.321
Y-Int	5.236	4.368	3.614	5.355	3.781	4.251	3.868
R^2	0.655	0.694	0.771	0.720	0.851	0.898	0.891
SEE	0.354	0.234	0.207	0.189	0.288	0.192	0.263
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.125	0.055	0.043	0.036	0.083	0.037	0.069
QMLE	1.064	1.028	1.022	1.018	1.042	1.019	1.035
MPE	25.798	20.291	17.296	15.028	21.920	13.377	16.839
20%	0.441	0.455	0.706	0.813	0.600	0.684	0.688
m2AR							
N	65	33	17	16	32	17	15
Slope	0.982	1.313	1.452	1.062	1.254	1.172	1.204
Y-Int	5.270	4.225	3.785	5.063	3.891	4.395	3.931
R^2	0.648	0.719	0.724	0.790	0.852	0.867	0.888
SEE	0.358	0.224	0.227	0.163	0.292	0.227	0.273
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.128	0.050	0.052	0.027	0.086	0.051	0.075
QMLE	1.066	1.025	1.026	1.014	1.044	1.026	1.038
MPE	37.636	52.819	26.626	56.696	22.146	17.351	18.399
20%	0.431	0.485	0.706	0.750	0.531	0.647	0.733

TABLE 7
Continued

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
m3AW							
N	59	30	16	14	29	17	12
Slope	1.600	2.213	2.308	1.957	2.106	2.052	2.039
Y-Int	6.149	5.224	5.170	5.552	4.883	5.103	4.871
R^2	0.629	0.601	0.615	0.776	0.848	0.817	0.910
SEE	0.352	0.257	0.277	0.149	0.283	0.266	0.251
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.124	0.066	0.077	0.022	0.080	0.071	0.063
QMLE	1.064	1.034	1.039	1.011	1.041	1.036	1.032
MPE	26.383	19.249	20.701	11.788	21.860	18.453	19.640
20%	0.441	0.667	0.688	0.857	0.483	0.647	0.750
m3PW							
N	59	30	16	14	29	17	12
Slope	1.779	2.309	2.421	1.951	2.026	2.000	1.943
Y-Int	5.925	5.131	5.037	5.641	5.279	5.430	5.301
R^2	0.714	0.608	0.625	0.711	0.860	0.826	0.919
SEE	0.309	0.254	0.274	0.170	0.271	0.260	0.239
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.096	0.065	0.075	0.029	0.074	0.067	0.057
QMLE	1.049	1.033	1.038	1.015	1.038	1.034	1.029
MPE	23.856	20.056	21.432	14.032	21.930	17.202	17.995
20%	0.508	0.600	0.750	0.714	0.517	0.647	0.583
m3L							
N	62	30	16	14	32	19	13
Slope	1.570	2.205	2.419	1.740	1.774	1.734	1.716
Y-Int	5.640	4.395	4.021	5.293	4.994	5.228	4.939
R^2	0.729	0.740	0.822	0.763	0.837	0.855	0.903
SEE	0.300	0.207	0.189	0.153	0.285	0.229	0.251
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.090	0.043	0.036	0.024	0.081	0.052	0.063
QMLE	1.046	1.022	1.018	1.012	1.041	1.026	1.032
MPE	21.696	17.226	13.439	11.289	22.606	14.092	18.297
20%	0.581	0.733	0.688	0.857	0.531	0.737	0.615
m3AR							
N	59	30	16	14	29	17	12
Slope	0.835	1.190	1.272	0.984	0.966	0.941	0.938
Y-Int	5.743	4.489	4.264	5.183	4.986	5.213	4.946
R^2	0.713	0.722	0.777	0.804	0.854	0.840	0.916
SEE	0.310	0.214	0.211	0.139	0.277	0.249	0.243
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.096	0.046	0.045	0.019	0.077	0.062	0.059
QMLE	1.049	1.023	1.023	1.010	1.039	1.031	1.030
MPE	31.758	45.409	23.886	50.655	21.689	16.847	18.603
20%	0.525	0.600	0.625	0.714	0.483	0.647	0.667
M1AW							
N	64	34	18	16	30	16	14
Slope	2.122	2.723	2.842	2.392	2.791	2.583	2.744
Y-Int	5.108	4.187	4.057	4.695	3.510	4.092	3.439
R^2	0.629	0.614	0.541	0.808	0.851	0.878	0.881
SEE	0.364	0.269	0.327	0.152	0.294	0.224	0.284

TABLE 7
Continued

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
M1AW (*continued*)							
p-Value	0.000	0.000	0.001	0.000	0.000	0.000	0.000
MSE	0.133	0.072	0.107	0.023	0.086	0.050	0.081
QMLE	1.069	1.037	1.055	1.012	1.044	1.025	1.041
MPE	26.179	21.235	25.753	11.217	21.291	15.551	19.424
20%	0.484	0.559	0.500	0.875	0.500	0.625	0.500
M1PW							
N	63	34	18	16	29	16	13
Slope	2.290	2.668	2.719	2.453	2.737	2.739	2.536
Y-Int	4.904	4.378	4.396	4.646	3.825	3.963	4.040
R^2	0.688	0.583	0.532	0.790	0.870	0.910	0.896
SEE	0.336	0.280	0.331	0.159	0.279	0.193	0.274
p-Value	0.000	0.000	0.001	0.000	0.000	0.000	0.000
MSE	0.113	0.078	0.109	0.025	0.078	0.037	0.075
QMLE	1.058	1.040	1.056	1.013	1.040	1.019	1.038
MPE	24.745	21.859	24.385	11.558	19.964	14.288	17.351
20%	0.508	0.588	0.556	0.813	0.517	0.813	0.692
M1L							
N	64	34	18	16	30	16	14
Slope	2.099	2.860	3.212	2.288	2.667	2.537	2.565
Y-Int	5.040	3.788	3.220	4.752	3.616	4.035	3.669
R^2	0.665	0.729	0.806	0.746	0.858	0.887	0.880
SEE	0.346	0.226	0.213	0.175	0.287	0.216	0.285
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.120	0.051	0.045	0.030	0.082	0.047	0.081
QMLE	1.062	1.026	1.023	1.015	1.042	1.024	1.041
MPE	25.668	17.821	17.188	13.795	21.532	16.385	16.423
20%	0.484	0.588	0.722	0.750	0.500	0.688	0.786
M1AR							
N	63	34	18	16	29	16	13
Slope	1.109	1.523	1.670	1.270	1.381	1.321	1.318
Y-Int	4.893	3.540	3.088	4.369	3.546	3.935	3.638
R^2	0.680	0.723	0.739	0.827	0.873	0.907	0.892
SEE	0.341	0.228	0.247	0.144	0.276	0.196	0.279
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.116	0.052	0.061	0.021	0.076	0.038	0.078
QMLE	1.060	1.026	1.031	1.011	1.039	1.019	1.040
MPE	31.735	35.384	25.757	35.224	19.683	15.028	16.836
20%	0.413	0.588	0.611	0.688	0.517	0.750	0.692
M2AW							
N	67	34	18	16	33	18	15
Slope	1.921	2.337	2.520	1.993	2.776	2.604	2.673
Y-Int	5.248	4.632	4.366	5.195	3.133	3.668	3.182
R^2	0.622	0.670	0.640	0.827	0.846	0.870	0.883
SEE	0.368	0.249	0.290	0.144	0.292	0.223	0.273
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.135	0.062	0.084	0.021	0.085	0.050	0.075
QMLE	1.070	1.031	1.043	1.011	1.043	1.025	1.038
MPE	25.955	20.404	22.657	11.276	22.894	15.704	19.849
20%	0.448	0.588	0.389	0.813	0.515	0.667	0.667

TABLE 7
Continued

	All Cercopithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
M2PW							
N	64	34	18	16	30	16	14
Slope	2.016	2.533	2.932	2.054	2.776	2.629	2.675
Y-Int	5.202	4.420	3.778	5.199	3.355	3.815	3.406
R^2	0.626	0.706	0.759	0.820	0.839	0.840	0.878
SEE	0.366	0.235	0.237	0.147	0.305	0.257	0.287
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.134	0.055	0.056	0.022	0.093	0.066	0.082
QMLE	1.069	1.028	1.028	1.011	1.048	1.034	1.042
MPE	26.182	18.864	17.696	12.366	24.017	17.295	22.613
20%	0.484	0.588	0.722	0.813	0.400	0.688	0.643
M2L							
N	67	34	18	16	33	18	15
Slope	1.729	2.393	2.927	1.738	2.431	2.313	2.329
Y-Int	5.580	4.469	3.505	5.648	3.760	4.197	3.791
R^2	0.625	0.703	0.842	0.646	0.849	0.901	0.893
SEE	0.366	0.236	0.192	0.206	0.289	0.195	0.261
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.134	0.056	0.037	0.042	0.083	0.038	0.068
QMLE	1.069	1.028	1.019	1.021	1.042	1.019	1.035
MPE	26.784	20.571	16.038	16.686	21.668	13.155	15.244
20%	0.433	0.471	0.667	0.688	0.576	0.722	0.733
M2AR							
N	64	34	18	16	30	16	14
Slope	0.936	1.279	1.483	1.004	1.301	1.237	1.256
Y-Int	5.347	4.213	3.514	5.172	3.489	3.933	3.509
R^2	0.63	0.735	0.804	0.779	0.856	0.894	0.892
SEE	0.37	0.223	0.214	0.163	0.288	0.209	0.27
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MSE	0.13	0.05	0.05	0.03	0.08	0.04	0.07
QMLE	1.07	1.03	1.02	1.01	1.04	1.02	1.04
MPE	46.355	87.162	40.709	87.322	22.121	14.796	18.225
20%	0.406	0.471	0.611	0.625	0.533	0.750	0.786
			Cranial Models				
BIOR							
N	54	27	15	12	27	13	14
Slope	2.862	**1.852**			3.550		3.581
Y-Int	−2.654	**1.564**			−5.580		−5.736
R^2	0.529	**0.338**			0.637		0.777
SEE	0.370	**0.302**			0.415		0.346
p-Value	0.000	**0.001**			0.000		0.000
MSE	0.137	**0.091**			0.172		0.120
QMLE	1.071	**1.047**			1.090		1.062
MPE	27.345	**24.304**			27.512		23.386
20%	0.426	**0.519**			0.481		0.429
GLBA							
N	44	18	9	9	26	14	12
Slope	**2.620**				**3.975**	**4.439**	
Y-Int	**−1.779**				**−7.736**	**−9.814**	
R^2	**0.61**				**0.701**	**0.644**	

TABLE 7
Continued

	All Cerco-	Colobinae			Cercopithecinae		
	pithecidae	All	Male	Female	All	Male	Female
GLBA (*continued*)							
SEE	**0.292**				**0.274**	**0.296**	
p-Value	**0.000**				**0.000**	**0.001**	
MSE	**0.085**				**0.075**	**0.087**	
QMLE	**1.043**				**1.038**	**1.044**	
MPE	**20.532**				**17.3**	**17.244**	
20%	**0.636**				**0.769**	**0.714**	
GLIN							
N	55	27	15	12	28	15	13
Slope	2.757	**3.186**	**3.192**	**2.706**	4.894	6.540	
Y-Int	−3.018	**−4.811**	**−4.783**	**−2.763**	−12.956	−20.597	
R^2	0.640	**0.776**	**0.794**	**0.740**	0.758	0.812	
SEE	0.269	**0.175**	**0.189**	**0.138**	0.242	0.210	
p-Value	0.000	**0.000**	**0.000**	**0.000**	0.000	0.000	
MSE	0.072	**0.031**	**0.036**	**0.019**	0.059	0.044	
QMLE	1.037	**1.016**	**1.018**	**1.010**	1.030	1.022	
MPE	19.049	**13.869**	**14.247**	**9.778**	16.726	13.753	
20%	0.618	**0.815**	**0.733**	**0.917**	0.571	0.733	
NABA							
N	47	18	9	9	29	15	14
Slope	**2.911**				4.151	**4.713**	**4.780**
Y-Int	**−2.953**				−8.351	**−10.848**	**−10.971**
R^2	**0.598**				0.684	**0.568**	**0.593**
SEE	**0.301**				0.289	**0.318**	**0.268**
p-Value	**0.000**				0.000	**0.001**	**0.001**
MSE	**0.090**				0.084	**0.101**	**0.072**
QMLE	**1.046**				1.043	**1.052**	**1.037**
MPE	**20.436**				18.027	**17.001**	**19.341**
20%	**0.617**				0.759	**0.733**	**0.786**
NAIN							
N	44	18	9	9	26	14	12
Slope	**2.924**	3.466			4.816	5.778	
Y-Int	**−3.819**	−6.081			−12.607	−17.072	
R^2	**0.629**	0.536			0.791	0.829	
SEE	**0.283**	0.230			0.229	0.205	
p-Value	**0.000**	0.001			0.000	0.000	
MSE	**0.080**	0.053			0.053	0.042	
QMLE	**1.041**	1.027			1.027	1.021	
MPE	**20.614**	18.679			16.067	13.427	
20%	**0.591**	0.611			0.692	0.714	
ORBH							
N	48	21	11	10	27	13	14
Slope	3.480				3.420		
Y-Int	−1.558				−1.302		
R^2	0.397				0.406		
SEE	0.460				0.531		
p-Value	0.000				0.000		
MSE	0.212				0.282		
QMLE	1.112				1.151		
MPE	34.25				34.454		
20%	0.438				0.407		

TABLE 7
Continued

	All Cercopithecidae	Colobinae All	Colobinae Male	Colobinae Female	Cercopithecinae All	Cercopithecinae Male	Cercopithecinae Female
ORBW							
N	41	18	9	9	23	12	11
Slope	2.729				**3.037**		
Y-Int	0.534				**−0.512**		
R^2	0.478				**0.431**		
SEE	0.327				**0.370**		
p-Value	0.000				**0.001**		
MSE	0.107				**0.137**		
QMLE	1.055				**1.071**		
MPE	25.799				**28.176**		
20%	0.390				**0.435**		
ORBAR							
N	41	18	9	9	23	12	11
Slope	0.003						
Y-Int	7.844						
R^2	0.416						
SEE	0.346						
p-Value	0.000						
MSE	0.120						
QMLE	1.062						
MPE	375.559						
20%	0.000						
PORB							
N	54	27	15	12	27	13	14
Slope	3.022	**2.375**			**3.555**		3.474
Y-Int	−2.336	**0.187**			**−4.467**		−4.310
R^2	0.501	**0.384**			**0.560**		0.641
SEE	0.381	**0.291**			**0.457**		0.439
p-Value	0.000	**0.000**			**0.000**		0.001
MSE	0.145	**0.085**			**0.209**		0.192
QMLE	1.075	**1.043**			**1.110**		1.101
MPE	29.202	**22.624**			**36.270**		32.616
20%	0.463	**0.481**			**0.333**		0.429

Models derived from entire sample, including test subsamples. Values in **bold** are used to estimate mass in fossils; remaining values are ranked too low in preliminary test analysis (reported in table 6) to be used for fossil mass estimation; empty cells are those regressions whose p-value was higher than 0.001, the modified Bonferroni equivalent for a 0.05 alpha level (see text).

Y-Int, y-intercept; SEE, standard error of the estimate; p-Value, probability associated with regression; MSE, mean square error; QMLE, quasi-maximum likelihood estimator correction factor for exponentiation; MPE, mean prediction error of estimate; 20%, frequency of estimated values within 20% of known (associated or compiled) mass. AP, anteroposterior midshaft diameter; TR, transverse midshaft diameter. Abbreviations for cranial and dental measurements are explained in the text.

ferroni approach to rejecting elements at a more stringent level than 0.05, but not as stringent as the "pure" Bonferroni correction of p/N; in the latter situation, with 245 tests and a desired p-value of 0.05, the effective rejection level would be 0.0002. Inspection of table 7 revealed that 33 equations have p-values greater than 0.001, which closely corresponds to the corrected confidence level for that number of cases (for N = 31, p = 0.0016); these equations with p-values greater than or equal to 0.002 are rejected, and only their Ns are reported in table 7.

The ranking procedure we employed resulted in the inclusion of some cranial variables with MPE values up to 29% (a value over 30% led to immediate rejection) and

TABLE 8
Modern Taxa Analyzed in Detail

	Mean mass		Postcrania		Craniodental	
Taxon	Male	Female	Mass	No mass	Mass	No mass
Colobus guereza occidentalis	9	7.5		1 M, 1 F		5 M, 7 F
Colobus guereza matschiei	10	8	5 M, 10 F			
Procolobus verus	4	4	4 M, 1 F			1 M, 1 F
Procolobus badius oustaleti	13	8.5		2 M, 0 F		
Nasalis (Nasalis) larvatus	20	10	4 M, 5 F	3 M, 1 F		
Pygathrix (Rhinopithecus) bieti	22	12		8 M, 5 F		
Semnopithecus entellus schistacea	22	15	1 M, 0 F		2 M, 3 F	
Semnopithecus (T.) obscura obscura	8	7	5 M, 5 F		3 M, 3 F	
Semnopithecus (T.) cristata ultima	6.5	5.5	6 M, 6 F			4 M, 6 F
Cercopithecus aethiops pygerythrus	5.5	3.5	3 M, 5 F			6 M, 0 F
Macaca sylvanus sylvanus	(15)	(10)		3 M, 2 F		6 M, 5 F
Macaca nemestrina nemestrina	11.5	6.5	1 M, 4 F			0 M, 1 F
Macaca nemestrina leonina	8	5	1 M, 2 F			1 M, 0 F
Macaca arctoides	12	8	2 M, 1 F			1 M, 0 F
Macaca fascicularis	5	3	10 M, 8 F			0 M, 1 F
Lophocebus albigena	8	5.5	4 M, 2 F			1 M, 1 F
Papio hamadryas cynocephalus Darajani sample	23	12	12 M, 10 F		1 M (av), 1 F (av)	
Papio hamadryas ursinus	30	15	2 M, 2 F	1 M, 0 F	3 M, 0 F	72 M, 64 F (mainly teeth)
Mandrillus sphinx	(35)	(13)	1 M	2 M, 1 F	1 M	3 M, 1 F
Theropithecus gelada	18	12	0 M, 1 F	3 M, 2 F	1 M, 4 F	4 M (1 av), 3 F (1 av)

All mass values are expressed in kg, rounded to the nearest kg (or half-kg for values under 12 kg). Mean mass, estimate used in model development (values in parentheses were not used in model development, but provide test of model here). Postcrania, number of included male (M) and female (F) specimens with or without associated mass. Craniodental, number of included male and female specimens with or without associated mass. When there was no associated mass, sample average mass was used instead; "av" notations indicate that average values from the literature were used.

As discussed in the section on Estimation Model Construction and Evaluation, mean masses such as these are themselves estimates. There may well be important differences between values for postcranial and craniodental subsamples and between values for individuals with associated mass and these means.

rankings as low as 28th out of 35 within certain taxon-sex groups. For example, in the all-cercopithecine group, two cranial variables had MPEs above 28% and ranked 27th and 28th. Only two cranial variables could be utilized for the female cercopithecine group, only one for all-colobines and none for sexed colobines, due to rejection of regressions for overly high p- or MPE values. This lack of acceptable cranial variables reduces the impact of the estimation analysis, but it could not have been determined in advance. Future extension of this study with additional variables (such as facial lengths) and modern taxa might improve the results.

EVALUATION OF ESTIMATOR VARIABLES

Comparing Estimator Performance Between Anatomical Regions

In order to assess the performance of these models, we chose a subsample of 20 taxa (listed in table 8 with their sample sizes and masses) in which to examine predictions from the final model. These taxa were selected to span the range of body sizes in each subfamily and because many of their sample mean masses were associated values. As noted above, two of these taxa, *Macaca sylvanus* and *Mandrillus sphinx,* were not included in the construction of any estimation models.

Thus the predictions for these species closely resemble the case for fossils. Mass values are presented as rounded kg (or half-kg under 12), the level of precision used for the fossils below.

Table 9 presents the mean, minimum, and maximum of the estimates of mass in those 20 taxa for each of the three anatomical regions as calculated from the sex-specific subfamily models. For example, if six models were calculated for dental variables in male cercopithecines, the average of those estimates was tabulated as the mean, and the largest and smallest estimates called the maximum and minimum, respectively. In those cases where no valid estimate could be calculated from the by-sex model, the combined-sex subfamily (or even full-family) model was used and is so noted. In addition, in line with the concept that an estimate within 20% of the "true" value is a desirable goal, values 20% above and below the estimates are compared to the compiled sample mean mass (presented in the leftmost column).

Of 95 total cases (population by sex by body region), 66 estimates were clearly within 20% of the compiled mass; in two other cases, estimates were produced for male African colobines using both family and subfamily models, and one was within but the other beyond the 20% Rubicon. Without being overly precise, about 70% of the estimates were thus within 20% of the target values.

There was no clear pattern of "errors" in our data in terms of subfamily, sex, and body region. Errors ranged from 73% below the compiled mass (*Nasalis larvatus* male cranial measures based on the subfamily regression; in fact, its estimate from the family regression was next worst, at 58% below) to 50% above (*Macaca fascicularis* female dental variables); these are, in fact, the largest colobine and the smallest cercopithecine in the sample. Although not all large and small taxa were thus affected, at least some of the error is probably due to populations being at the extremes of the studied distribution. Roughly half the errors were positive and half negative. Eight occurred in both the postcranial and dental datasets, and most of these involved cercopithecines (especially males) that are more common among the taxa examined. In the cranial dataset, there were 13 errors, mainly among the colobines (and mostly in males, especially of the largest taxa), reflecting the poor predictive ability of these variables as discussed above.

Despite these errors, a success rate of 70% of estimation within 20% appears quite acceptable for this approach. In terms of using these equations to estimate mass in fossils, it is clear that postcranial and dental estimates are to be trusted somewhat more than those derived from cranial measures when considering larger colobines (of which there are many in the fossil sample), but otherwise it is not easy to choose a preferred region. Thus, the range of mean estimates can provide a first approach to an estimation range, while a closer estimate might be obtained from the 20% range around the grand mean.

We can examine the results more closely for the two taxa not included in the original regressions, *Macaca sylvanus* and *Mandrillus sphinx*. For the former, compiled mass is 15 kg in males and 10 in females. The male estimates range from 12 to 16 kg, averaging 13; female estimates range from 8 to 11.5, averaging 9.5. In mandrills, compiled mass is 35 kg in males and 13 in females. The male estimates range from 26 to 39 kg, averaging 34; female estimates range from 9.5 to 15, averaging 13. As a result of testing a case like this, where we can examine both accuracy and consistency, the prognosis for mass estimation in "true" unknowns (fossils) is decidedly encouraging.

Comparison of Estimation Accuracy With Previous Studies

In order to evaluate the performance of the equations developed here relative to previous work, we calculate estimates of body mass using prediction equations reported in several sources, including Gingerich et al. (1982), Conroy (1987), and Dechow (1983). Additionally, we compare our methods and results with the methods presented in Hens et al., 1998 (see also Konigsberg et al., 1998). Unfortunately, few other authors have provided alternative models for cercopithecid body mass estimation with which comparisons can be made. The equations included as an ap-

TABLE 9
Mass Prediction Evaluation for Sample of Modern Taxa Treated as Fossils

		Postcranium		Dentition		Cranium	
	Compiled mass	Calculated mass	Calc. mass ± 20%	Calculated mass	Calc. mass ± 20%	Calculated mass	Calc. mass ± 20%
Colobus guereza occidentalis							
Male	9						
Mean		9.5		**11.5**		**11.5**^{F}	
Min		8.5	7.5	11	9.5	10^{F}	9.5^{F}
Max		10.5	11.5	13	13.5	13^{F}	13.5^{F}
Mean*						10.5^{S}	
Female	7.5						
Mean		8.5		8.5		**11**^{F}	
Min		7.5	6.5	7.5	6.5	9^{F}	8.5^{F}
Mean*						**10**^{S}	
Max		9	10.5	9	10.5	12^{F}	13.5^{F}
Colobus guereza matschiei							
Male	10.5						
Mean		10.5					
Min		9	8.5				
Max		12	12.5				
Female	8						
Mean		8.5					
Min		7.5	6.5				
Max		10	10.5				
Procolobus verus							
Male	4.5						
Mean		4.5		4.5			
Min		4	3.5	4	3.5		
Max		5	5.5	5	5.5		
Female	3.5						
Mean		4.5		**5**			
Min		3.5	3.5	4.5	4.5		
Max		5.5	5.5	5	6.5		
Procolobus badius oustaleti							
Male	12						
Mean		**9**		11		12^{F}	
Min		7.5	7.5	9.5	8.5	11.5^{F}	10^{F}
Max		10	10.5	14	13.5	12^{F}	14^{F}
Mean*						**8.5**^{S}	
Female	8.5						
Mean				8.5		9.5^{F}	
Min				8	6.5	9^{F}	7.5^{F}
Max				9.5	10.5	10^{F}	11.5^{F}
Mean*						8.5^{S}	
Nasalis (Nasalis) larvatus							
Male	19						
Mean		20		**13**		**12**^{F}	
Min		19	16	12	10	11.5^{F}	10^{F}
Max		21	24	14	16	13^{F}	14^{F}
Mean*						**11**^{S}	
Female	9.5						
Mean		11		9		9^{F}	
Min		9.5	8.5	8.5	7.5	8.5^{F}	7.5^{F}
Max		12	13.5	9	10.5	9.5^{F}	10.5^{F}
Mean*						10^{S}	

TABLE 9
Continued

		Postcranium		Dentition		Cranium	
	Compiled mass	Calculated mass	Calc. mass ± 20%	Calculated mass	Calc. mass ± 20%	Calculated mass	Calc. mass ± 20%
Pygathrix (Rhinopithecus) bieti							
Male	22						
Mean		**16**		19		**14**[S]	
Min		13	13	18	15		11
Max		18	19	21	23		17
Female	13						
Mean		11		12		14[S]	
Min		10.5	8.5	11.5	10		11
Max		11.5	13.5	13	14		17
Semnopithecus entellus schistacea							
Male	20						
Mean		20		25		**15**[S]	
Min		16	16	19	20		12
Max		22	24	27	30		18
Female	15						
Mean				15		15[S]	
Min				15	12		12
Max				16	18		18
Semnopithecus (Trachypithecus) obscura							
Male	7						
Mean		7		8.5		**9**[S]	
Min		6	5.5	7	6.5		7.5
Max		7.5	8.5	10.5	10.5		10.5
Female	6.5						
Mean		7		7		**9**[S]	
Min		6.5	5.5	6.5	5.5		7.5
Max		7	8.5	7	8.5		10.5
Semnopithecus (Trachypithecus) cristata ultima							
Male	6.5						
Mean						**7**[S]	
Mean		7				6.5[F]	
Min		6.5	5.5			6.5[F]	5.5[F]
Max		8	8.5			7[F]	7.5[F]
Female	5.5						
Mean		6				6.5[F]	
Min		5.5	4.5			6.5[F]	5.5[F]
Max		6.5	7.5			7[F]	7.5[F]
Mean*						**7.5**[S]	
Cercopithecus aethiops pygerythrus							
Male	5.5						
Mean		6		5.5			
Min		5.5	4.5	5	4.5		
Max		6	7.5	5.5	6.5		
Female	3.5						
Mean		4		3			
Min		3.5	3.5	3	2.5		
Max		5.5	4.5	3.5	3.5		

TABLE 9
Continued

	Compiled mass	Postcranium Calculated mass	Postcranium Calc. mass ± 20%	Dentition Calculated mass	Dentition Calc. mass ± 20%	Cranium Calculated mass	Cranium Calc. mass ± 20%
Macaca sylvanus sylvanus							
Male	15						
Mean		16		**12**		**12**	
Min		11.5	13	11.5	10	9.5	10
Max		20	19	13	14	15	14
Female	10						
Mean		11.5		**8**		9	
Min		6.5	9.5	6.5	6.5	8	7.5
Max		16	13.5	9.5	9.5	10	10.5
Macaca nemestrina nemestrina							
Male	9						
Mean		**12**					
Min		9.5	10				
Max		14	14				
Female	6.5						
Mean		6.5				**9**	
Min		6	5.5			7	7.5
Max		8	7.5			11.5	10.5
Macaca nemestrina leonina							
Male	8						
Mean		**11**		**11**		**14**	
Min		9	8.5	10.5	8.5	11	11
Max		13	13.5	11	13.5	16	17
Female	6.5						
Mean		6					
Min		5.5	4.5				
Max		7	7.5				
Macaca arctoides							
Male	11.5						
Mean		**9.5**		12			
Min		8	7.5	11.5	10		
Max		10.5	11.5	13	14		
Female	6						
Mean	9						
Min	7	7.5					
Max	11.5	10.5					
Macaca fascicularis							
Male	5						
Mean		5.5					
Min		5	4.5				
Max		6	6.5				
Female	3						
Mean		3.5		**6**			
Min		3	2.5	6	4.5		
Max		3.5	4.5	6	7.5		
Lophocebus albigena							
Male	8						
Mean		**12**		9.5		8	
Min		10.5	10	8	7.5	7.5	6.5
Max		16	14	11	11.5	8.5	9.5

TABLE 9
Continued

	Compiled mass	Postcranium: Calculated mass	Postcranium: Calc. mass ± 20%	Dentition: Calculated mass	Dentition: Calc. mass ± 20%	Cranium: Calculated mass	Cranium: Calc. mass ± 20%
Lophocebus albigena (continued)							
Female	5.5						
Mean		6.5				**8**	
Min		5.5	5.5				6.5
Max		7.5	7.5				9.5
Papio hamadryas cynocephalus Darajani							
Male	23						
Mean		25		25		19	
Min		22	20	24	20		15
Max		27	30	27	30		23
Female	13						
Mean		12		15		13	
Min		11	10	14	12	11	10
Max		13	14	15	18	15	16
Papio hamadryas ursinus							
Male	31						
Mean		26		29		30	
Min		23	21	28	23	28	24
Max		30	31	31	35	32	36
Female	15						
Mean		15		17		19	
Min		13	12	16	14	17	15
Max		17	18	17	20	21	23
Papio (Mandrillus) sphinx							
Male	35						
Mean		39		**26**		36	
Min		29	31	25	21	27	29
Max		47	47	29	31	52	43
Female	13						
Mean		**9.5**		15		14	
Min		6.5	7.5	12	12	13	11
Max		12	11.5	16	18	16	17
Theropithecus gelada							
Male	20						
Mean		**16**		23		21	
Min		14	13	19	18	18	17
Max		19	19	27	28	23	25
Female	12						
Mean		11				10.5	
Min		9	8.5			7	8.5
Max		12	13.5			14	12.5

All mass values are expressed in kg, rounded to the nearest kg (or half-kg for values under 12 kg). For Calculated mass, Mean = mean of values calculated from highest ranking variables for the model used; Min = lowest value; Max = highest value. For Calc. mass ± 20%, Min = 80% of Mean; Max = 120% of Mean.

All values are calculated from sex-specific subfamily models unless noted by superscript letters as follows: S = combined-sex subfamily model; F = combined-sex family model. **Bold** indicates that the ±20% range does not include the compiled "true" value. For some taxa, means (designated Mean*) from an additional model are reported for the Cranium dataset. The S model is preferred to the F model, when possible (as discussed in the text), but often only a single estimate was available from the S model.

pendix in Damuth and MacFadden (1990), for example, contain no data for cercopithecids. Leakey (1993) used measures of femoral head size (following Ruff, 1988) taken on a sample of individual *Papio hamadryas cynocephalus* to estimate mass in fossil *Theropithecus* (see below). However, it must be noted that this (unpublished) equation would be especially limited in its application to a taxon other than the *one* from which it was derived.

In order to compare our equations with those of Gingerich et al. and Conroy, we use our data for the first lower molar, and construct an area estimate by multiplying the length of the tooth by the greatest width, following their methods. (Note that our own area estimate incorporates two width measurements and as such is not strictly comparable.) We examine performance among taxa with compiled mass. Our main criterion for evaluating prediction performance is the Mean Prediction Error (MPE). We use Gingerich et al.'s model including all primates (*Galago* to *Gorilla*) and Conroy's "monkey" grade equation. MPE values are compared between studies at several taxonomic levels (table 10).

The MPEs for the most inclusive models (all cercopithecids) are quite similar, in spite of the relatively large differences in sample size, taxonomic coverage, and body weight provenance among the studies. Gingerich et al. examined 21 Old World monkey taxa (16 cercopithecines/5 colobines), Conroy 22 (16/6), with most taken from Gingerich's previous study. Conroy restricted the bulk of his study to males, calculating a separate anthropoid female prediction equation (which is not further considered here). The range of MPEs is similar in Conroy and the current analysis; however, the magnitudes are smaller in the present study (21–32 vs. 12–24). MPEs derived from application of Gingerich et al.'s model results in the most variable, and largest, MPE values.

Conroy's study is similar to the present analysis in basic methodological outline, but he used a gradistic approach to grouping primate taxa (prosimians, monkeys, apes, etc.). Although he did not provide the data for analyses of covariance based on these groups, he did note that differences in slope

TABLE 10
Mean Prediction Errors (MPE) for Mass Estimates Based on Lower First Molar Area[a]

	Gingerich et al.	Conroy	This study
All cercopithecids	27	26	24
Colobines			
All	29	21	18
Males	40	28	19
Females	18	—[b]	12
Cercopithecines			
All	25	32	21
Males	20	26	16
Females	32	—[b]	18

Equations published in Gingerich et al. (1982) and Conroy (1987) were used with extant taxon mean dental and body mass values from the current study. We correct for log-bias by applying the quasi-maximum likelihood estimator (QMLE) to all predictions (as calculated by Smith, 1993, for Gingerich et al. and for Conroy).

[a] Here, area = length × maximum width, as in previous studies.

[b] No estimation routines were performed for females based on Conroy's equations as his data are restricted to males.

were not significant between groups. He did not, however, report the results of analyses of elevation. Our analysis (see scaling section below) similarly finds few differences in slope values. On the other hand, statistically significant differences in elevation were found to be pervasive in the dentition. This pattern of association between dental dimensions and weight contributes to the variation in prediction accuracy.

It is instructive to note that the correlation coefficients of the models used in the preceding contrast are high (0.93 for Conroy, 0.97 for Gingerich et al.), but performance variation (as judged by MPE) is quite variable. We strongly agree with Conroy (1987: 121) that these results "... should be viewed as a cautionary note to those who uncritically use high correlation coefficients [or coefficients of determination] to justify their predictive equations." Perhaps more interesting findings are that the application of estimation models from the data in the present study results in smaller MPEs, and that the correlation coefficient of m1 area and weight is (only) 0.84 (based on our area estimate that incorporates both anterior and posterior width).

Additionally, it is important to recall that first lower molar area is by no means consistently one of the most reliable dental variables in the present study. It is the second "best" dental estimator for all cercopithecids and all cercopithecines, and the sixth best for all colobines, but is never highly ranked for sex-specific models. In most cases, therefore, we have better confidence in estimation routines that employ other independent variables. The above contrast was undertaken merely to examine the performance of two widely cited estimation models when used to "predict" known (associated) mass in cercopithecids.

As opposed to the single-variable models of Gingerich et al. (1982) and Conroy (1987), Dechow (1983) evaluated a variety of single cranial and dental variables, as well as multivariable constructions to estimate mass in "baboons": populations of *Papio, Mandrillus,* and *Theropithecus.* Dechow tested these estimates for "accuracy" through simple comparison with the original mean masses used to develop the regressions. He found that the most accurate estimators were those based on factor scores derived from principal component analyses of multiple raw measures, but among the individual cranial variables, glabella-basion (GLBA) and glabella-inion (GLIN) were almost as accurate. In fact, we selected these variables to study in part on the basis of Dechow's results. Most individual dental measures were poor predictors of mass. We examined three of Dechow's variables to see how they would behave in our much broader sample: GLBA, GLIN, and m2L. From our modern populations, we selected 17 colobine male and 14 colobine female taxa, and 19 cercopithecine taxa of each sex. Not all taxa were represented by both sexes, and few had all three variables. Recall that Dechow's equations were not sex-specific and were derived from analysis of cercopithecines with mass between 10 and 35 kg.

Only one colobine taxon of each sex had its mass estimated within 20% by Dechow's GLIN equation; the GLBA equation estimated mass "correctly" in four male and one female colobines; and no colobine's mass was accurately estimated by the m2L equation. Of the cercopithecines, the mass of two (of six possible) males and two (of five) females was estimated within 20% by the GLIN and GLBA equations (the same taxa for females, different for males). Six male and six female cercopithecine taxa had their mass estimated within 20% by the m2L equation. (Two female taxa lacked the variable.) Most of the accurate dental estimates were on larger taxa, but several were not, and none of the accurate cranial estimates were on large-bodied taxa. Clearly, these equations are not as broadly useful as those developed in our analysis, and they do not even perform well on the large cercopithecines from which they were developed. This comparison confirms our view that regressions should not be too readily applied to taxa different from those used in their construction.

Recently, Konigsberg et al., 1998 (see also Hens et al., 1998) have developed a routine for estimating a global size variable (e.g., body mass, body length) from some local size variable (e.g., femur length). They used five different models (Inverse, Classical, RMA, MA, and Ratio; the program is available at http://konig.la.utk.edu/5reg.html). These workers have established some patterns resulting from the use of these various approaches to estimation. Of particular interest here is the discussion of estimating size in taxa either larger or smaller than those found in the comparative sample. Konigsberg and colleagues stress that if the assumption is made that unknown taxa share the same size distribution and scaling as the comparative sample, then the inverse "calibration" (body size on organ size) is the minimum variance unbiased estimator. On the other hand, if we extrapolate to larger or smaller sizes, and assume the same scaling, then we should use the classical calibration (organ size on body size). Note that if allometries are expected to *differ* between the comparative and target samples, then there is no a priori basis for choosing an optimal estimator.

Given this, we are interested in comparing the results of classical calibration to our estimates (the inverse calibration in their terms) for the largest fossil taxa. We wish to know if the difference is large enough to affect our interpretations of biology. We expect that estimates will be larger when calculated with classical calibration.

We selected some of our largest taxa for this exercise as it is these taxa that are surely outside the range of the modern data. We report below, in the section on fossil estimates, the results of the classical model in estimating the mass of five male *Theropithecus* postcranial samples. All estimates derived from these models are indeed larger than the estimates resulting from the models used in the main part of this study. As expected, the estimates for certain taxa are nearly twice the mass of our "inverse" estimates. We did not apply a correction factor to account for log-detransformation bias; this would increase each estimate by approximately 2–5% judged from the magnitudes of QMLE. It is worth noting, however, that when one incorporates the ± 20% interval of each estimate, the differences are less striking, and ranges of estimates resulting from the two methods usually overlap. The most important conclusion resulting from this exercise is that the largest taxa are estimated with a large amount of "error", and this should be recognized when the mass estimates of these taxa are used in any paleobiological application.

SCALING OF PREDICTOR VARIABLES

It has been demonstrated that estimates of body mass can be strongly influenced by the existence of functional and/or phylogenetic subsets in the sample used for model construction (e.g., Conroy, 1987; Damuth and MacFadden, 1990; Dagosto and Terranova, 1992). As such, the discovery of scaling differences between groups is an important step in the identification of reliable estimator variables. One approach to the elucidation of group effects is to examine the scaling patterns of all estimator variables relative to body mass in the comparative sample. This examination can also help to better understand the meaning of variation in estimates from different reference samples (see also Gingerich et al., 1982) or different anatomical regions. The current sample provides valuable insight into the scaling of cranial, dental, and postcranial measures with mass in cercopithecid primates, as the sample is largely composed of individuals with associated body masses. Recognizing the need to characterize the relationships between mass and estimator variables, we provide sex-specific scaling equations for each cranial, dental, and postcranial variable in the two subfamilies under study (table 11).

We examine adult interspecific scaling patterns of several skeletal and dental dimensions relative to body mass. We have two goals in the scaling analyses: (1) to demonstrate the relationships between mass and skeletal or dental dimensions in the present sample (and to compare the patterns with previously published descriptions of scaling in cercopithecids); and (2) to use scaling relationships to assist in evaluating estimates of mass in fossil taxa, especially when estimates based on different regions of the skeleton result in widely divergent estimates.

Ordinary Least Squares (Model I) regression was used in the estimation routines because the goal was prediction of a unique y (body mass estimate), given an x (skeletal or dental measurement). For the present set of analyses, we examine bivariate Reduced Major Axis (Model II) regression of the natural logarithm of taxon-mean body mass and a skeletal or dental measure. Our goal is to explore functional relationships of dental and skeletal measures with mass (Rayner, 1985). In addition to determining the scaling patterns of cranial, dental, and postcranial dimensions with size (mass), we are interested in examining the relationship between scaling and mass estimation.

The sample includes all of the taxa used in the generation of prediction models, and scaling patterns are examined within the same taxonomic groups (all cercopithecids, all colobines, colobine males, colobine females, etc.). Of the cranial measures, only GLIN, NABA, and PORB are examined at the lowest taxonomic level (by sex and subfamily), as linear regression is not always significant for the other measures.

For each of six subsamples we calculate slope estimates and their 95% confidence intervals. Slope estimates are compared among the various datasets as well as to theoretical expectations of geometric scaling. Further, we evaluate the effect of a potential mass-surrogate's scaling (isometry or allometry)

TABLE 11
Reduced Major Axis Regression Equations Detailing the Association Between Skeletal or Dental Dimensions (y) and Body Mass (x)

	All Cercopithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
Humerus length							
N	84	42	23	19	42	24	18
r	0.938	0.880	0.902	0.808	0.958	0.954	0.945
Slope	0.344	0.358	0.356	0.390	0.328	0.332	0.324
95% CI for slope	0.323/0.368	0.307/0.426	0.291/0.449	0.304/0.545	0.303/0.354	0.304/0.371	0.278/0.393
Y-Int	1.924	1.787	1.802	1.515	−0.538	−0.577	−0.496
95% CI for Y-Int	1.707/2.110	1.183/2.247	0.962/2.373	0.139/2.259	−0.770/0.314	−0.932/−0.309	−1.082/−0.103
Humerus AP							
N	83	42	23	19	42	24	18
r	0.912	0.885	0.888	0.832	0.936	0.918	0.947
Slope	0.416	0.410	0.411	0.380	0.417	0.429	0.431
95% CI for slope	0.389/0.442	0.332/0.476	0.341/0.493	0.312/0.476	0.389/0.447	0.388/0.479	0.395/0.524
Y-Int	−1.418	−1.396	−1.397	−1.136	−1.395	−1.523	−1.492
95% CI for Y-Int	−1.659/−1.178	−1.993/−0.878	−2.162/−0.782	−2.012/0.540	−1.673/−1.13	−1.992/−1.12	−2.261/−1.18
Humerus TR							
N	84	42	23	19	42	24	18
r	0.898	0.902	0.927	0.884	0.910	0.871	0.869
Slope	0.350	0.378	0.382	0.340	0.337	0.315	0.341
95% CI for slope	0.323/0.372	0.336/0.437	0.343/0.461	0.279/0.431	0.308/0.360	0.284/0.358	0.281/0.436
Y-Int	−0.801	−1.068	−1.117	−0.759	−0.647	0.441	−0.690
95% CI for Y-Int	−1.007/−0.563	−1.621/−0.727	−1.843/−0.763	−1.588/−0.223	−0.857/−0.380	−0.846/−0.143	−1.486/−0.200
Femur length							
N	81	40	23	17	41	23	18
r	0.889	0.839	0.836	0.773	0.940	0.925	0.938
Slope	0.312	0.264	0.252	0.298	0.309	0.312	0.312
95% CI for slope	0.281/0.345	0.219/0.312	0.185/0.312	0.203/0.425	0.285/0.341	0.285/0.365	0.291/0.387
Y-Int	2.405	2.882	2.985	2.575	2.389	2.351	2.369
95% CI for Y-Int	2.121/2.651	2.451/3.293	2.438/3.616	1.459/3.423	2.108/2.603	1.888/2.615	1.737/2.565
Femur AP							
N	83	41	23	18	42	24	18
r	0.936	0.881	0.898	0.807	0.958	0.954	0.945
Slope	0.335	0.348	0.327	0.371	0.328	0.332	0.324
95% CI for slope	0.317/0.357	0.316/0.395	0.292/0.385	0.304/0.491	0.303/0.354	0.304/0.371	0.278/0.393
Y-Int	−0.590	−0.697	−0.492	−0.914	−0.538	−0.577	−0.496
95% CI for Y-Int	−0.790/−0.427	−1.121/−0.412	−1.026/−0.173	−1.986/−0.334	−0.770/0.314	−0.932/−0.309	−1.082/−0.103
Femur TR							
N	83	41	23	18	42	24	18
R	0.935	0.905	0.888	0.929	0.947	0.921	0.961
Slope	0.347	0.365	0.359	0.397	0.340	0.332	0.347
95% CI for slope	0.325/0.372	0.321/0.422	0.309/0.442	0.313/0.475	0.316/0.367	0.296/0.385	0.306/0.398
Y-Int	−0.697	0.855	−0.812	−1.136	−0.636	−0.556	−0.699
95% CI for Y-Int	−0.913/−0.501	−1.366/−0.465	−1.543/−0.350	−1.818/−0.375	−0.876/−0.419	−1.036/−0.203	−1.129/−0.354
m1AW							
N	58	28	14	14	30	17	13
r	0.799	0.736	0.631	0.853	0.900	0.881	0.926
Slope	0.380	0.246	0.213	0.339	0.367	0.410	0.384
95% CI for slope	0.328/0.438	0.181/0.283	0.108/0.309	0.250/0.373	0.299/0.425	0.327/0.530	0.258/0.435
Y-Int	−1.760	−0.623	−0.334	−1.442	−1.550	−2.005	−1.645
95% CI for Y-Int	−2.319/−1.285	−0.966/−0.025	−1.262/0.639	−1.730/−0.666	−2.094/−0.916	−3.154/−1.19	−2.117/−0.475
m1PW							
N	58	28	14	14	30	17	13
r	0.834	0.791	0.720	0.862	0.901	0.908	0.914
Slope	0.382	0.254	0.223	0.339	0.383	0.425	0.406
95% CI for slope	0.325/0.442	0.191/0.289	0.117/0.338	0.253/0.368	0.319/0.451	0.309/0.544	0.311/0.518
Y-Int	−1.743	−0.639	−0.365	−1.391	−1.683	−2.139	−1.824
95% CI for Y-Int	−2.299/−1.237	−0.965/−0.065	−1.458/0.623	−1.651/−0.622	−2.332/−1.08	−3.229/−1.45	−2.856/−0.944

TABLE 11
Continued

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
m1L							
N	59	28	14	14	30	17	13
r	0.841	0.818	0.846	0.841	0.944	0.957	0.950
Slope	0.342	0.250	0.219	0.346	0.321	0.349	0.339
95% CI for slope	0.296/0.386	0.194/0.298	0.133/0.302	0.269/0.446	0.281/0.355	0.319/0.396	0.257/0.386
Y-Int	−1.152	−0.402	−0.129	−1.244	−0.884	−1.185	−0.996
95% CI for Y-Int	−1.566/−0.740	−0.833/0.112	−0.905/0.665	−2.151/−0.563	−1.210/−0.497	−1.635/−0.884	−1.444/−0.253
m1AR							
N	58	28	14	14	30	17	13
r	0.839	0.845	0.823	900	0.928	0.936	0.941
Slope	0.714	0.481	0.407	0.661	0.689	0.754	0.736
95% CI for slope	0.618/0.808	0.361/0.555	0.228/0.587	0.522/0.734	0.579/0.780	0.657/0.897	0.542/0.871
Y-Int	−2.829	−0.858	−0.199	−2.450	−2.439	−3.140	−2.740
95% CI for Y-Int	−3.731/−1.967	−1.533/0.236	−1.873/1.459	−3.118/−1.21	−3.302/−1.40	−4.482/−2.20	−3.998/−0.988
m2AW							
N	60	28	14	14	32	17	15
r	0.758	0.791	0.734	0.878	0.904	0.904	0.927
Slope	0.411	0.296	0.240	0.420	0.355	0.379	0.383
95% CI for slope	0.355/0.490	0.215/0.336	0.130/0.354	0.309/0.494	0.304/0.410	0.310/0.468	0.295/0.474
Y-Int	−1.865	−0.942	−0.436	−2.040	−1.231	−1.511	−1.423
95% CI for Y-Int	−2.616/−1.350	−1.308/−0.209	−1.513/0.572	−2.726/−1.04	−1.757/−0.736	−2.380/−0.811	−2.272/−0.598
m2PW							
N	59	28	14	14	31	17	14
r	0.822	0.816	0.763	0.868	0.916	0.906	0.933
Slope	0.379	0.269	0.244	0.350	0.359	0.373	0.391
95% CI for slope	0.330/0.435	0.204/0.313	0.129/0.355	0.243/0.418	0.313/0.411	0.318/0.455	0.326/0.490
Y-Int	−1.576	−0.664	−0.446	−1.371	−1.307	−1.481	−1.544
95% CI for Y-Int	−2.111/−1.128	−1.069/−0.084	−1.476/0.617	−2.013/−0.435	1.798/−0.874	−2.283/−0.938	−2.442/−0.961
m2L							
N	60	28	14	14	32	17	15
r	0.800	0.807	0.879	0.811	0.920	0.947	0.941
Slope	0.423	0.325	0.280	0.459	0.379	0.410	0.409
95% CI for slope	0.367/0.501	0.246/0.385	0.173/0.382	0.345/0.619	0.327/0.430	0.371/0.481	0.320/0.494
Y-Int	−1.787	−1.008	−0.618	−2.183	−1.268	−1.625	−1.467
95% CI for Y-Int	−2.501/−1.282	−1.558/−0.278	−1.565/0.379	−3.663/−1.15	−1.761/−0.776	−2.306/−1.24	−2.256/−0.651
m2AR							
N	60	28	14	14	32	17	15
r	0.764	0.835	0.860	0.863	0.835	0.819	0.873
Slope	0.732	0.600	0.539	0.815	0.670	0.651	0.771
95% CI for slope	0.625/0.870	0.455/0.693	0.297/0.745	0.585/1.017	0.536/0.777	0.490/0.825	0.603/0.967
Y-Int	−2.766	−1.741	−1.227	−3.628	−2.025	−1.954	−2.799
95% CI for Y-Int	−4.047/−1.790	−2.587/−0.436	−3.169/1.009	−5.54/−1.60	−3.013/−0.797	−3.593/−0.473	−4.601/−1.293
m3AW							
N	53	25	13	12	28	17	11
r	0.788	0.723	0.752	0.818	0.919	0.904	0.951
Slope	0.491	0.299	0.274	0.441	0.437	0.441	0.472
95% CI for slope	0.423/0.581	0.204/0.348	0.134/0.381	0.253/0.549	0.386/0.509	0.353/0.539	0.409/0.635
Y-Int	−2.589	−0.954	−0.760	−2.203	−1.968	−2.048	−2.218
95% CI for Y-Int	−3.446/−1.976	−1.409/−0.094	−1.764/0.533	−3.181/−0.513	−2.648/−1.47	−3.011/−1.17	−3.746/−1.668
m3PW							
N	53	25	13	12	28	17	11
r	0.841	0.709	0.745	0.737	0.926	0.910	0.956
Slope	0.472	0.301	0.278	0.438	0.458	0.455	0.497
95% CI for slope	0.417/0.538	0.206/0.369	0.147/0.374	0.210/0.596	0.406/0.529	0.379/0.538	0.438/0.684
Y-Int	−2.483	−1.008	−0.817	−2.215	−2.270	−2.290	−2.562
95% CI for Y-Int	−3.112/−1.993	−1.630/−0.138	−1.703/0.386	−3.653/−0.154	−2.941/−1.78	−3.086/−1.52	−4.292/−2.057

TABLE 11
Continued

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
m3L							
N	54	25	13	12	29	17	12
r	0.848	0.826	0.901	0.839	0.913	0.924	0.947
Slope	0.536	0.362	0.334	0.527	0.516	0.530	0.555
95% CI for slope	0.476/0.615	0.287/0.415	0.250/0.399	0.358/0.739	0.447/0.613	0.450/0.628	0.382/0.754
Y-Int	−2.649	−1.151	−0.930	−2.605	−2.373	−2.751	−2.622
95% CI for Y-Int	−3.388/−2.099	−1.906/−0.457	−1.530/−0.145	−4.507/−1.06	−3.277/−1.70	−3.507/−1.76	−4.466/−0.985
m3AR							
N	53	25	13	12	28	17	11
r	0.842	0.816	0.879	0.847	0.923	0.918	0.954
Slope	1.003	0.636	0.590	0.922	0.955	0.976	1.027
95% CI for slope	0.884/1.152	0.470/0.767	0.365/0.746	0.562/1.312	0.825/1.125	0.821/1.164	0.810/1.381
Y-Int	−5.054	−1.891	−1.530	4.403	−4.418	−4.711	−4.905
95% CI for Y-Int	−6.442/−3.97	−3.089/−0.388	−2.966/0.528	−7.943/−1.17	−6.01/−3.16	−6.51/−3.18	−8.19/−2.80
M1AW							
N	58	29	15	14	29	16	13
r	0.795	0.762	0.722	0.868	0.922	0.938	0.934
Slope	0.368	0.260	0.236	0.351	0.329	0.364	0.343
95% CI for slope	0.320/0.421	0.194/0.295	0.143/0.314	0.238/0.390	0.276/0.378	0.303/0.422	0.225/0.414
Y-Int	−1.477	−0.559	−351	−1.350	−0.992	−1.350	−1.059
95% CI for Y-Int	−1.960/−1.011	−0.877/0.043	−1.098/0.495	−1.704/−0.344	−1.450/−0.479	−1.704/−0.344	−1.720/2.159
M1PW							
N	57	29	15	14	28	16	12
r	0.831	0.727	0.702	0.843	0.932	0.954	0.943
Slope	0.361	0.279	0.273	0.347	0.340	0.349	0.376
95% CI for slope	0.316/0.398	0.222/0.323	0.188/0.364	0.257/0.409	0.273/0.377	0.303/0.385	0.247/0.426
Y-Int	−1.435	−0.759	−0.740	−1.341	−1.161	−1.293	−1.424
95% CI for Y-Int	−1.794/−1.023	−1.158/−0.258	−1.610/0.035	−1.906/−0.535	−1.514/−0.521	−1.733/−0.839	−1.869/−0.225
M1L							
N	58	29	15	14	29	16	13
r	0.817	0.834	0.886	0.837	0.926	0.944	0.937
Slope	0.386	0.286	0.270	0.372	0.347	0.372	0.370
95% CI for slope	0.332/0.440	0.226/0.337	0.180/0.335	0.280/0.487	0.289/0.388	0.328/0.438	0.250/0.415
Y-Int	−1.562	−0.738	−0.622	−1.487	−1.098	−1.379	−1.244
95% CI for Y-Int	−2.079/−1.067	−1.189/−0.199	−1.209/0.204	−2.542/−0.674	−1.482/−0.548	−1.993/−0.945	−1.654/−0.142
M1AR							
N	58	29	15	14	29	16	13
r	0.826	0.835	0.858	0.887	0.927	0.954	0.910
Slope	0.731	0.514	0.477	0.682	0.676	0.723	0.703
95% CI for slope	0.635/0.823	0.397/0.580	0.285/0.583	0.504/0.772	0.565/0.755	0.633/0.832	0.462/0.808
Y-Int	−2.834	−1.020	−0.728	−2.485	−2.143	−2.650	−2.310
95% CI for Y-Int	−3.719/−1.954	−1.617/−027	−1.678/1.045	−3.316/−0.905	−2.897/−1.80	−3.691/−1.75	−3.245/−0.100
M2AW							
N	59	29	15	14	30	16	14
r	0.776	0.794	0.787	0.878	0.916	0.933	0.936
Slope	0.400	0.326	0.294	0.445	0.331	0.355	0.352
95% CI for slope	0.345/0.476	0.246/0.376	0.172/0.386	0.313/0.556	0.281/0.388	0.294/0.415	0.268/0.458
Y-Int	−1.614	−1.049	−0.780	−2.088	−0.854	−1.129	−0.989
95% CI for Y-Int	−2.327/−1.100	−1.503/−0.341	−1.648/0.327	−3.123/−0.922	−1.390/−0.373	−1.712/−0.524	−1.986/−0.198
M2PW							
N	58	29	15	14	29	16	13
r	0.790	0.820	0.863	0.870	0.914	0.917	0.935
Slope	0.388	0.307	0.276	0.431	0.330	0.349	0.356
95% CI for slope	0.330/0.454	0.243/0.362	0.166/0.338	0.328/0.580	0.286/0.382	0.293/0.408	0.297/0.458
Y-Int	−1.570	−0.936	−0.689	−2.026	−0.931	−1.156	−1.103
95% CI for Y-Int	−2.200/−1.047	−1.431/−0.360	−1.253/0.333	−3.376/−1.11	−1.413/−0.516	−1.718/−0.577	−2.059/−0.572

TABLE 11
Continued

	All Cerco-pithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
M2L							
N	59	29	15	14	30	16	14
r	0.780	0.824	0.928	0.760	0.918	0.949	0.942
Slope	0.449	0.328	0.288	0.459	0.380	0.407	0.407
95% CI for slope	0.384/0.531	0.263/0.384	0.216/0.356	0.324/0.648	0.318/0.432	0.377/0.479	0.293/0.486
Y-Int	−2.022	−1.052	−0.709	−2.199	−1.250	−1.577	−1.426
95% CI for Y-Int	−2.797/−1.427	−1.573/−0.459	−1.327/−0.050	−3.938/−1.01	−1.748/−0.665	−2.255/−1.27	−2.171/−0.366
M2AR							
N	59	29	15	14	30	16	14
r	0.757	0.846	0.904	0.851	0.841	0.840	0.893
Slope	0.752	0.620	0.554	0.856	0.644	0.625	0.740
95% CI for slope	0.642/0.906	0.485/0.710	0.354/0.699	0.589/1.136	0.509/0.752	0.472/0.780	0.556/0.935
Y-Int	−2.823	−1.825	−1.263	−3.884	−1.628	−1.569	−2.347
95% CI for Y-Int	−4.246/−1.814	−2.649/−0.605	−2.612/0.577	−6.492/−1.54	−2.606/−0.375	−2.994/−0.141	−4.183/−0.657
BIOR							
N	48	21	12	9	26	13	13
r	0.765	0.621	0.669	ns	0.800	ns	0.881
Slope	0.231	0.250	0.220		0.225		0.249
95% CI for slope	0.169/0.266	0.154/0.356	0.132/0.395		0.141/0.261		0.086/0.286
Y-Int	2.044	1.867	2.148		2.105		1.884
95% CI for Y-Int	1.720/2.638	0.881/2.774	0.492/2.989		1.783/2.913		1.572/3.377
GLBA							
N	41	18	9	9	23	12	11
r	0.762	0.684	0.732	ns	0.832	0.804	0.753
Slope	0.290	0.270	0.238		0.211	0.183	0.180
95% CI for slope	0.250/0.355	0.188/0.392	0.142/0.448		0.182/0.252	0.120/0.251	0.123/0.302
Y-Int	1.464	1.671	1.963		2.337	2.627	2.599
95% CI for Y-Int	0.924/1.924	0.560/2.422	0.072/5.536		1.924/2.630	1.934/3.261	1.453/3.118
GLIN							
N	47	22	12	10	25	13	12
r	0.760	0.851	0.881	0.776	0.862	0.899	0.764
Slope	0.282	0.258	0.252	0.341	0.179	0.138	0.217
95% CI for slope	0.240/0.328	0.203/0.303	0.174/0.305	0.188/0.456	0.154/0.213	0.114/0.194	0.160/0.398
Y-Int	1.859	2.021	2.066	1.279	2.891	3.291	2.530
95% CI for Y-Int	1.421/2.259	1.611/2.530	1.559/2.780	0.247/2.658	2.564/3.142	2.722/3.540	0.819/3.046
NABA							
N	44	18	9	9	26	13	13
r	0.758	0.647	0.705	ns	0.821	0.758	0.760
Slope	0.267	0.269	0.230		0.201	0.163	0.160
95% CI for slope	0.227/0.310	0.194/0.395	0.127/0.418		0.177/0.236	0.097/0.225	0.112/0.248
Y-Int	1.734	1.671	2.022		2.395	2.787	2.749
95% CI for Y-Int	1.320/2.122	0.535/2.353	0.322/6.149		2.055/2.637	2.142/3.432	1.912/3.181
NAIN							
N	41	18	9	9	23	12	11
r	0.773	0.732	0.804	0.697	0.879	0.907	0.774
Slope	0.269	0.211	0.187	0.300	0.184	0.157	0.207
95% CI for slope	0.230/0.312	0.155/0.267	0.149/0.364	0.165/0.497	0.167/0.215	0.121/0.212	0.143/0.374
Y-Int	1.989	2.466	2.675	1.669	2.841	3.110	2.620
95% CI for Y-Int	1.571/2.363	1.971/2.984	0.161/2.998	−0.077/5.805	2.540/3.067	2.554/3.465	1.051/3.191
ORBH							
N	47	21	11	10	26	13	13
r	0.628	0.528	0.55	ns	0.635	ns	0.705
Slope	0.182	0.176	0.183		0.187		0.205
95% CI for slope	0.149/0.197	0.118/0.242	0.101/0.318		0.130/0.250		0.130/0.276
Y-Int	1.431	1.490	1.413		1.379		1.239
95% CI for Y-Int	1.297/1.743	0.890/1.994	0.158/4.942		0.751/1.931		0.578/6.706

TABLE 11
Continued

	All Cercopithecidae	Colobinae			Cercopithecinae		
		All	Male	Female	All	Male	Female
ORBW							
N	40	18	9	9	22	12	10
r	0.687	0.571	0.733	ns	0.653	0.598	ns
Slope	0.252	0.190	0.168		0.216	0.198	
95% CI for slope	0.214/0.299	0.129/0.289	0.086/0.337		0.170/0.280	0.115/0.279	
Y-Int	0.879	1.418	1.598		1.246	1.423	
95% CI for Y-Int	0.434/1.234	0.516/1.953	0.095/2.340		0.618/1.693	0.572/4.868	
ORBAR							
N	40	18	9	9	22	12	10
r	0.637	0.475	ns	ns	0.591	ns	ns
Slope	0.401	0.322			0.385		
95% CI for slope	0.329/0.468	0.165/0.479			0.301/0.505		
Y-Int	2.606	3.306			2.785		
95% CI for Y-Int	2.0/3.28	1.887/4.691			1.584/3.597		
PORB							
N	48	22	12	10	26	13	13
r	0.700	0.598	0.681	0.602	0.744	0.544	0.788
Slope	0.233	0.260	0.247	0.395	0.210	0.220	0.229
95% CI for slope	0.200/0.294	0.192/0.344	0.161/0.405	0.155/0.638	0.183/0.277	0.132/0.375	0.166/0.453
Y-Int	1.683	1.399	1.489	0.210	1.931	1.805	1.776
95% CI for Y-Int	1.098/1.998	0.631/2.019	−0.009/2.284	−1.975/2.370	1.271/2.196	0.225/2.720	−0.349/2.284

We report R^2 (coefficient of determination = percent variation explained) in the estmation equations (table 7) but report r (Pearson correlation coefficient) here. The 95% confidence intervals (95% CI) for slope and y-intercept (Y-Int) are based on a bootstrap routine. AP, anteroposterior midshaft diameter; TR, transverse midshaft diameter; ns, regression not significant. Abbreviations for cranial and dental measurements are explained in the text.

on estimation accuracy. Similarly, the elevations of scaling equations are important to compare, as transpositions are not only of functional importance, but can help in assessing the performance of body mass estimator variables. Our test for significant transpositions is performed at the weighted mean of the sample, which excludes the problem of testing for elevation differences in data-sparse regions such as at the y-intercept. Ninety-five percent confidence intervals of both the slope and y-intercept are based on an unpublished routine using 3,000 bootstrapped estimates, and are accomplished with a program written and provided by Dr. T. M. Cole.

Postcranial Scaling

Correlations between mass and postcranial dimensions range between 0.77 and 0.99 (table 11). No significant slope differences exist between subfamilies (sexes combined). However, elevations of the subfamily data scatters of humeral diameters and femoral length differ (fig. 1, esp. B and C).

Slope and elevation estimates do not differ between sexes within subfamilies (table 12). Differences in elevation are evident, and significant, in same-sex contrasts between subfamilies for humeral diameters (but not length) and femur length (but not diameters).

Femoral length and diameters are isometric with mass in all subsets, except for the negative allometry of male colobine femur length. Humeral length is isometric with mass, as is cercopithecine humeral transverse diameter. Colobine humeral transverse diameter and all humeral anteroposterior diameters are positively allometric. Length-diameter scaling of both long bones is negatively allometric. Geometric similarity predicts a slope of 1.0, but in these data the exponents range from 0.78 to 0.87 (table 13).

Overall, geometric similarity characterizes humeral and femoral dimensions relative to body mass (0.33 cannot be excluded as a slope estimate). Positively allometric shape changes are found in colobine femur length and humeral transverse diameter as well as cercopithecid humeral anteroposterior diam-

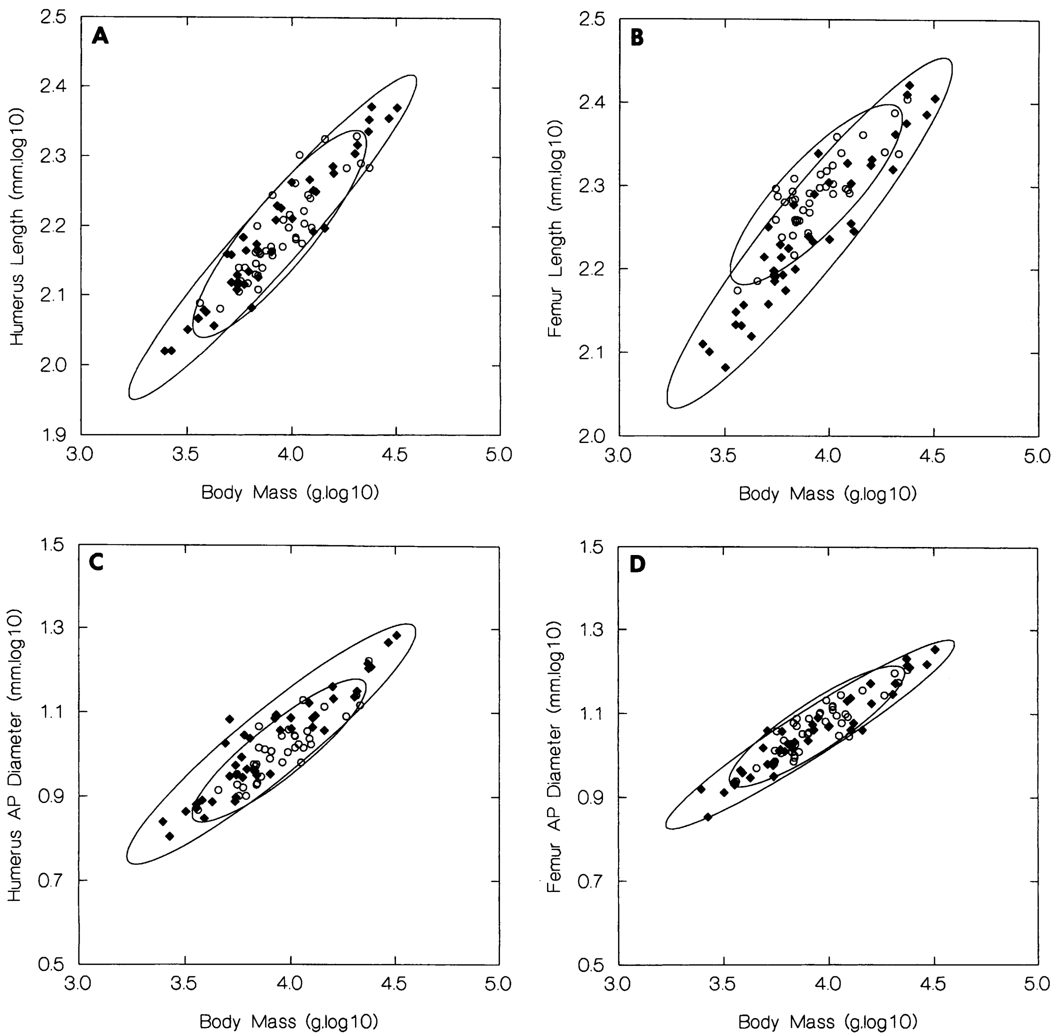

Fig. 1. Scaling of postcranial dimensions with body mass in extant Cercopithecidae. Open circles are colobines, solid diamonds are cercopithecines. 95% confidence ellipses are superimposed on each subfamily scatter. Sexes are combined in the plot, but not in the scaling analysis. See tables 11–13 for scaling equations and contrasts. Log_{10} (taxon-mean mass by sex, in g) plotted against log_{10} (taxon-mean value of variable, in mm): **(A)** humerus length (HL); **(B)** femur length (FL); **(C)** humerus anteroposterior diameter (HAP); **(D)** femur anteroposterior diameter (FAP).

eter, while negative allometry characterizes length-diameter scaling in both the humerus and femur. The combination of these relationships is exemplified in the short, thick humeri and femora of the largest (extant) cercopithecids.

Colobines have longer hindlimbs than cercopithecines at a common mass. This has been reported previously (e.g., Jungers, 1985) and has been linked to the different locomotor repertoires of the two subfamilies: colobines engage in more frequent leaping behaviors than do cercopithecines. The increase in length of the femur results in an absolutely longer time for acceleration of the mass of the body at takeoff and, as importantly, an increase in the time available to decelerate at landing.

This subfamily difference in femoral length is considerably less pronounced in

TABLE 12
Analysis of Covariance (ANCOVA) Results of Tests for Slope and Elevation Differences Based on Reduced Major Axis Regression: Colobinae vs. Cercopithecinae

	Sexes combined		Males		Females	
	Slope	Elevation	Slope	Elevation	Slope	Elevation
Humerus length	ns	ns	ns	ns	ns	ns
Humerus AP	ns	ns	ns	ns	ns	0.004
Humerus TR	ns	0.00002	ns	ns	ns	0.004
Femur length	ns	0.00001	ns	0.003	ns	0.003
Femur AP	ns	ns	ns	ns	ns	ns
Femur TR	ns	ns	ns	ns	ns	ns
M1AW	ns	0.00001	ns	0.00006	ns	0.00013
M1PW	ns	0.00001	ns	0.00009	ns	0.00118
M1L	ns	0.00001	ns	0.00001	ns	0.00000
M1Area	ns	0.00001	ns	0.00006	ns	0.00013
M2AW	ns	0.00001	ns	0.00001	ns	0.00000
M2PW	ns	0.00001	ns	0.00001	ns	0.00000
M2L	ns	0.00001	0.013	—	0.018	—
M2Area	ns	0.00001	ns	0.0015	ns	0.00000
m1AW	0.013	—	0.014	—	0.023	—
m1PW	0.006	—	0.008	—	0.014	—
m1L	ns	0.00001	0.010	—	ns	0.00003
m1Area	0.006	—	0.003	—	ns	0.00000
m2AW	ns	0.00001	ns	0.00001	ns	0.00000
m2PW	ns	0.00001	ns	0.00006	ns	0.00000
m2L	ns	0.00001	ns	0.00000	ns	0.00000
m2Area	ns	0.00001	ns	0.0045	ns	0.00000
m3AW	ns	0.00001	ns	0.00002	ns	0.00000
m3PW	ns	0.00311		0.0014	ns	0.0074
m3L	ns	0.00001	0.008	—	ns	0.00000
m3Area	0.006	—	0.004	—	ns	0.00000
BIOR	ns	ns	ns	ns	ns	ns
GLBA	ns	0.00006	ns	0.0034	ns	ns
GLIN	ns	0.00001	0.005	—	ns	0.00191
NABA	ns	0.00020	ns	0.0005	ns	ns
NAIN	ns	0.00001	ns	ns	ns	ns
ORBH	ns	ns	ns	ns	ns	ns
ORBW	ns	ns	ns	ns	ns	ns
ORBArea	ns	ns	ns	ns	ns	ns
PORB	ns	ns	ns	ns	ns	ns

AP, anteroposterior midshaft diameter; TR, transverse midshaft diameter. Abbreviations for cranial and dental measurements are explained in the text.

All probabilities <0.05 are given; those >0.05 are listed as ns (not significant). See table 11 for equations and figs. 1–3 for graphical depictions of the data.

taxa of large body mass (fig. 1A). Indeed, negative allometry of femoral length on mass characterizes male colobines (table 11). This pattern indicates that the largest of the (male) colobines are structurally similar to the cercopithecines. Because many of the colobine fossils are in the size range of the largest extant taxa, it is important to note this allometry and to expect that the femoral proportions of these taxa will converge on those of cercopithecines (assuming that scaling patterns are the same in extinct and extant taxa).

TABLE 13
Length-Diameter Scaling in Cercopithecidae

	Length* Mass	Diameter* Mass	Diameter	Length* Diameter
Humerus	0.34	0.42	ap	0.79
		0.35	tr	0.87
Femur	0.31	0.34	ap	0.80
		0.35	tr	0.78

An assumption that this structural similarity implies behavioral similarity is intriguing and may add to indications derived from joint morphology that some of the large fossil colobines were terrestrial.

Cercopithecines have relatively robust humeral shafts, especially in the transverse dimension. Diameter measurements were taken at the inferiormost extent of the deltoid tuberosity in an attempt to monitor shape features of the shaft at a point where development of muscle attachments is minimal. Inasmuch as this goal was attained, it seems reasonable to hypothesize functional differences in the forelimb based on the shape differences uncovered here.

Assuming that the external dimensions are tracking mechanically sensitive aspects of diaphyseal structure, it is possible that cercopithecines load their forelimbs in substantially different ways than do colobines. The more circular cross section of the colobine humerus is equally resistant to bending loads in all planes, whereas that of cercopithecines appears to have enhanced rigidity and strength in accommodating loads restricted to the mediolateral plane. It is likely that the three-dimensional arboreal environment of colobines is associated with forelimb loading in a variety of planes. Conversely, the more terrestrial cercopithecines are well suited to resist mediolateral loading of the proximal forelimb. This may be associated with loading differences related to weight-bearing terrestrial locomotion, and perhaps with differences in manual dexterity between the subfamilies. Stabilization of the elbow during reaching and grabbing of small (food) objects may reasonably result in mediolateral loading of the humerus (as a result of the actions of, for example, brachioradialis).

It would be necessary to examine the distribution of cortical bone within a cross section of the diaphysis to further evaluate the differences in external shape. Jungers et al. (1998) have examined the cross-sectional morphology of cercopithecid limb long bones. Their findings are similar to ours. They attribute differences in limb structure between subfamilies to substrate compliance variation in an arboreal (colobine) or terrestrial (cercopithecine) milieu. At present, it is difficult to test if substrate compliance, forelimb manipulation, or some yet unidentified aspect of the biological role of the cercopithecid forelimb is responsible for the scaling patterns uncovered here.

Cercopithecid length-diameter relationships are similar to those demonstrated in a broad interspecific mammalian sample (Biewener, 1982), but the negative allometry in the current sample is more marked. Negative allometry of humeral and femoral length to diameter in anthropoids has been contrasted with the positive allometry found in "prosimians" (Terranova, 1995).

Dental Scaling

Correlations between dental measures and body mass range from 0.63 to 0.96. This range is slightly greater than that for the postcranial measures.

As in the postcranium, the majority of scaling differences in dental measures are found between subfamilies (sexes combined, table 12). These differences are primarily in elevation: In general, colobines are transposed below cercopithecines (fig. 2).

As opposed to the pattern seen in the postcranium, sexual dimorphism underlies many of the higher-level scaling differences. Differences between sexes within and between subfamilies are abundant. The vast majority of these differences obtain as a result of the pattern of male colobine dental scaling. Although not always different from female colobines (in widths, but not lengths), male colobine lower molar scaling differs from cercopithecines in either slope, elevation, or both (fig. 2A). This pattern is less clear in the upper teeth.

As with the postcrania, most molar measures scale isometrically with mass. Correlations are generally high and similar to

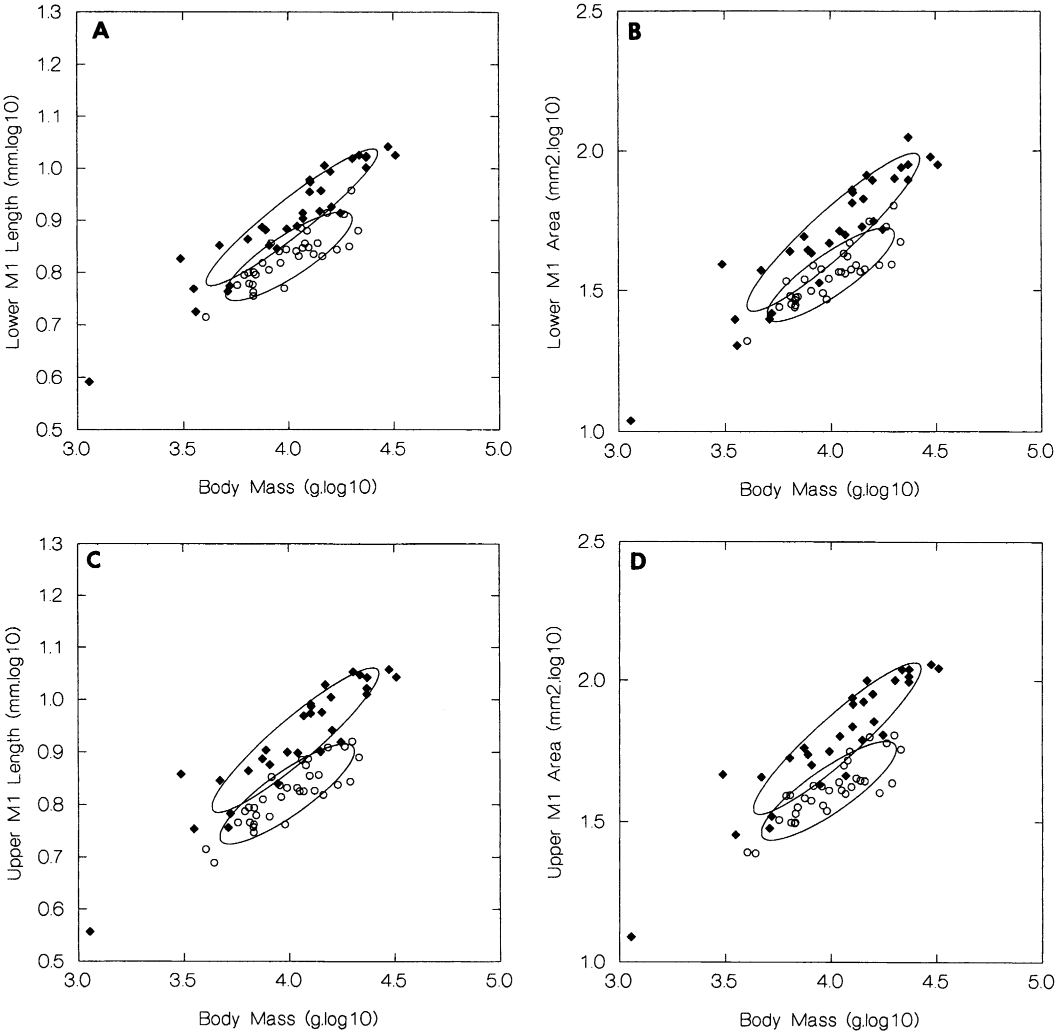

Fig. 2. Scaling of dental dimensions with body mass in extant Cercopithecidae. Conventions as in figure 1. (A) m1 length (m1L); (B) m1 area (m1AR); (C) M1 length (M1L); (D) M1 area (M1AR).

those found between postcranial dimensions and mass. Cercopithecine mandibular second and third molar length and third molar widths and area are positively allometric. Most mandibular and maxillary first molar dimensions are negatively allometric in male colobines. On the other hand, mandibular third molar length, width, and area are positively allometric with mass in all cercopithecids and in all lower categories. It is likely that the reduction of m3 hypoconulids in *Miopithecus* and *Presbytis* is relevant to this pattern.

The major differences in scaling between the two subfamilies are transpositions. Colobines tend to have smaller molar teeth at every position than do comparably sized cercopithecines. On the one hand, this might be expected, given the relatively large digestive tract (and thus "extra" mass) in colobines (see further discussion below, p. 86). But on the other hand, we might be surprised at a pattern of smaller teeth in folivores, given the quantity of low-quality foodstuffs those teeth have to process. This problem deserves further study, as does the idiosyncratic scaling of male colobines at most positions compared to all other groups.

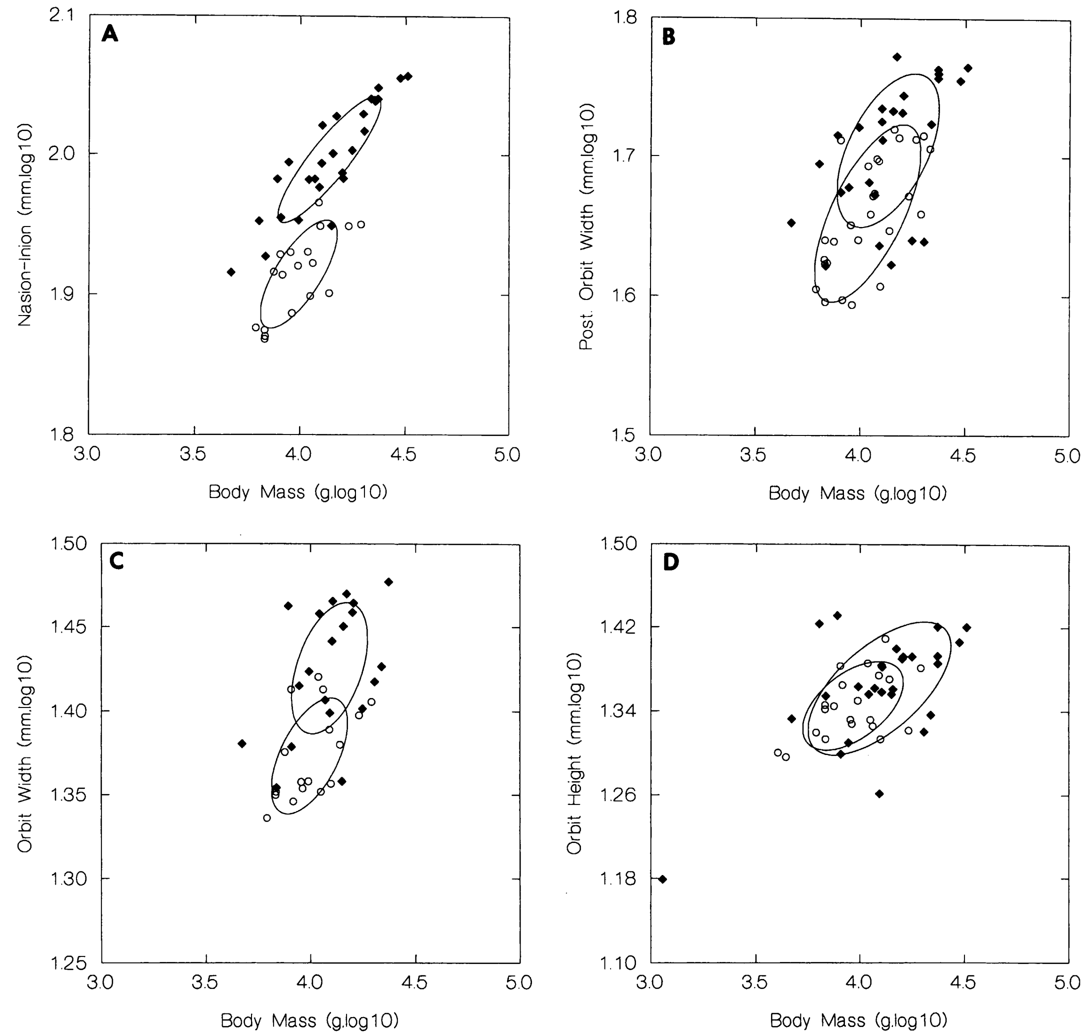

Fig. 3. Scaling of cranial dimensions with body mass in extant Cercopithecidae. Conventions as in figure 1. (A) nasion-inion length (NAIN); (B) minimum postorbital constriction diameter (PORB); (C) orbit width (ORBW); (D) orbit height (ORBH).

Cranial Scaling

Correlations between length measures of the skull (NAIN, GLIN, NABA, GLBA) and body mass range between 0.51 and 0.91 (table 11). In general, the association between mass and cranial dimensions is poorly estimated with linear regression. Indeed, the data for female colobine GLBA and NABA are not correlated significantly ($p < 0.05$); thus, no scaling equations were calculated. For all other subsets of the data, and for all groups combined, differences in y-intercept are apparent (fig. 3) and significant ($p < 0.0002$).

Correlations between measurements of upper face width and orbital shape (PORB, BIOR, ORBW, ORBH, ORBAR) with mass range between 0.33 and 0.89. Correlations are significant in all groups only for PORB; for all other variables at least two and up to four correlations within sex-by-subfamily samples are not significant, and no scaling equations were calculated. No differences in scaling are apparent among groups in PORB.

Facial and orbital measures exhibit negative allometry with mass (figs. 3 C–D). However, correlations are quite low, and linear equations explain little of the total variation in the data (table 11). No scaling differences were found between groups, but this result should be seen as provisional. More data are needed to fully demonstrate scaling patterns.

Neurocranial lengths have higher correlations with mass than do the facial and orbital measures. Cercopithecine lengths tend to be negatively allometric with mass, whereas colobine lengths are isometric. At a common body mass, cercopithecines have longer neurocrania than colobines. Reminiscent of the femoral-length scaling, at large sizes the two subfamilies appear to converge: Differences in cranial dimensions (lengths) are less distinct in larger taxa. Functional implications of the scaling patterns reported here are difficult to derive, as the rostral portion of the skull has not been included in our dataset. Much previous work (e.g., Ravosa, 1990, 1991) has focused on differences in the splanchnocranium, as well as how the splanchno- and neuro-cranium are hafted onto one another. We are unable to evaluate any of these patterns with the present data.

Implications for Estimating Body Mass

In addition to deriving mass estimates for fossil taxa, estimation models are needed for a variety of comparative studies. Most osteology collections of primates (and other mammals) do not record the mass of the specimens. Therefore, skeletal or dental surrogates of size must be constructed. Since there are no associated masses, it is impossible to examine the performance (in terms of accuracy) of any given measure. Several suggestions have been made to help address the problem. For example, it has been suggested that size surrogates should be not only highly correlated, but also isometric with mass (e.g., Smith, 1985).

In the present sample the majority of skeletal and dental measures are indeed isometric with mass; however, a great deal of estimation performance variation (as judged by MPE) is evident. In the known-mass sample, where estimation accuracy can be established, there is a consistent pattern of subfamilies being characterized by isometric slopes, but significantly different y-intercepts. These transpositions indicate that at a common body mass, one group has relatively "more" of the skeletal feature (e.g., femur length).

When comparing the performance of two estimation models where the slope estimates are similar (and independent of the exact value of the point estimate), differences in the y-intercept will result in a consistent pattern of estimation errors for taxa that are improperly assigned, or when the groups are lumped. For example, using a cercopithecine model to estimate the mass of a colobine based on femur length or transverse humeral midshaft diameter will result in an underestimate of the actual mass.

Correlation coefficients are also somewhat variable with respect to accuracy. Although all measures that result in MPEs below 15% are generally characterized by correlations above 0.90, it is not necessarily the case that the highest correlation is always associated with the lowest MPE. Certainly, the correlation between mass and any potential estimator must be sufficiently high to attain statistical significance, but it is not straightforward to suggest that a correlation of 0.98 indicates a better estimator than one of 0.90.

It is not sufficiently convincing to select a size surrogate based on only the slope value, the correlation coefficient, or any single parameter of the linear regression. This is especially the case when scaling variation exists in the measurement of interest and the phylogenetic (or functional) affiliation of the taxon to be estimated is equivocal. The variation in scaling patterns in part underlies the finding that lower taxonomic prediction models tend to return estimates with low Mean Prediction Errors (see also Conroy, 1987; Dagosto and Terranova, 1992).

In this paper we employ a method of estimation model selection that is based primarily on MPE of taxa that are not included in the development of the model. This is a rigorous test of accuracy but is not possible in samples where associated masses are unknown and sample size is small. Although models selected on this basis tend to be those that are characterized by high correlations, isometric slopes and low standard errors of the estimate, it is unclear how any single parameter describing the regression can be used to select a good estimator variable. It will be important to continue to document the accuracy and variation of selected dental and skeletal mass surrogates based on examinations of known mass samples.

The most specific suggestion that will apply to any study employing estimated mass is that the required precision of the analysis needs to be explicitly considered. A determination of taxon mass within 30% requires a far less precise model than does an evaluation of encephalization quotients or a reconstruction of dietary ecology based on notions of size-related phenomena. Moreover, it should be expected that the level of error in the estimates would be at least as high as that in the dataset used to construct the estimation model. *Caveat emptor*!

ESTIMATED MASS IN FOSSIL CERCOPITHECID TAXA

The ultimate goal of this exercise has been to produce a set of mass estimates for a large variety of extinct Old World monkey taxa. The full range of values obtained is presented in tables 14–17. Each estimate is accompanied by the 20% range, which we believe should include the actual average mass of the taxon-sex sample in most if not all cases. In many cases, there are differences between estimates from the several body regions and/or reasons (explained in the text) why the final or "consensus" estimate would differ from those in the table. These consensus estimates are not presented in the tables in order to emphasize that they are best understood in light of the relevant text discussion. The relationship between estimated mass and selected variables is illustrated in figures 4, 6, 10, and 13 (and also 19, in the discussion). The taxon-mean estimated (consensus) masses are plotted against taxon-mean measurements in a $\log_{10}$-$\log_{10}$ format, which simplifies conversion to unlogged values.

It is neither possible nor necessary to discuss each of these estimates extensively, but in the following sections we will consider a selection of them in greater detail. We concentrate on: (a) taxa with estimates from all three body regions or from two with differing values; (b) taxa whose mass has previously been estimated very differently from our results; and (c) taxa at the extreme ends of the body mass range. The data on which these estimates are based are presented in appendix tables 3–6.

In this discussion, references will not be provided for all taxa, in order to avoid duplication. Szalay and Delson (1979) surveyed all fossil cercopithecids known at that time, and Delson (1994) recently reviewed all fossil colobines. Specific citations will only be provided for populations not discussed in those publications, or if additional data or mass estimates were provided. As noted earlier, Fleagle (1988, 1998) tabulated body mass estimates for a number of extinct species, but these were not separated by sex, so it is not clear if he was estimating an average of male and female mass for those species in which both sexes are known. Moreover, no indication was provided of the precise methods whereby the estimates were derived. In several cases, we will refer to these estimates in the discussion that follows. Similarly, we have applied the equations derived from the "classical" model (following Konisgberg et al., 1998, as above) to selected fossil postcrania, and we report the range of estimates.

COLOBINAE

AFRICA

The smallest known fossil colobine is Late Miocene *Microcolobus* from Ngeringerowa, dated to about 9 Ma (million years ago) by Hill (1995). If, as ED suggests, the unique mandible was possibly from a male individual, its estimated mass would be 5 kg, slightly larger than the 4.4 kg mean for *Procolobus verus,* but smaller than all other living colobines (see fig. 4). This estimate would fit with the general size of the mandible, somewhat larger than that of *P. verus*. On the other hand, Benefit and Pickford (1986) argued that this fossil was probably female. In that case, a mass of 8 kg would place it in the range of living African *Procolobus badius* and various *Colobus* species. Fleagle (1988) suggested a mass of 4 kg without reference to sex.

A partial colobine skeleton from Leadu, near Hadar, is the best-preserved individual

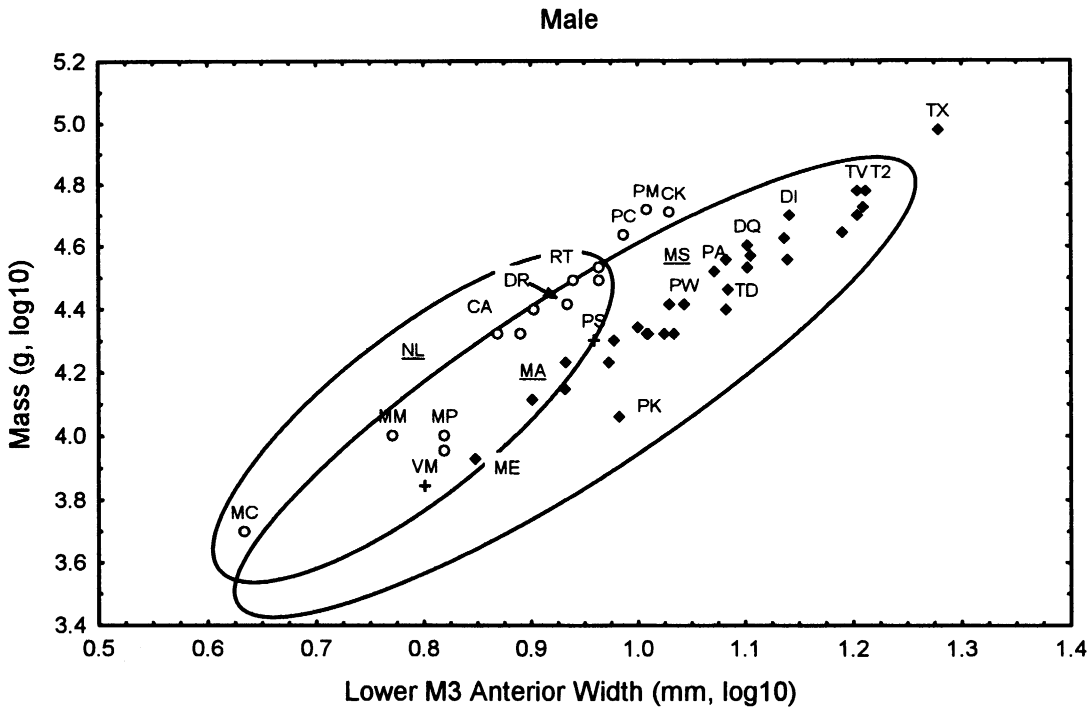

Fig. 4. Estimated mass in extinct cercopithecids compared to m3 anterior width, males only. Circles are colobines, triangles are cercopithecines. 95% confidence ellipses for extant members of each subfamily are provided to indicate the modern range; the colobine ellipse is the smaller. Underlined symbols indicate position of selected extant taxa. Taxon-mean value of estimated (consensus) mass ($\log_{10}$, in g) plotted against taxon-mean value ($\log_{10}$, in mm) of m3AW. Taxon identifications as follows: CA, Colobinae sp. indet. "species A", Hadar and Leadu; CK, *Cercopithecoides kimeui*; DI, *Papio (Dinopithecus) ingens*; DQ, *Papio (Dinopithecus) quadratirostris,* Omo; DR, *Dolichopithecus ruscinensis*; MA, *Macaca sylvanus*; MC, *Microcolobus tugenensis*; ME, ?*Macaca* sp. indet., Menacer; MM, *Mesopithecus monspessulanus*; MP, *Mesopithecus pentelicus*; ms, *Mandrillus sphinx*; NL, *Nasalis larvatus*; PA, *Paradolichopithecus arvernensis*; PC, *Paracolobus chemeroni*; PK, *Parapapio* sp. indet., Kanapoi; PM, *Paracolobus mutiwa*; PW, *Parapapio whitei*; RT, *Rhinocolobus turkanaensis*, Turkana and Hadar; T1, *Theropithecus oswaldi* cf. *oswaldi,* Olduvai Bed I; T2, *Theropithecus oswaldi* cf. *leakeyi,* Olduvai Upper Bed II; TD, *Theropithecus darti,* Hadar; TV, *Theropithecus oswaldi leakeyi* Olduvai Masek (lower Ndutu?) and Kapthurin; TX, *Theropithecus oswaldi leakeyi, Olorgesailie maximum*; VM, *Victoriapithecus macinnesi* (Benefit mean).

of the as-yet unnamed taxon informally known as species A. A mandible and some other fragments from the main Hadar sequence have been referred to this taxon, and teeth of comparable size are known from the Turkana Basin and Laetoli, resulting in an estimated time range from 3.6–2 Ma. The 21 kg dental estimate from Leadu and Hadar fits with a size somewhat larger than living African colobines and, in fact, is larger than any extant Asian form as well. Unfortunately, no postcranial element is complete enough to provide a mass estimate using our variables. Colobine dentitions from Aramis (4.4 Ma) currently being analyzed by ED and S. Frost appear comparable to species A, but slightly smaller than the younger samples, which agrees with the size estimate obtained here (see table 14).

Late Miocene *Libypithecus* is comparable in size and cranial conformation to living *Procolobus.* Both the upper dentition and the cranium (based on family equations given the poor performance of colobine by-sex or mixed-sex cranial equations) yield estimates averaging 12 kg, close to the mass of male

TABLE 14
Fossil Colobine Mass Estimates

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Africa						
Microcolobus tugenensis Ngeringerowa						
?Male						
Mean	8.0[a]		5.0			
Min	8.0[a]	6.5[a]	4.5	4.5		
Max	8.5[a]	9.5[a]	5.5	6.5		
Colobine sp. "A" Hadar/Leadu						
Male						
Mean			21.0			
Min			18.0	17.0		
Max			28.0	25.0		
Colobinae cf. sp. "A" Aramis						
Male						
Mean			18.0			
Min			15.0	14.0		
Max			20.0	22.0		
Female						
Mean			9.0			
Min			7.0	7.5		
Max			12.0	10.5		
Colobus? flandrini Menacer						
Sex unknown						
Mean			21.0[S]			
Min			18.0	17.0		
Max			26.0♂	25.0♂		
Libypithecus markgrafi Wadi Natrun						
Male						
Mean			12.0		12.0[F]	
Min			10.0	10.0	10.5[F]	10.0[F]
Max			15.0	14.0	15.0[F]	14.0[F]
Mean*					10.0[S]	
Rhinocolobus turkanaensis Turkana & Hadar						
Male						
Mean			31.0		20.0[F]	
Min			23.0	25.0	17.0[F]	16.0[F]
Max			39.0	37.0	23.0[F]	24.0[F]
Mean*					13.0[S]	
Female						
Mean			17.0		23.0[F]	
Min			15.0	14.0	19.0[F]	18.0[F]
Max			22.0	20.0	27.0[F]	28.0[F]
Mean*					13.0[S]	
Paracolobus chemeroni Chemeron JM90						
Male						
Mean	39.0		46.0		19.0	
Min	27.0	31.0	32.0	37.0		15.0
Max	56.0	47.0	55.0	55.0		23.0

TABLE 14
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Paracolobus mutiwa Turkana						
?Male						
Mean			54.0			
?Male[b]						
Mean			51.0			
Min			29.0	41.0		
Max			66.0	61.0		
?Female						
Mean			27.0			
Min			24.0	22.0		
Max			29.0	32.0		
Paracolobus? sp. Laetoli						
?Male[b]						
Mean			34.0			
Min			28.0	27.0		
Max			41.0	41.0		
?Female[c]						
Mean			17.0			
Min			15.0	14.0		
Max			19.0	20.0		
Cercopithecoides williamsi Makapan/Sterkfontein/Bolt's Farm						
Male						
Mean			23.0		18.0[F]	
Min			20.0	18.0	17.0[F]	14.0[F]
Max			27.0	28.0	21.0[F]	22.0[F]
Mean*					17.0[S]	
Female						
Mean			16.0		14.0[F]	
Min			15.0	13.0	14.0[F]	11.0[F]
Max			18.0	19.0	14.0[F]	17.0[F]
Mean*					13.0[S]	
Cercopithecoides williamsi Leba						
?Female						
Mean			16.0			
Min			15.0	13.0		
Max			16.0	19.0		
Cercopithecoides williamsi Swartkrans, Mbr unknown						
Male						
Mean			23.0			
Min			20.0	18.0		
Max			25.0	28.0		
Cercopithecoides cf. *williamsi* Kromdraai						
Female						
Mean			23.0		14.0[S]	
Min			20.0	18.0		11.0
Max			27.0	28.0		17.0

TABLE 14
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Cercopithecoides? cf. *williamsi* Koobi Fora						
?Male						
Mean	27.0[S]		25.0			
Min	20.0[S]	22.0[S]	22.0	20.0		
Max	34.0[S]	32.0[S]	33.0	30.0		
Mean*	21.0♂					
Cercopithecoides kimeui Koobi Fora						
Male						
Mean			51.0			
Min			35.0	41.0		
Max			62.0	61.0		
Female						
Mean			25.0		20.0[F]	
Min			23.0	20.0	19.0[F]	16.0[F]
Max			27.0	30.0	23.0[F]	24.0[F]
Cercopithecoides kimeui Olduvai						
Sex unknown						
Mean			40.0[S]		21.0	
Min			26.0♀	32.0♀	15.0[S]	18.0[S]
Max			47.0♂	48.0♂	27.0[F]	24.0[F]
Asia						
Pygathrix (*Rhinopithecus*) *roxellana*? Honan						
?Female						
Mean			16.0		12.0[S]	
Min			15.0	13.0		10.0
Max			18.0	19.0		14.0
Pygathrix (*Rhinopithecus*) *lantianensis* Gongwangling						
Male						
Mean			31.0			
Min			30.0	25.0		
Max			33.0	37.0		
?*Semnopithecus sivalensis* Hasnot/Domeli						
Sex unknown						
Mean			8.0[S]			
Min			7.5♀	6.5♀		
Max			9.0♂	9.5♂		
?*Semnopithecus* sp. Yushe Mahui						
Sex unknown						
Mean			22.0[S]			
Min			18.0♀	18.0♀		
Max			28.0♂	26.0♂		
Europe (and Asia)						
Mesopithecus pentelicus Pikermi						
Male						
Mean	11.0		14.0		13.0[S]	
Min	8.5	8.5	13.0	11.0		10.0
Max	14.0	13.5	15.0	17.0		16.0

TABLE 14
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Mesopithecus pentelicus Pikermi (*continued*)						
Female						
Mean	8.0		10.5		7.5[F]	
Min	7.0	6.5	9.5	8.5	7.0[F]	6.5[F]
Max	9.5	9.5	11.0	12.5	8.0[F]	9.5[F]
Mesopithecus pentelicus Macedonia						
Male						
Mean			13.0			
Min			9.5	10.0		
Max			15.0	16.0		
Female						
Mean			10.5			
Min			10.0	8.5		
Max			11.5	12.5		
Mesopithecus monspessulanus Various						
Male						
Mean			10.5			
Min			10.0	8.5		
Max			11.5	12.5		
Female						
Mean			7.5			
Min			7.5	6.5		
Max			7.5	9.5		
Dolichopithecus ruscinensis Perpignan						
Male						
Mean	22.0		28.0			
Min	14.0	18.0	27.0	22.0		
Max	26.0	26.0	30.0	34.0		
Female						
Mean	14.0		17.0		13.0[S]	
Min	10.5	11.0	15.0	14.0		10.0
Max	20.0	17.0	18.0	20.0		16.0
Dolichopithecus? eohanuman Shamar						
Female						
Mean			21.0			
Min			18.0	17.0		
Max			23.0	25.0		

For each population, mass estimates expressed in kg, rounded to the nearest kg (or half-kg for values under 12 kg), are provided for one to three body regions, as possible. A question mark preceding sex denotes uncertainty about the sex of the specimen(s) evaluated. For Estimated mass, Mean = mean of several estimates; Min = lowest estimate; Max = highest estimate. For Est. mass ± 20%, Min = 80% of Mean; Max = 120% of Mean. For some taxa, means (designated Mean*) from an additional equation are reported.

All values are estimated from sex-specific subfamily equations unless noted by superscript characters as follows: S = combined-sex subfamily equations; F = combined-sex family equations; ♂ (or ♀) = male (or female) equation(s) for relevant subfamily; av, average of minimum and maximum values given, whatever their source.

[a] If female.

[b] Probable male specimens plus largest isolated teeth (see text).

[c] Probable female specimens plus smallest isolated teeth.

P. badius oustaleti. Fleagle (1988) suggested a lower value of 8.4 kg.

Three large colobine genera are known from the Pliocene of eastern Africa. *Rhinocolobus* was probably the most arboreally adapted, but the only humeri are too fragmentary to provide mass estimates with our variable set. Male dentitions (including large but unsexed teeth) yield a mass estimate of ca. 31 kg, while a reasonably well-preserved cranium yields only 20 kg (even less, based on the subfamily equation, for PORB). Female dentitions suggest 17 kg, which results in a reasonable degree of dimorphism. The only female skull is laterally crushed, which probably led to an overestimate of some dimensions, in turn yielding a mass prediction of 23 kg, larger than both the male skull and the female teeth. The dental estimates are preferred. Fleagle (1988) estimated 21 kg, presumably the average of both sexes.

Paracolobus is known from three species, of which the oldest is smallest and the youngest largest. The best known is *P. chemeroni,* dating to ca. 3.2 Ma and represented by a partial male skeleton lacking the neurocranium (see cover and fig. 5). There is excellent agreement between the dental and postcranial mass estimates for this individual, resulting in a consensus estimate of 43 kg. As opposed to the apparently smallish teeth of some modern large colobines, this species is surely not microdont: The teeth yield a slightly greater mass estimate than do the long bones. One could argue that the postcranial value should be accepted in preference to the dental (resulting in an assessment of macrodonty), but it seems more reasonable to assume both regions are equally accurate, given the closeness of the predictions. The only high-ranking cranial variable that can be measured is PORB, which yields a mass estimate from the colobine mixed-sex equation of 19 kg, clearly far too low. Perhaps the poor performance of PORB in large colobines is due to allometric relationships among mass and the relative size of brain and temporal musculature. BIOR yields a family-equation prediction of 45 kg, but that equation had an extremely high MPE on the test sample (table 6). Fleagle's (1988) estimate was 35 kg.

Looking more closely at the OLS postcranial estimates (see fig. 6), femoral length predicts a mass of only 27 kg, while femoral transverse diameter predicts 56 kg (femoral anteroposterior diameter yields 39 kg and humeral length 34 kg, both low but reasonable as within the 20% range of 34 to 52 kg). In all taxon-sex groups, FTR predicts the highest mass, between 50 and 60 kg; FAP, on the other hand, yields values between 38 and 43 kg. But the scaling review above found that both these dimensions normally scale isometrically with mass, and in most colobines they are nearly equal. In *Paracolobus,* however, FTR is ca. 21, while FAP is 23 mm, indicating differential stressing as in humeri. Although humeral diameters were not used to determine mass estimates here, the equations again yield very different values across all three taxon-sex groups, but are tightly internally consistent: HAP 28–29 kg, HTR 48–50 kg. Humeral length, which scaled isometrically in the modern sample, produced low mass estimates of 32–36 kg here, but not as low as the negatively allometric FL (25–27 kg).

P. mutiwa, mainly represented by dental remains, is known from younger sediments in the Turkana Basin. A single large mandible with m3 from the Shungura Formation leads to an estimate of 54 kg, while combining partial jaws and larger isolated teeth suggests a male mass of 51 (or 52 as a consensus) and a female mass of 27 kg, thus a roughly 2:1 dimorphism. This compares to *Nasalis larvatus* and the largest *Papio* varieties, but at far greater body size. Incompletely published material from West Turkana includes a male snout and partial skeleton, in which the face is larger than that of *P. chemeroni,* but the humerus is shorter. From Laetoli, ca. 3.6 Ma, comes a sample of dental remains referred to *Paracolobus* sp. indet. Again combining the few sexed teeth with the largest and smallest specimens (allocated as male and female, respectively), we obtain mass estimates of 34 and 17 kg, presenting the same dimorphism pattern as in *P. mutiwa,* here at overall size close to that of the largest *Papio h. anubis.* Postcrania of both samples would be of great interest for comparison to the Chemeron skeleton.

The third of the large African Pliocene colobines is *Cercopithecoides,* known mainly from South African sites that also yield australopiths. *C. williamsi* is represented by numerous cranial and dental specimens, but as yet no reliably identified postcrania. Combining these values yields a consensus of 21 kg for males and 15 kg for females. The size and dimorphism level is most comparable to those of the largest modern colobines, *Semnopithecus entellus* of the *schistacea* group. More fragmentary remains of a male palate from an uncertain horizon at Swartkrans (the type of *C. "molletti"*) and a female mandible from Leba exactly match the larger combined samples from Makapan, Sterkfontein Mbr. 4, and Bolt's Farm. A female face from Kromdraai B, representing a population that Delson has previously termed a "large variant", was estimated from its teeth at 23 kg, equivalent to the dental estimates for the "typical" males; a lower prediction based on BIOR from an all-colobine equation is rejected.

Two sizes of "*Cercopithecoides*" have also been reported from East Africa by Leakey (1982, 1987). The smaller form was referred to *C. williamsi* and appears to have approximately the same mass as the southern taxon, but details of its dento-facial morphology (as well as its highly terrestrial habitus) led Delson (1994) to question its specific allocation. Humeral length yields an estimate of ca. 21 kg from all three relevant equations (male colobines, all colobines, all cercopithecids; see fig. 7). Humeral transverse diameter yields a higher estimate of ca. 33 kg from all three equations (although it is high-ranked only for all colobines). The HTR value may reflect its terrestrial adaptation (as in cercopithecines). Combining these values with the dental estimates, we arrive at a consensus mean mass of 25 kg.

The larger Turkana species, *C. kimeui,* yielded estimates of 51 kg for male teeth and 25 for female (with a slightly lower value for a cranium from family-wide equations). These numbers are almost identical to those obtained for *Paracolobus mutiwa,* which has not been reported from Koobi Fora sediments. The two species are readily differentiated based on both cranial and dental morphology. A presumed male neurocranium with upper teeth from Olduvai Gorge (the holotype of *C. kimeui*) yields dental estimates of 47 kg (range 39–55 kg) if male, 27 kg if female, and 40 kg from mixed-sex regressions. An estimate of 27 kg from NAIN (family-wide equation) is probably not reliable. The implication is of a probably smaller population than known from Koobi Fora. No limb bones have yet been identified. Fleagle (1988) noted in text (p. 407) that *C. williamsi* (*sensu lato*) might have had a mass of ca. 15 kg, but listed a mass of 33 kg in his table 14.3; the latter may have been a *lapsus* for *C. kimeui,* but given that sex was ignored, it is hard to be certain. There was no change in the 1998 edition.

EURASIA

Fossil colobines from Asia are less frequent, but three taxa are worth noting. The earliest Asian colobines have had a checkered taxonomic history, but it now seems best to refer them to a broadly construed genus *Semnopithecus.*? *S. sivalensis* from the Late Miocene of Pakistan (ca. 7–5.5 Ma) is known from a small sample of upper and lower teeth not allocated to sex. Estimates average 8 kg (depending on the by-sex or mixed-sex model used), in the range of *S. (Trachypithecus) obscura.* A larger colobine is known from the roughly contemporaneous (6–5.5 Ma) Mahui Formation of the Yushe Basin, China; the single m3 yields a rough estimate of 22 kg, comparable to the males of *Semnopithecus entellus schistacea,* the largest living species group of that genus. *Pygathrix* (*Rhinopithecus*) *lantianensis* is an Early Pleistocene Chinese species that was originally misidentified as a macaque ("*Megamacaca*"; see Jablonski and Gu, 1991). Male teeth yield an estimate of 31 kg, about 50% larger than males of *Pygathrix* (*R.*) *bieti,* the largest species. On the other hand, it must be recalled that the two known mass "values" for *P.* (*R.*) *bieti* are 13 kg for a juvenile and an anecdotal estimate of "more than 30" for an adult male, while the largest mass for *P.* (*R.*) *roxellana* is 26.5 kg (Jablonski and Pan, 1995).

The extinct colobines of Europe are better known, with some species being represented by all parts of the body. *Mesopithecus pentelicus* is known by hundreds of specimens, probably representing dozens of individuals

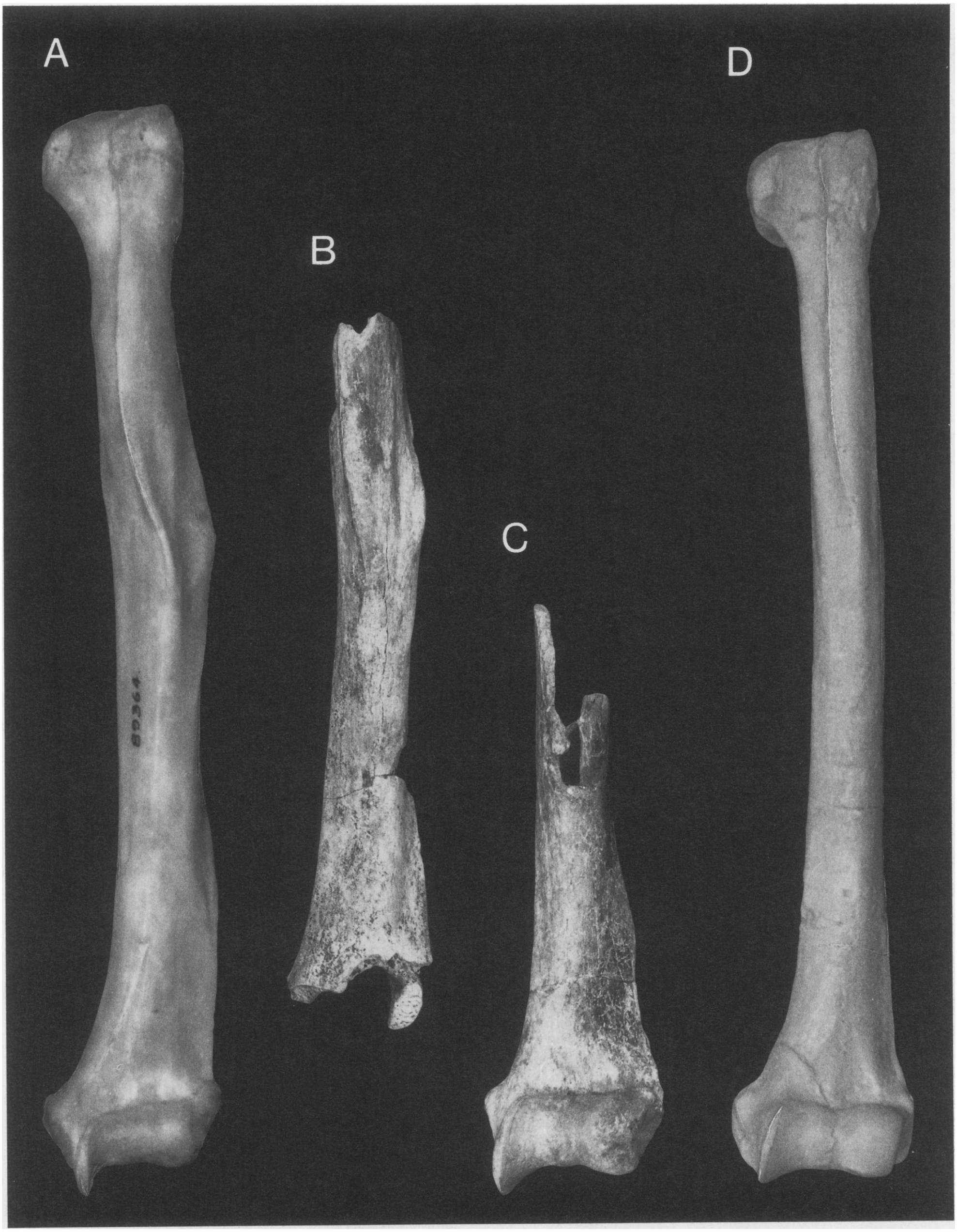

Fig. 5. Anterior view of male left humerus (A, B, C, D) and femur of: *Mandrillus sphinx* (A and E); *Paradolichopithecus arvernensis* (B, C, F: two humeral fragments and femoral shaft [posterior view]; B and F photographically reversed); and *Paracolobus chemeroni* (D and G).

from the Late Miocene (ca. 8.5 Ma) of Pikermi, near Athens (see Zapfe, 1991; Szalay and Delson, 1979). There is remarkable agreement among estimates from the three body regions, with 13 kg as the best consensus mass for males, and 9 kg for females. Given that cranial remains are often crushed and that the few estimates are based on either subfamily or family-wide equations, this agreement represents additional significant

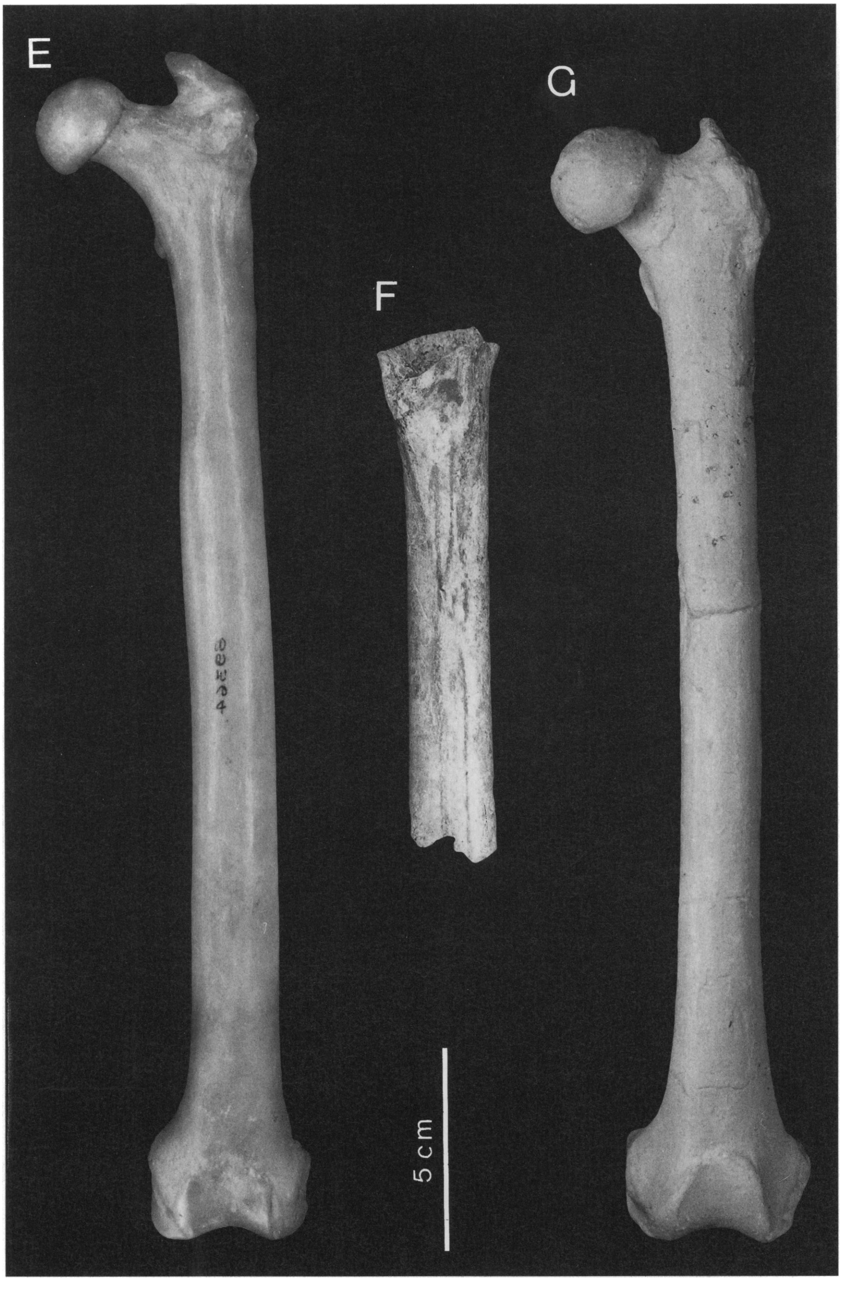

Fig. 5. *(Continued)*.

support for the approach utilized here (see fig. 8).

Another sample of *M. pentelicus* is known from northern Greece, Bulgaria, and (ex-Yugoslavian) Macedonia; the name *M. delsoni* has been proposed for specimens from the first of these areas, but Delson (1994; in Andrews et al., 1996) has rejected the supposed species distinctions. Although this sample was claimed to be larger in size than the Pikermi population, mass estimates are nearly identical. These estimates are in the range of

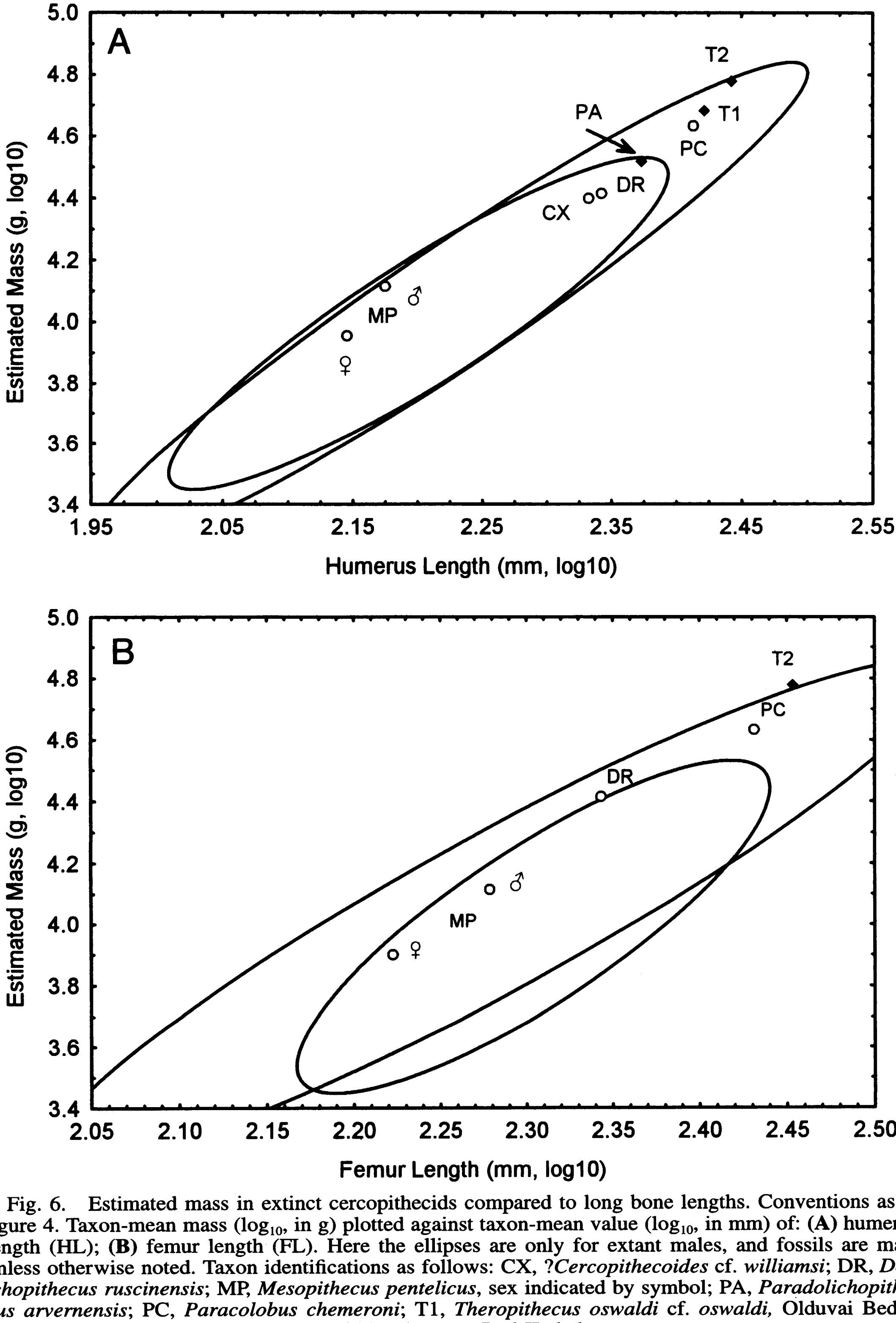

Fig. 6. Estimated mass in extinct cercopithecids compared to long bone lengths. Conventions as in figure 4. Taxon-mean mass ($\log_{10}$, in g) plotted against taxon-mean value ($\log_{10}$, in mm) of: **(A)** humerus length (HL); **(B)** femur length (FL). Here the ellipses are only for extant males, and fossils are male unless otherwise noted. Taxon identifications as follows: CX, ?*Cercopithecoides* cf. *williamsi*; DR, *Dolichopithecus ruscinensis*; MP, *Mesopithecus pentelicus*, sex indicated by symbol; PA, *Paradolichopithecus arvernensis*; PC, *Paracolobus chemeroni*; T1, *Theropithecus oswaldi* cf. *oswaldi*, Olduvai Bed I; T2, *Theropithecus oswaldi* cf. *leakeyi*, Olduvai Upper Bed II skeleton.

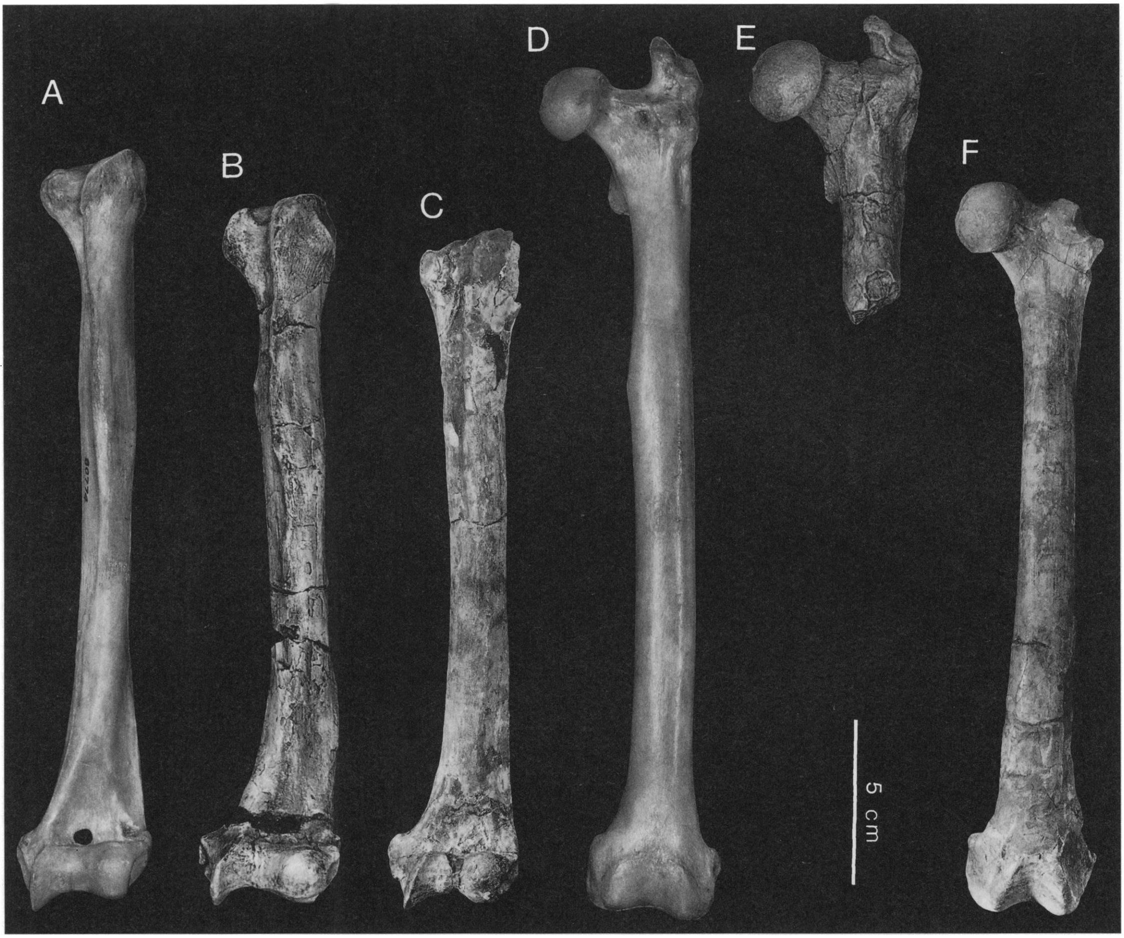

Fig. 7. Anterior view of male left humerus (A, B and C) and femur of: *Papio hamadryas ursinus* (A and D), ?*Cercopithecoides* cf. *williamsi* from Koobi Fora (B and E, casts), *Dolichopithecus ruscinensis* (C and F, casts).

such taxa as the mid-sized subspecies of *Semnopithecus entellus* and *S.* (*Trachypithecus*) *pileata shortridgei,* which also have similar dimorphism levels. *M. pentelicus* has been compared to *S. entellus* by several authors in terms of its locomotor adaptation as well (e.g., see Delson, 1994).

M. monspessulanus is a mainly Pliocene (5–3 Ma) species known from France through Romania. In addition to being smaller, it has been suggested to be less terrestrial than its congener. Dental estimates are about 70–75% of the dental values for *M. pentelicus,* but 80–83% of the consensus values. On that basis, consensus "guesstimates" for *M. monspessulanus* might be 10 and 7 kg, for males and females, respectively.

On the other hand, *Dolichopithecus ruscinensis* is a larger and more terrestrial species with an even wider range (Spain to Ukraine), contemporaneous and often sympatric with *M. monspessulanus.* Dental estimates for males average 28 kg, while postcranial values average 22 (or 25 if the very low value of 14 kg based on femur length is excluded). A consensus mass of 26 kg seems most reasonable (see fig. 7). Female dental and postcranial values average about 15 kg, surprisingly close to the single cranial estimate of 13 (based on the subfamily mixed-

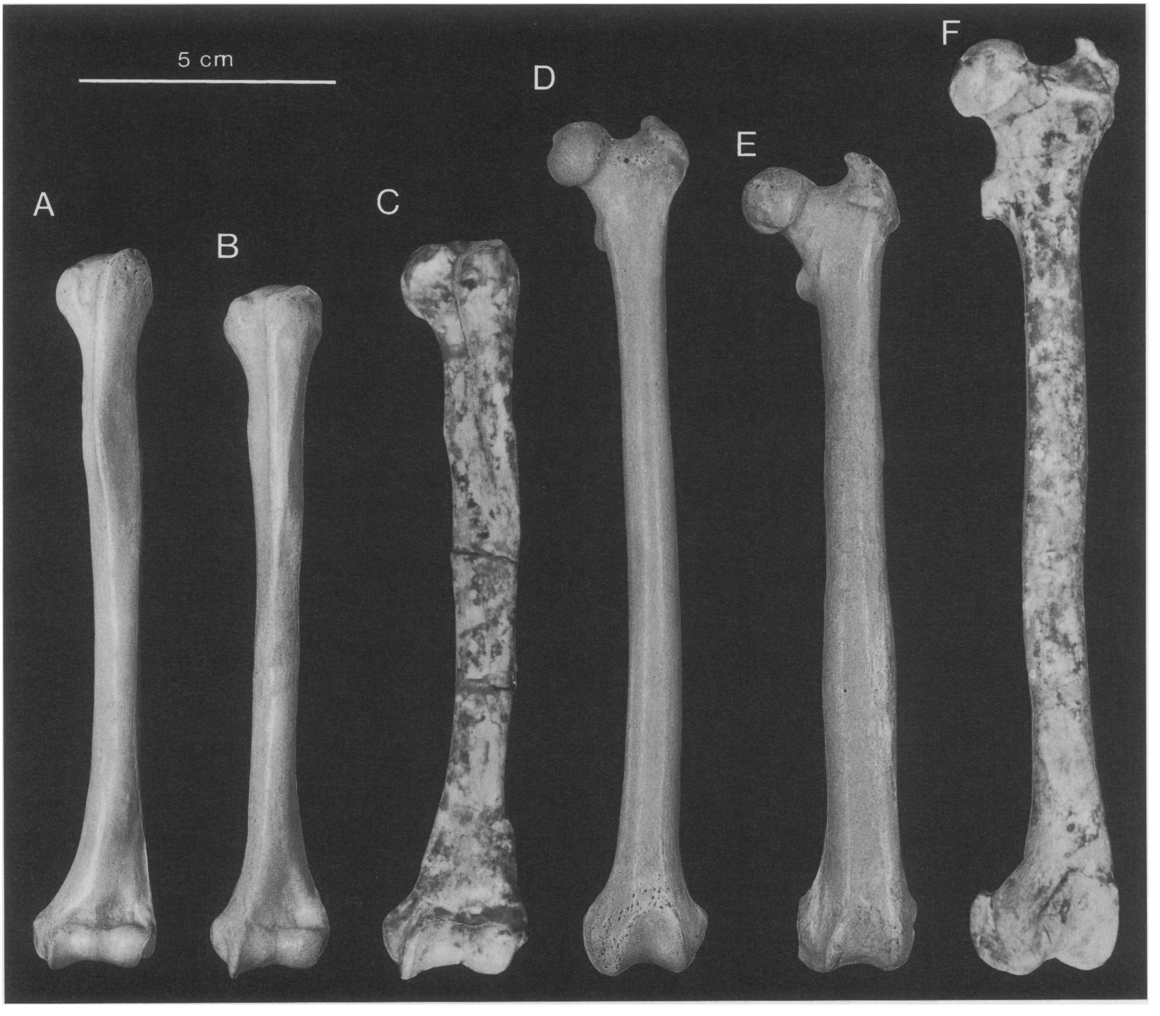

Fig. 8. Anterior view of left humerus (A, B and C) and femur of: *Procolobus badius temmincki* female (A and D); and *Mesopithecus pentelicus* female (B and E, casts) and male (C and F) (humeri photographically reversed).

sex equation for PORB). This mass is greater than that for any living colobine, approaching the values for the largest *Papio* baboons (at least for females), with slightly lower dimorphism. Fleagle (1988) suggested a range of 15–20 kg, but whether for both sexes together or their average, is not known.

The taxon termed *Parapresbytis eohanuman,* from the later Pliocene of Mongolia and Siberia, has been referred to *Dolichopithecus* (perhaps as a subgenus) by Delson (1994). Its mass of 21 kg for a female is slightly larger than that known for *D. ruscinensis* or any living cercopithecid.

Cercopithecinae

Eurasia

The majority of extinct cercopithecines in Eurasia have been referred to *Macaca,* which first appears in the Late Miocene of northern Africa. A series of populations is known in Europe (and rarely in North Africa) from the Early Pliocene through the late Middle or early Late Pleistocene, almost all of which have been considered to be temporal subspecies of the extant *M. sylvanus.* Mass estimates for these are comparable to those of the modern taxon. *M. majori* is a smaller

TABLE 15

North African and Eurasian Fossil Cercopithecine Mass Estimates

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Macaca sylvanus cf. *sylvanus* Ain Mefta						
?Male						
Mean	12.0					
Min	11.5	10.0				
Max	13.0	14.0				
Macaca sylvanus ?pliocena Various sites, Europe						
Male						
Mean	13.0♂?		14.0			
Min		10.0	14.0	11.0		
Max		16.0	16.0	17.0		
Macaca sylvanus ?pliocena 'Ubeidiya						
Female						
Mean			7.5			
Min			6.0	6.5		
Max			9.0	9.5		
Macaca sylvanus ?florentina Valdarno						
Male						
Mean			13.0			
Min			12.0	10.0		
Max			13.0	16.0		
Female						
Mean			10.5			
Min			9.0	8.5		
Max			12.0	12.5		
Macaca sylvanus ?prisca Various Europe						
Male						
Mean			12.0			
Min			9.0	10.0		
Max			16.0	14.0		
Macaca majori Capo Figari						
Male						
Mean			9.5		6.5S	
Min			9.5	7.5	5.5S	5.5S
Max			10.5	11.5	7.0S	7.5S
Female						
Mean			6.0			
Min			5.5	4.5		
Max			6.5	7.5		
Macaca libyca Wadi Natrun						
Female						
Mean			10.0S			
Min			9.5♀	8.5♀		
Max			10.0♂	12.5♂		
Macaca? sp. Menacer						
Sex unknown						
Mean			8.5S			
Min			7.0♀	6.5♀		
Max			10.0♂	10.5♂		

TABLE 15
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Macaca anderssoni Mien Chih						
Male						
Mean			14.0		10.5[S]	
Min			12.0	11.0		8.5
Max			17.0	17.0		12.5
Macaca anderssoni ("*robusta*") Zhoukoudian						
?Male						
Mean			17.0		11.0	
Min			14.0	14.0	10.5	8.5
Max			20.0	20.0	11.5	13.5
Female						
Mean			10.5			
Min			10.0	8.5		
Max			11.5	12.5		
Macaca palaeindica Upper Siwaliks						
Sex unknown						
Mean			13.0			
Min			10.5	10.0		
Max			13.0	16.0		
Paradolichopithecus arvernensis Senèze						
Female						
Mean			19.0		15.0	
Min			17.0	15.0	10.5	12.0
Max			20.0	23.0	20.0	18.0
Paradolichopithecus arvernensis Graunceanu						
?Male						
Mean	34.0					
Min	29.0	27.0				
Max	38.0	41.0				
Male						
Mean			31.0		33.0	
Min			29.0	25.0	24.0	26.0
Max			33.0	37.0	39.0	40.0
Female						
Mean			19.0			
Min			17.0	15.0		
Max			23.0	23.0		
Paradolichopithecus sushkini Kuruk						
Male						
Mean			36.0		27.0[S]	
Min			24.0	29.0		22.0
Max			44.0	43.0		32.0
Female						
Mean			35.0[S]		14.0	
Min			31.0[S]	28.0[S]	12.0	12.0
Max			39.0[S]	42.0[S]	18.0	18.0
Mean*			29.0♀			

TABLE 15
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Paradolichopithecus sp. Cova Bonica						
Male						
Mean			22.0			
Min			19.0	18.0		
Max			25.0	26.0		
Procynocephalus wimani Honan						
Female						
Mean			18.0			
Min			16.0	14.0		
Max			20.0	22.0		
Procynocephalus subhimalayanus Pinjor						
?Male						
Mean			13.0			
Min			11.5	10.0		
Max			14.0	16.0		
Female						
Mean			24.0			
Min			23.0	19.0		
Max			26.0	29.0		
Procynocephalus? sp. Dongcun						
Sex unknown						
Mean			26.0[S]			
Min			22.0[♀]	21.0[♀]		
Max			28.0[F]	31.0[F]		
Procynocephalus? sp. Yushe						
Sex unknown						
Mean			25.0[S]			
Min			21.0[S]	20.0[S]		
Max			31.0[S]	30.0[S]		

See notes for table 14.

form known on Sardinia, which has been termed a "dwarf macaque", but is only about 15% smaller dentally than *M. sylvanus.* A consensus mass for the male of about 8.5 kg and a female value of about 6 kg is significantly less than those of the living species (see table 15).

The best-preserved Asian material is the sample from the later Middle Pleistocene *Homo erectus* site of Zhoukoudian. Here *Macaca anderssoni* (or *M. robusta*) is estimated at 17 kg for a male, 10.5 kg for a female. The male is in the range of the living *M. thibetana,* which Delson (1980) thought might be morphologically similar, but the female is much smaller; the dimorphism ratio is close to that seen in *M. assamensis,* however, which is probably the closest relative of *M. thibetana.*

Of greater interest than *Macaca* are the two larger Eurasian cercopithecines that may be its descendants: western *Paradolichopithecus* and eastern *Procynocephalus.* The taxonomic distinction between these two is still not clear, but preliminary analysis of female muzzle shape reveals some differences that suggest that they are better retained as separate genera at this time. The holotype of *Paradolichopithecus arvernensis* is a female skull from Senèze (France), dated ca. 2–1.6 Ma. Given the tendency for PORB to underestimate mass, a consensus estimate of 18 kg

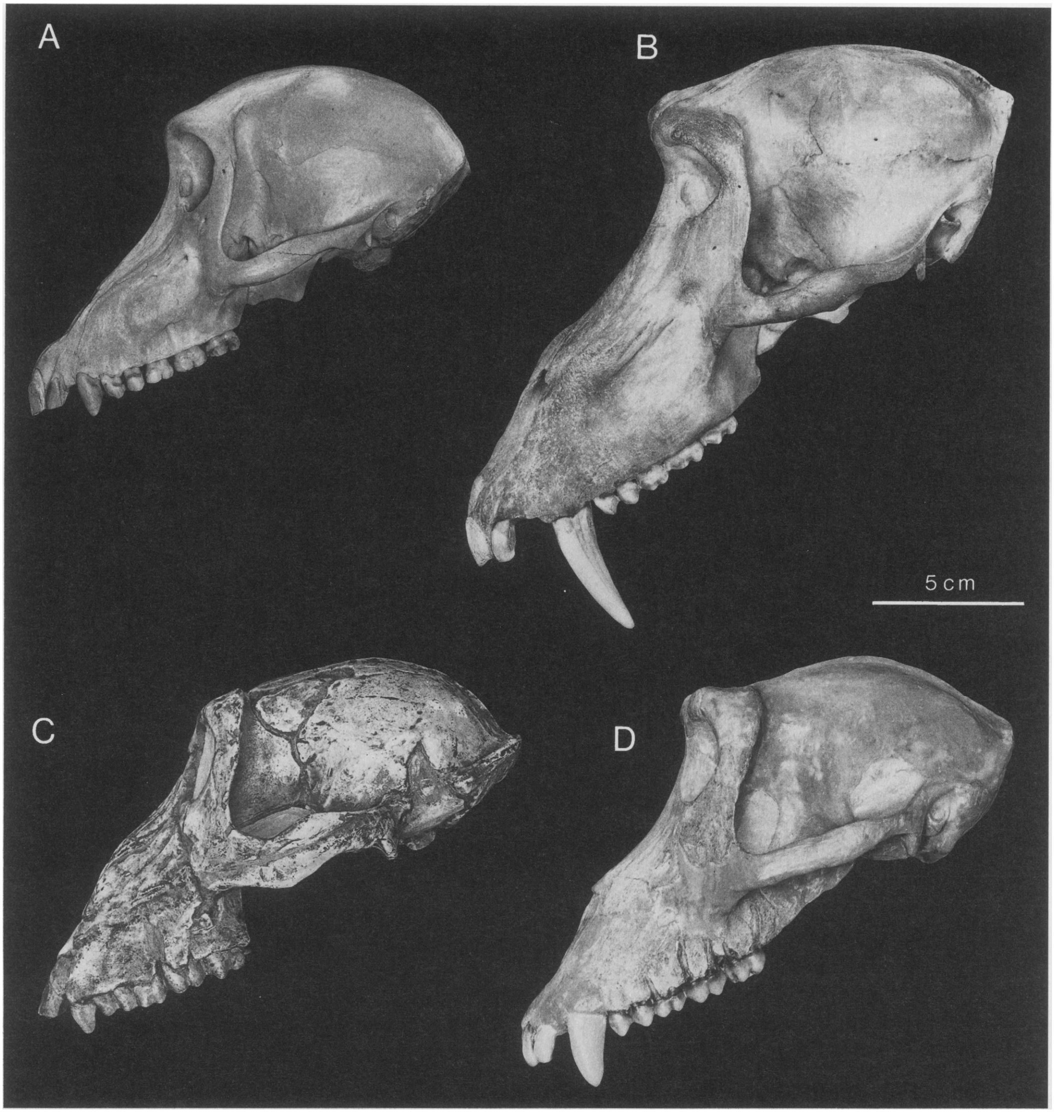

Fig. 9. Left lateral views of crania of *Papio hamadryas ursinus* [**(A)** female, **(B)** male] and *Paradolichopithecus arvernensis* [**(C)** female, **(D)** reconstructed male]. B and C photographically reversed. Note that the male crania are similar in size (especially of neurocranium), but the female fossil is rather larger than the extant female. This results in apparently low cranial sexual size dimorphism in *Paradolichopithecus* if the French female and Romanian male specimens indeed represent the same population. The modern compiled mean masses are 30 and 15 kg, while the fossils were estimated at 33 and 18 kg, for slightly lower mass dimorphism.

is suggested. Fleagle's (1988) estimate of 23 kg probably referred to this individual.

A large sample from Graunceanu (Romania), dated ca. 2 Ma, includes a reconstructed adult male skull and two good partial crania (as well as parts of two others), two juvenile male mandibles, a juvenile female maxilla, and an adult female muzzle, as well as unsexed limb elements. The female teeth closely match those from France and in fact produce almost exactly the same mass estimate and range, although the m2 is larger. The male crania and teeth agree extremely well with a consensus mass of 32 kg. What is most fascinating is that the actual size of the Senèze female cranium is only slightly smaller than the Graunceanu male, a surprising lack of cranial dimorphism in a species the size of the largest living *Papio* varieties (see fig. 9). The mass estimate of 34 kg from humeral and femoral diaphyses (and estimated humeral length) is based on male equations—the female and mixed-sex equations yielded similar values, which suggest the bones are from males (see figs. 5 and 10). This number is essentially identical to those obtained from the crania and teeth, suggesting a final consensus of ca. 33 kg. In turn, this yields a mass dimorphism comparable to those of middle-sized *Papio hamadryas* subspecies, although the male mass is closest to those of the largest subspecies and the female mass higher than in any living cercopithecid taxon.

Paradolichopithecus sushkini from Kuruksay (Tajikistan, also ca. 2 Ma) is broadly comparable in size and in mass dimorphism, although the actual estimates are more variable. The male teeth produce a mass prediction of 36 kg, while the fragmentary face allows only a subfamily-equation estimate based on PORB (identical to that from the male equation); 35–36 kg is probably reasonable. Only upper teeth are known for the female cranium, which results in a single value of 29 kg from a female equation and higher values from the subfamily mixed-sex models. The cranium itself yielded estimates quite close to those for the Senèze skull. The large range means that a good estimate is not possible, but the population may have been somewhat larger than its western congeners. A smaller-sized population is known from Early Pliocene sites in Spain and France, with a juvenile male mandible estimated at 22 kg.

Specimens of *Procynocephalus* are even more fragmentary and scattered. The holotype female snout of *P. wimani* from deposits in Honan, thought to date roughly 1 Ma, yields an estimate of 18 kg. Postcrania perhaps referable to this taxon from Loc. 12 at Zhoukoudian (Teilhard, 1938) could not be located in Beijing and were probably lost with the "*Sinanthropus*" fossils in 1941. Two other sets of large cercopithecine teeth from China are tentatively referred to this genus, from the earlier Pliocene of Yushe and the later Pliocene of Dongcun (Nei Mongol/ Inner Mongolia); both average around 25–26 kg, using mainly subfamily models. *P. subhimalayanus* from the Indian Siwalik Pinjor horizon is represented by a female maxilla and mandible that yield a 24 kg mass estimate. A large mandible with heavily worn teeth from the same deposits was originally named "*Cynocephalus falconeri*", but referred to *P. subhimalayanus* by Szalay and Delson (1979). The estimate of 13 kg may indicate that a different taxon is involved (as for Jolly, 1967) or may just be a reflection of the extremely worn teeth.

AFRICA

Taxa other than *Theropithecus*: The earliest well-known cercopithecines in Africa are assigned to the genus *Parapapio,* which appears broadly macaquelike in its adaptations and (conservative) facial morphology. Three species have been distinguished at Sterkfontein and Makapan (between 3 and 2.6 Ma; see Freedman, 1957; Freedman and Stenhouse, 1972) on the basis of relative tooth size. With the recovery of more complete crania, some of those distinctions have been questioned. Our estimates here appear to support the Freedman system.

P. jonesi at both sites was of similar mass, perhaps 17 kg for males and 12–13 kg for females. Specimens from Hadar (ca. 3–2.9 Ma) have been referred to this species and are of comparable size from dental estimates on heavily worn teeth—the Hadar male cranium is badly crushed and estimates may not be meaningful. On the other hand, a partial femur and humerus from the same restricted locality as the two skulls yield minimum values for diameters, which in turn produce variable mass estimates averaging ca. 25 kg. (Those from the lower-ranked transverse diameters are ca. 23 and 28 kg.) This may imply that the dental estimates are also too low. Perhaps the Hadar male had a mass of at least 20 kg (see table 16).

P. broomi from Sterkfontein and Makapan is slightly larger, with males around 21 kg and females ca. 15 kg. *P. whitei* is rarer but still larger, perhaps 26 kg for males (there are several good crania from Makapan) and 19

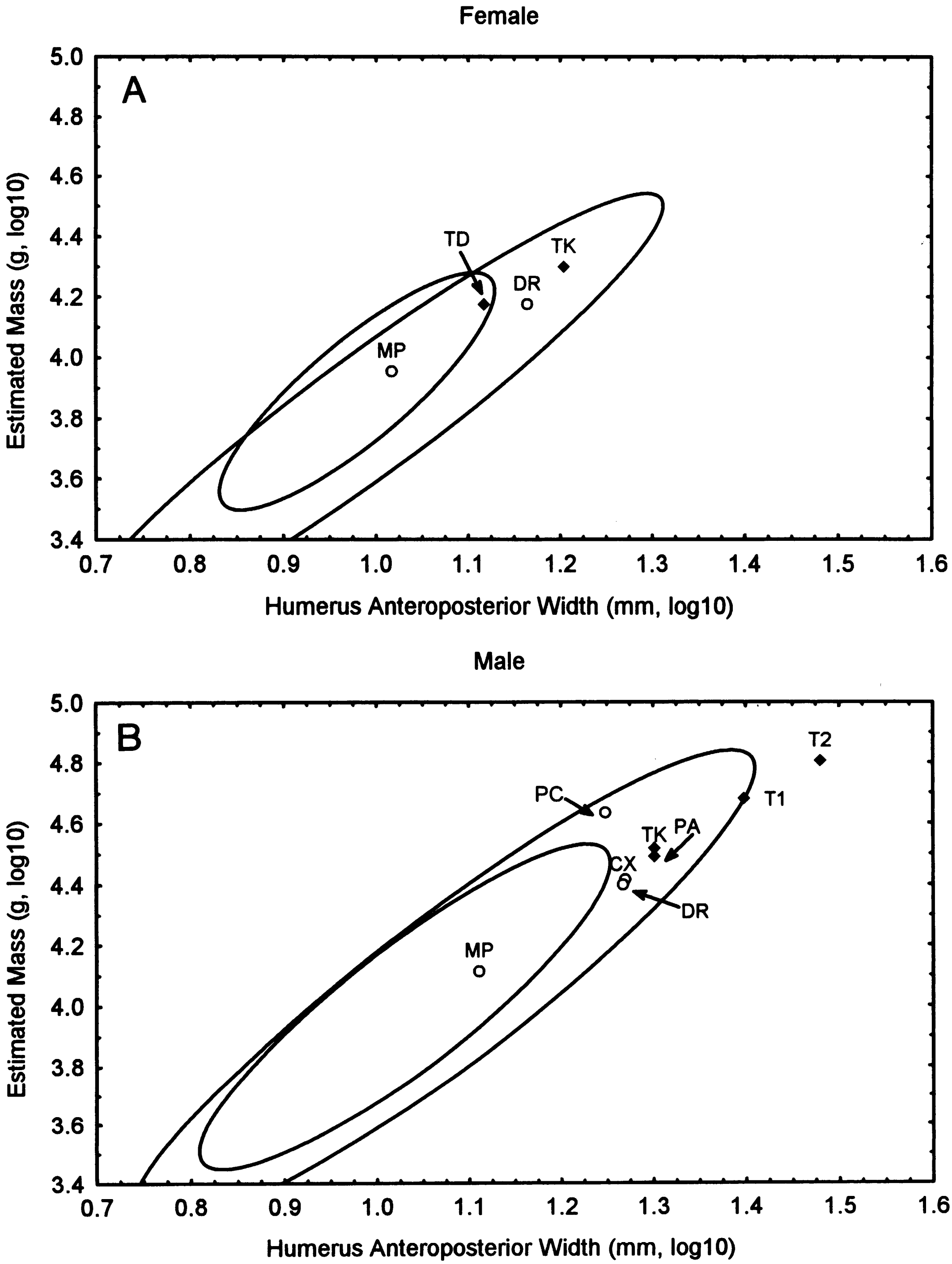

Fig. 10. Estimated mass in extinct cercopithecids compared to humerus anteroposterior diameter: (**A**) females; (**B**) males. Conventions as in figure 4. Taxon identifications as follows: CX, ?*Cercopithecoides* cf. *williamsi*; DR, *Dolichopithecus ruscinensis*; MP, *Mesopithecus pentelicus*, sex indicated by symbol; PA, *Paradolichopithecus arvernensis*; PC, *Paracolobus chemeroni*; TD, *Theropithecus darti*, Hadar; TK, *Theropithecus oswaldi oswaldi*, Kanjera; T1, *Theropithecus oswaldi* cf. *oswaldi*, Olduvai Bed I; T2, *Theropithecus oswaldi* cf. *leakeyi*, Olduvai Upper Bed II skeleton.

TABLE 16
Other African Fossil Cercopithecine Mass Estimates

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Cercocebus? or *Parapapio jonesi* Makapan						
Sex unknown						
Mean			15.0^{S}			
Min			9.5♀	12.0♀		
Max			17.0♂	18.0♂		
Cercocebus? or *Parapapio jonesi* Kromdraai A						
Sex unknown						
Mean			13.0^{S}			
Min			11.5♀	10.0♀		
Max			15.0♂	16.0♂		
Cercocebus? or *Parapapio jonesi* Taung						
Sex unknown						
Mean			10.0^{S}			
Min			8.5♀	8.5♀		
Max			10.5♂	12.5♂		
Parapapio jonesi Sterkfontein						
Male						
Mean			17.0			
Min			14.0	14.0		
Max			19.0	20.0		
Female						
Mean			11.5			
Min			11.0	9.5		
Max			12.0	13.5		
Parapapio cf. *jonesi* Makapan						
Male						
Mean			17.0		16.0	
Min			15.0	14.0	14.0	13.0
Max			21.0	20.0	17.0	19.0
Female						
Mean			12.0		15.0^{S}	
Min			10.5	10.0	13.0^{S}	12.0^{S}
Max			13.0	14.0	17.0^{S}	18.0^{S}
Mean*					14.0	
Parapapio cf. *jonesi* Hadar						
Male						
Mean	24.0		16.0		10.5	
Min	17.0	19.0	10.5	13.0	8.5	8.5
Max	30.0	29.0	19.0	19.0	13.0	12.5
Female						
Mean			13.0			
Min			12.0	10.0		
Max			15.0	16.0		
Parapapio broomi Makapan						
Male						
Mean			20.0		18.0^{S}	
Min			17.0	16.0	16.0^{S}	14.0^{S}
Max			23.0	24.0	19.0^{S}	22.0^{S}

TABLE 16
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Parapapio broomi Makapan (*continued*)						
Female						
Mean			15.0		14.0[S]	
Min			14.0	12.0	13.0[S]	11.0[S]
Max			16.0	18.0	15.0[S]	17.0[S]
Mean*					13.0	
Parapapio broomi Sterkfontein						
Male						
Mean			22.0			
Min			18.0	18.0		
Max			26.0	26.0		
Female						
Mean			15.0			
Min			14.0	12.0		
Max			16.0	18.0		
Parapapio broomi or *whitei* Bolt's Farm						
Male						
Mean			24.0		22.0	
Min			22.0	19.0	18.0	18.0
Max			27.0	29.0	27.0	26.0
Parapapio whitei Makapan						
Male						
Mean			25.0		28.0	
Min			22.0	20.0	20.0	22.0
Max			30.0	30.0	43.0	34.0
Parapapio whitei Sterkfontein						
Female						
Mean			19.0			
Min			16.0	15.0		
Max			21.0	23.0		
Parapapio antiquus Taung						
Male						
Mean			18.0		10.5	
Min			17.0	14.0	10.0	8.5
Max			20.0	22.0	12.0	12.5
Female						
Mean			15.0[S]		14.0	
Min			14.0[S]	12.0[S]	12.0	11.0
Max			16.0[S]	18.0[S]	16.0	17.0
Mean*			13.0			
Parapapio? *ado* Laetoli						
Male						
Mean			21.0			
Min			19.0	17.0		
Max			25.0	25.0		
Female						
Mean			12.0			
Min			11.0	10.0		
Max			13.0	14.0		

TABLE 16
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
?Parapapio sp. Kanapoi						
Male						
Mean			11.5			
Min			10.0[S]	9.5[S]		
Max			16.0[S]	13.5[S]		
?Parapapio sp. Aramis						
Female						
Mean			8.0			
Min			8.0	6.5		
Max			8.0	9.5		
Papio hamadryas robinsoni Sterkfontein and Bolt's Farm						
Male						
Mean			28.0			
Min			21.0	22.0		
Max			31.0	34.0		
Female						
Mean			19.0		15.0	
Min			17.0	15.0		12.0
Max			22.0	23.0		18.0
Papio hamadryas robinsoni Swartkrans Mbr 1						
Male						
Mean			30.0			
Min			30.0	24.0		
Max			31.0	36.0		
Female						
Mean			16.0			
Min			15.0	13.0		
Max			17.0	19.0		
Papio angusticeps Kromdraai and Cooper's						
Male						
Mean			21.0		16.0	
Min			21.0	17.0	16.0	13.0
Max			22.0	25.0	17.0	19.0
Female						
Mean			18.0		9.5	
Min			14.0	14.0	9.0	7.5
Max			20.0	22.0	10.0	11.5
Papio izodi Taung						
Male						
Mean			22.0		13.0	
Min			20.0	17.0	13.0	10.0
Max			24.0	25.0	13.0	16.0
Female						
Mean			17.0		11.5	
Min			13.0	14.0	9.0	9.5
Max			21.0	20.0	14.0	13.5

TABLE 16
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Papio cf. *izodi* Sterkfontein						
Female						
Mean			21.0[S]			
Min			20.0[S]	17.0[S]		
Max			21.0[S]	25.0[S]		
Papio (*Dinopithecus*) *quadratirostris* Omo						
Male						
Mean			37.0		43.0	
Min			34.0	30.0		34.0
Max			39.0	44.0		52.0
Female						
Mean			20.0		14.0[S]	
Min			19.0	16.0	13.0[S]	11.0[S]
Max			22.0	24.0	15.0[S]	17.0[S]
Papio (*Dinopithecus*) cf. *quadratirostris* Leba						
Male						
Mean			44.0			
Min			40.0	35.0		
Max			48.0	53.0		
Female						
Mean			21.0			
Min			18.0	17.0		
Max			25.0	25.0		
Papio (*Dinopithecus*) *ingens* Swartkrans and Schurweburg						
Male						
Mean			46.0		40.0	
Min			40.0	37.0	37.0	32.0
Max			57.0	55.0	43.0	48.0
Female						
Mean			35.0[S]		11.0	
Min			33.0[S]	28.0[S]	8.0	8.5
Max			37.0[S]	42.0[S]	13.0	13.5
Mean*			29.0[Fe]			
Gorgopithecus major Kromdraai and Cooper's						
Male						
Mean			37.0			
Min			34.0	30.0		
Max			39.0	44.0		
Female						
Mean			30.0[S]			
Min			28.0[S]	24.0[S]		
Max			32.0[S]	36.0[S]		
Theropithecus darti Makapan						
Male						
Mean			34.0			
Min			31.0	27.0		
Max			35.0	41.0		

TABLE 16
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Theropithecus darti Makapan (*continued*)						
Female						
Mean			23.0		21.0	
Min			21.0	18.0	18.0	17.0
Max			24.0	28.0	23.0	25.0
Theropithecus cf. *darti* Hadar						
Male						
Mean	26.0		25.0			
Min		21.0	24.0	20.0		
Max		31.0	27.0	30.0		
Female						
Mean	15.0		17.0		12.0	
Min	12.0	12.0	15.0	14.0	9.0	10.0
Max	19.0	18.0	17.0	20.0	15.0	14.0
Theropithecus oswaldi oswaldi Kanjera						
Male						
Mean	34.0		48.0		53.0	
Min	33.0	27.0	42.0	38.0		42.0
Max	35.0	41.0	54.0	58.0		64.0
Female						
Mean	16.0		23.0		19.0	
Min	13.0	13.0	20.0	18.0	11.5	15.0
Max	19.0	19.0	26.0	28.0	27.0	23.0
Theropithecus oswaldi oswaldi Swartkrans Mbr 1						
Male						
Mean			42.0			
Min			35.0	34.0		
Max			54.0	50.0		
Female						
Mean			26.0		22.0	
Min			25.0	21.0	14.0	18.0
Max			27.0	31.0	27.0	26.0
Theropithecus oswaldi oswaldi Koobi Fora						
Male						
Mean			36.0		72.0	
Min			25.0	29.0	58.0	58.0
Max			49.0	43.0	91.0	86.0
Female						
Mean					26.0	
Min					23.0	21.0
Max					28.0	31.0
Theropithecus oswaldi oswaldi? Olduvai FLK I						
?Male						
Mean	48.0					
Min	39.0	38.0				
Max	56.0	58.0				
Theropithecus oswaldi oswaldi? Olduvai DK I						
Female						
Mean			30.0			
Min			28.0	24.0		
Max			32.0	36.0		

TABLE 16
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Theropithecus oswaldi leakeyi? Olduvai MCK II						
Male						
Mean	64.0		55.0			
Min	36.0	51.0	48.0	44.0		
Max	91.0	77.0	61.0	66.0		
Theropithecus oswaldi leakeyi Olduvai Masek and Kapthurin						
Male						
Mean			58.0			
Min			55.0	46.0		
Max			63.0	70.0		
Theropithecus oswaldi leakeyi Tighenif (Ternifine)						
?Male						
Mean			53.0			
Min			42.0	42.0		
Max			60.0	64.0		
Theropithecus oswaldi leakeyi Thomas Quarry						
Male						
Mean			50.0			
Min			48.0	40.0		
Max			52.0	60.0		
Theropithecus oswaldi leakeyi Hopefield						
Male						
Mean			50.0			
Min			48.0	40.0		
Max			53.0	60.0		
Female						
Mean			37.0			
Min			32.0	30.0		
Max			40.0	44.0		
Theropithecus oswaldi leakeyi Olorgesailie						
Male						
Mean	95.0		74.0			
Min	61.0	76.0	66.0	59.0		
Max	128.0	114.0	84.0	89.0		
Female						
Mean	40.0		37.0			
Min	39.0	32.0	37.0	30.0		
Max	40.0	48.0	38.0	44.0		
Theropithecus oswaldi leakeyi Bodo						
Male						
Mean			59.0		77.0	
Min			58.0	47.0	73.0	62.0
Max			60.0	72.0	81.0	92.0
Theropithecus oswaldi delsoni Mirzapur						
Sex unknown (male?)						
Mean			53.0[av]			
Min			42.0♀	42.0♀		
Max			72.0♂	64.0♂		

TABLE 16
Continued

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Theropithecus oswaldi delsoni? Cueva Victoria						
Sex unknown (male?)						
Mean			44.0av			
Min			38.0♀	35.0♀		
Max			50.0♂	53.0♂		
Theropithecus "*atlanticus*" Ahl al Oughlam						
Sex unknown						
Mean			29.0S			
Min			24.0S	23.0S		
Max			31.0S	35.0S		
?*Theropithecus* (*Omopithecus*) *baringensis* Chemeron JM90						
Male						
Mean			23.0		29.0	
Min			20.0	18.0	23.0	23.0
Max			28.0	28.0	33.0	35.0
Theropithecus (*Omopithecus*) *brumpti* Shungura cranium						
Male						
Mean					30.0	
Min					28.0	24.0
Max					31.0	36.0
Theropithecus (*Omopithecus*) *brumpti* West Turkana cranium						
Male						
Mean					60.0	
Min					47.0	48.0
Max					82.0	72.0
Theropithecus (*Omopithecus*) *brumpti* Turkana Basin mean						
Male						
Mean			36.0			
Min			34.0	29.0		
Max			39.0	43.0		
Female						
Mean			24.0		17.0S	
Min			23.0	19.0	16.0S	14.0S
Max			26.0	29.0	18.0S	20.0S
Mean*					13.0	
Theropithecus sp. indet. Lothagam						
Sex unknown						
Min			23.0♀			
Max			32.0♂			

See notes for table 14.

kg for females. A male cranium from Bolt's Farm (significantly younger at ca. 2.3–2 Ma) is intermediate in both size and morphology. Several East African samples are older than those from the south. *P. ado* from Laetoli may be close in size to *P. broomi*, while earlier samples from Kanapoi (4.2–4 Ma) and Aramis (ca. 4.4 Ma) are smaller; it is not yet certain if the latter two might represent the same species.

Parapapio is often thought of as a small animal, but most species had masses in the range of living *Papio*. Their level of sexual dimorphism appears to have been significantly less than that of living cercopithecines of comparable mass. A simple male:female ratio falls mostly between 1.3 and 1.4, while baboons with male mass between 15 and 26 kg have dimorphism ratios of 1.6–1.8. On the other hand, *Macaca thibetana* males have a mass about 18 kg, but females only 14 kg (ratio 1.25), more like the situation in some *Parapapio* species; other macaques have higher dimorphism. *Parapapio ado* has a ratio of 1.75, with masses for both sexes close to those of the mid-sized *Papio* varieties.

Fossil *Papio* are less widespread than *Parapapio,* with the greatest variety again from South Africa. Freedman (1957 et seq.) described *P. robinsoni* from Swartkrans as a distinct species but, especially in light of the inclusion of all modern populations within a single species, Szalay and Delson (1979) argued that the extinct form should also be considered a subspecies of *P. hamadryas.* It differs from such extant varieties as the chacma, anubis, and yellow baboons in ways analogous to their differences from each other. Small samples of *P. h. robinsoni* from Sterkfontein and Bolt's Farm yield dental estimates of 28 kg for males and 19 for females; the latter might be reduced to 18 in light of the lower cranial estimate, but as seen above most dental estimates for female *Papio* are already low. Estimates based on Freedman's (1957) larger samples from Swartkrans are essentially the same, yielding a consensus taxon estimate of 29 kg for males and 18 kg for females. These values are in the range of the largest extant males, although the female is larger than in any modern forms; in turn, the dimorphism level is slightly lower than that of any extant *Papio hamadryas* variety, but not so low as to question its inclusion in the living species.

This identification, as has been noted elsewhere, makes *Papio hamadryas* at ca. 2.6 Ma one of the longest-lived primate (or mammalian) species as recognized from well-preserved morphology (compared, for example, to the less certain referral of latest Miocene to Pleistocene populations of European macaques to *M. sylvanus*). For example, of about 110 species or lineages with a first appearance datum (FAD) after 4 Ma discussed by Vrba (1995), only eight appear to have originated before 2 Ma and have not yet become extinct. (One other went extinct late in the Middle Pleistocene.) Of these eight, two are lineages and two cf. referrals to living species; four appear to be as clear as *P. h. robinsoni* in registering the presence of a living species in the African Pliocene (with FADs between 2.9 and 2.3 Ma). By comparison, of the 15 suid species with comparable FADs discussed by White (1995), not one with a FAD over 1 Ma is still extant.

Two smaller forms of *Papio* have also been recognized in the South African Plio-Pleistocene. *P. "angusticeps"* is known from several sites in the 2–1.5 Ma range (?Swartkrans, Cooper's, Kromdraai), sometimes alongside *P. h. robinsoni.* Its morphology is comparable to that of the smaller living varieties of *Papio,* and it may also belong to the extant species, although this suggestion has not yet been analyzed in detail (see Delson, 1989). A combined dental sample from Kromdraai and Cooper's yields a male mass of 21 kg and a female mass of 18 kg, with cranial models suggesting somewhat lower values. The similarity of the male and female mass values is unexpected, given a typical cranial size dimorphism, and there may be a sampling problem involved. Cranial estimates are lower, and a guesstimate of 15 kg is perhaps better for the female.

The second small species is *Papio izodi,* known almost uniquely from Taung. As discussed by Delson (1989), specimens of *P. izodi* differ from those of the extant *P. h. kindae* and *P. "angusticeps"* in having larger teeth and orbits in a similar-sized skull. This suggests both macrodonty and a different morphological Bauplan, in turn implying that *P. izodi* is a truly distinct species. Male individuals yield dental mass estimates ca. 22 kg, with females at 17 kg, while crania suggest lower values; a single female from Sterkfontein yielded a higher estimate from subfamily models. Given the possible macrodonty and the common pattern of low cranial estimates, consensus masses might be 20 kg for males and 15 kg for females. This is about the same size as *P. "angusticeps"* with slightly low dimorphism, most comparable among cercopithecines to the similar-sized *Macaca thibetana.* The long-overdue detailed analysis of *Papio izodi* may clarify this situation.

At the other end of the African Plio-Pleistocene cercopithecine size range is a group of populations included in *Dinopithecus,* recognized as a subgenus of *Papio,* following Delson (1984). Specimens from the Ethiopian Omo Shungura and Usno deposits (dated ca. 3.4–2.5 Ma) have been allocated to *P.* (*D.*) *quadratirostris,* and others from Leba (Angola, estimated ca. 3–2 Ma) have been referred to that species (see Delson and Dean, 1993, contra Eck and Jablonski, 1987; and Jablonski, 1994). The Ethiopian sample yields male mass ca. 40 kg and female ca. 18 kg, while the less extensive Angolan sample is estimated to have been a bit larger. These are larger mean values than those of any living monkeys, and the dimorphism index of ca 2.3 is only slightly higher than that found in large living baboons.

P. (*D.*) *ingens* from Swartkrans and the minor locality of Schurweburg is known mostly from male craniodental elements that yield compatible estimates centering on 43 kg. Recall that it was Fleagle's (1988) estimate of 77 kg for this population that we cited above as an impetus for this project. The value of 43 kg, however, is lower than that estimated for the visually much smaller Leba maxilla, and the low estimates for the Swartkrans population are derived from heavily worn (and thus perhaps size-reduced) teeth. Emphasizing the values derived from less-worn teeth yields a mean mass for Swartkrans males of 50 kg. A partial female cranium is even harder to interpret. It is clearly larger than that of any living monkey, but cranial models yield low estimates. Only one maxillary dental model was high ranked, and subfamily models tended to estimate too high in the extant sample. If we again choose to emphasize the single model derived from sexed data, female mass would be 29 kg, but this could still be too great, given the macrodont nature of modern large female baboons and the resulting low dimorphism index of 1.7.

The last non-*Theropithecus* extinct monkey is *Gorgopithecus major,* known by a small sample from Kromdraai and perhaps one maxilla from Swartkrans. This taxon, like large extant *Papio,* presents strongly excavated facial fossae, on the mandibular corpus and the maxilla, especially in males. By contrast, *P.* (*D.*) *ingens* and its relatives appear to lack such fossae. Like the latter species, *G. major* is known from several male individuals (one good cranium is too fragmentary to allow cranial estimates), but only a single female maxilla, so that subfamily dental models had to be utilized. Freedman (1957) and later authors noted that there is low dental size dimorphism, which is reflected here in the closeness of the dental mass estimates. The value of 37 kg for males is reasonable, but the female value is questionable on several counts, and we do not recommend its ready acceptance, though we cannot yet suggest an alternative. Fleagle's (1988) estimate of 41 kg, which was questioned at the outset of this project, was apparently reasonable, if indeed it was derived from male teeth.

Taxa of the *Theropithecus* clade: There is some disagreement about the phylogenetic structure of this distinctive group of living and extinct cercopithecine species. Eck and Jablonski (1984, 1987; Jablonski, 1993, 1994) have argued for three effectively equidistant subclades: the extant *T. gelada*; the extinct *T. darti-oswaldi* lineage; and the extinct *T. baringensis-brumpti* lineage, including what they termed *T. quadratirostris.* Delson (1993) and Delson and Dean (1993) countered that there are only two main subclades, arguing that the first two are sister-clades, with the *T. baringensis-brumpti* lineage distinct at the subgeneric level, as *T.* (*Omopithecus*); others have thought that *baringensis* should not be linked to *Theropithecus* at all. An alternative phylogenetic interpretation of this taxon not previously considered is that it represents the ancestral morphotype for the whole genus, rather than only for the subgenus *T.* (*Omopithecus*). Pending further study, Delson's (1993) hypothesis is accepted here.

T. darti from Hadar and Makapan (ca. 3.4–2.9 Ma) is the oldest well-represented species of this genus. It is recognized here as a distinct species following Eck (1993), Delson (1993), and Jablonski (1993), despite the arguments of Leakey (1993) that it be considered a temporal subspecies of its sister-species and probable descendant *T. oswaldi.* The Makapan population is estimated to have a male mass of 34 kg and female perhaps 22 kg, given the close agreement of cranial and dental models. The older and smaller-sized Hadar sample yields a male dental estimate of 25 kg, and 26 kg for a large but unsexed partial humerus. Female estimates from all three body regions agree well, especially given that the low cranial estimate is from PORB, which tends to yield low values. A consensus mass of 15 kg seems reasonable. The two populations thus have closely comparable dimorphism ratios around 1.6, as does the still smaller extant *T. gelada.* Jolly (1972) had previously estimated the Makapan male mass at 33 kg from a dental model. Krentz (1993, using methods derived from Jolly, 1972 and Aiello, 1981) obtained estimates of ca. 15 kg for male and ca. 9.5 kg for female *T. darti* from Hadar. Using the classical calibration model for Hadar males, we obtained a mass range of 30–39 kg.

Later Pliocene and Pleistocene populations of the same lineage are here placed in the species *T. oswaldi,* with at least three recognized temporo-geographic subspecies. *T. oswaldi* first appears in Member D of the Omo Shungura Fm., dated at ca. 2.4 Ma. Specimens belonging to this lineage dating between 2.9 and 2.4 Ma are rare to nonexistent (assuming that no Makapan specimens fall into that range). No *Theropithecus* has yet been recognized at Sterkfontein or Taung, and only *T. brumpti* is present at that time in the Turkana Basin. Unpublished specimens dating ca. 2.5 Ma from the Middle Awash Valley appear to be *T. oswaldi,* but none are clearly in the 2.9–2.5 Ma range.

T. o. oswaldi is well represented at such localities as Kanjera (Kenya, the type site, dated ca. 1.2 Ma after Behrensmeyer et al., 1995), Swartkrans Members 1–3 (South Africa, dated ca. 1.9–1.6 Ma), Olduvai Bed I (Tanzania, dated 1.85–1.8 Ma), and in the Turkana Basin especially at Koobi Fora after 2.1 Ma. The upper limit of *T. o. oswaldi* in the Turkana Basin is unclear because of the lack of a sharp distinction between this subspecies and its successor *T. o. leakeyi* (see below). Leakey (1993) includes all Turkana Basin and Olduvai Lower Bed II specimens in *T. o. oswaldi,* but there is some gradation in size and cranial morphology toward *T. o. leakeyi* in the geologically younger individuals.

The male estimates for Kanjera agree well at ca. 50 kg for dental and cranial models (the latter only from NAIN, which seems to yield overly elevated mass values in large-sized taxa), but the AP measures on both humerus and femur yield far lower values of ca. 34 kg. A mass of 42 kg would seem a possible consensus estimate, especially if considered as the midpoint of a range. Female values agree better for all three regions, with an apparent average mass ca. 20 kg. However, the cranial estimate is pulled down by PORB, and the postcranial by humeral length, so the dental values might be better. On the other hand, the dental estimates are derived from measurements in Jolly (1972), which are uniformly high compared to those taken by ED on casts of the same specimens; for example, the Jolly value for m3AW yields a mass of 24 kg, while ED's measure leads to a mass of only 21 kg. A round 20 kg is accepted tentatively as a consensus mass. There is thus a dimorphism ratio of 2.1 (or higher, if the data are not "adjusted"). Three other authors have estimated mass for this population, using rather different methodology. Jolly (1972) estimated males at 35 kg and females at 21 kg from humeral and femoral diameters comparable to those we are using. His postcranial estimate matches ours for the male, but as noted, we consider that value too low; his female postcranial estimate is higher than ours and close to our consensus mass. Krentz (1993) obtained ca. 19 kg for females. Martin (1993) applied Dechow's (1983) equations from P3–M3 length to obtain estimates of ca. 60 kg for the male and ca. 28 kg for the female (averaging his OLS and major axis regression values). Both of these are quite high by comparison to the values we obtained. For males, we obtained a mass range of 36–42 kg using classical calibration.

The Swartkrans population is one of those most similar to Kanjera morphologically (Delson, 1993), and the mass values are also close. Here the estimation is easier, as the data are poorer: males at 42 kg dentally, females at least 24, perhaps 25 kg as a consensus. Two isolated specimens from Olduvai Bed I described by Jolly (1972) probably also represent *T. o. oswaldi.* A single, nearly complete, probably male humerus yields a mass estimate of 48 kg, while a partial female mandible yields 30 kg. Another isolated specimen is the well-preserved female cranium from Peninj (Tanzania, dated ca. 1.5 ± 0.2 Ma) discussed by Martin (1993). Martin estimated its mass with Dechow's (1983) P3–M3 equation at ca. 35 kg. This equation estimated values for the Kanjera crania well above those derived from our craniodental equations, suggesting that a value closer to 30 kg might be more reasonable for this large individual. It is unfortunate that Ndessokia's description of this specimen presented at the *Theropithecus* Conference was never published.

The specimens from Koobi Fora are sampled over a long interval of time. They yield a reasonable cranial female mass of 26 kg, but a single male (cast) skull dating ca. 2 Ma produces widely divergent estimates. The large dental range centers on 36 kg, while the even wider cranial range averages 72 kg. ED suggests reducing that, given the inflated estimates typical of NAIN at large size. Even with that adjustment, neither the 20% ranges nor the actual maxima and minima overlap! On the other hand, as discussed above, Leakey (1993) provided unsexed mass estimates from femoral head diameters (using a single large sample of *Papio h. cynocephalus* as the reference) of 27 to 37 kg for Koobi Fora. These are averages at four time horizons (total range 18–39 kg), which increase steadily with decreasing age. The largest estimate from the Upper Burgi horizon (equivalent to the large skull just mentioned) is 36 kg. Krentz (1993) published estimates of 43 kg for males and ca. 25 kg for females, with no indication of horizon. The dental and postcranial estimates are thus far lower than those from the cranium, but that cranium is much larger than the one from Kanjera, estimated here at 42 kg. It would seem that a male mass of 50 kg is a reasonable estimate for the average of this probably nonhomogeneous population.

Mass values rise significantly when considering the younger populations allocated to *T. o. leakeyi.* Males of two North African Middle Pleistocene populations (Tighenif or Ternifine and Thomas Quarry) are estimated at ca. 50 kg, as are males from the roughly contemporaneous South African site of

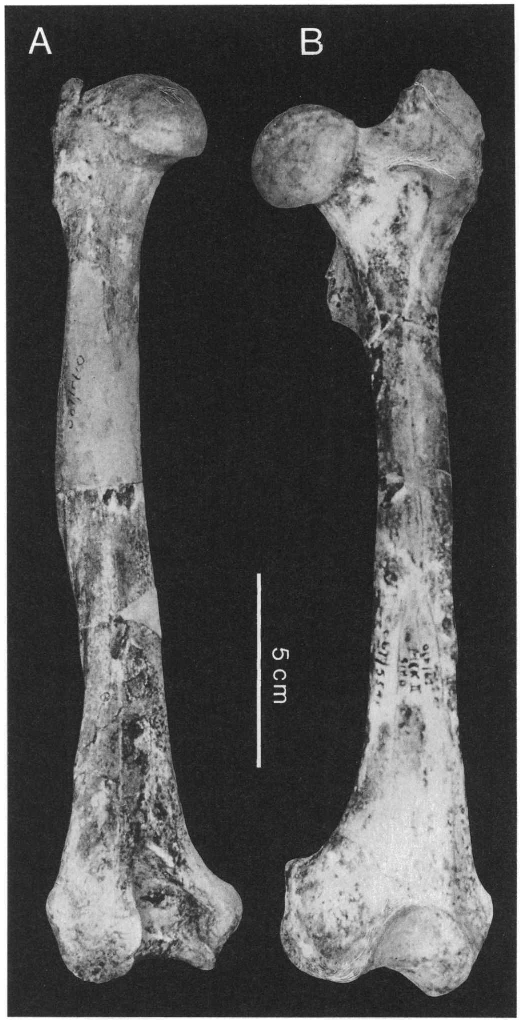

Fig. 11. **(A)** Left humerus, posterior view and **(B)** femur, anterior view: *Theropithecus oswaldi* cf. *leakeyi,* Olduvai Gorge Upper Bed II, courtesy F. Szalay.

Hopefield; females from the latter are estimated at 37 kg, for a low level of dimorphism. A partial male skeleton (fig. 11) with associated muzzle from Olduvai Upper Bed II (site MCK) provides numerous individual mass estimates, which agree reasonably well at ca. 60 kg (especially if extrema are rejected). Two of the largest mandibles of *T. oswaldi* are a new specimen from Kapthurin and the holotype of *T. "jonathoni"* (Leakey, 1993). The latter's horizon was originally described as upper Bed IV, but Hay (1976) redefined it as the Lower Ndutu Beds; Leakey

(1993) discussed it as from the older Masek Beds, but that may have been a lapsus. Mean measurements of these two jaws in Leakey (1993) also yield estimates close to 60 kg. Jolly (1972) estimated the mass of the Olduvai (lower) Bed IV holotype of this taxon at ca. 66 kg using a dental model, and we obtained 62 kg using his measures. Leakey and Leakey (1973, fig. 3) indicate that this specimen is larger in tooth area than any from Olorgesailie, but this appears to be due to the unworn elongate m2, as the m1 is even smaller than that of the Olduvai Bed II specimen.

The largest-sized sample of dental specimens of any *Theropithecus* come from Olorgesailie, Kenya (ca. 0.9–0.7 Ma), where there are also partial limb bones but no well-preserved crania. Models based on AP diameters of both humerus and femur yield an average male mass estimate of 95 kg, but the two estimates differ widely. Jolly (1972) estimated a mass of 63 kg for these elements. Male teeth provide a mean estimate of 75 kg, but the largest isolated teeth yield values up to 95 kg. A consensus estimate of 85 kg is reasonable, but a wide range around that is likely. For females, dental and postcranial estimates are closer and with a narrow range, averaging ca. 39 kg. The resulting dimorphism index of just over 2.0 is acceptable. Krentz (1993) obtained postcranial estimates of ca. 60 kg for males and 38 kg for females. Fleagle (1988) listed 96 kg for *T. oswaldi,* which presumably referred to this population. We obtained a mass range of 80–160 kg using classical calibration on partial postcranial elements.

The largest known cranium of *Theropithecus* is a specimen collected in the 1970s at Bodo (Ethiopia, ca. 0.6 Ma), but not previously published (fig. 12). A consensus estimate of 68 kg for a male appears reasonable. The teeth are smaller than those from Olorgesailie, implying that a male cranium from the latter site would have been significantly larger. It should be noted that only GLBA and NABA estimates were averaged to obtain the cranial value; the NAIN model yielded a mass of 317 kg, probably due to a combination of the extensive temporonuchal projection at inion and the apparent inflation of mass estimates at large size (strong positive allometry) for this variable (see fig. 13). This model also produced excessively high mass estimates for other large *Theropithecus* crania not reported here.

Although *Theropithecus* is essentially an African genus, two specimens have been reported from Eurasian localities. *T. o. delsoni* from Mirzapur (Early Pleistocene of India; see Delson, 1993) is known by an unsexed maxilla, while an isolated lower molar was reported from Cueva Victoria (Early Pleistocene of Spain; Gibert et al., 1995). In both cases, estimates were derived from male, female, and mixed-sex subfamily models to obtain a range of values. The result suggests a mass in the 45–50 kg range, implying that males of the Eurasian variety (varieties?) were of comparable size to their contemporaries in Africa.

Alemseged and Geraads (1998) have recently described a sample of mostly isolated teeth from Ahl al Oughlam, Morocco, dated ca. 2.5 Ma. They argued that this population could best be interpreted as a distinct species, *T. atlanticus,* whose holotype is an isolated lower molar from the slightly younger site of Ain Jourdel (Algeria; see Delson, 1993). ED is not convinced of this species distinction: Most of the diagnostic characters proposed by Alemseged and Geraads (1998) do not appear to be unique, and the supposedly short upper canine appears to be more worn than they thought. This may represent a population transitional between *T. darti* and *T. oswaldi* that also shows some distinctions due to geographic isolation. Unsexed teeth from Ahl al Oughlam yield mass estimates averaging 29 kg. The Ain Jourdel tooth was identified as an m1 by Delson (1993), in which case its mass estimate would be in the 40–50 kg range. But based on its size compared to the similar Ahl al Oughlam teeth, it may well be a small m2, which would produce a more reasonable mass estimate ca. 23 kg.

The other major extinct lineage, that leading to *T. brumpti,* is the most debated within the genus.? *T. baringensis* is only definitively known from locality JM 90 of the Chemeron Fm. (Kenya, ca. 3.2 Ma) by the holotype male skull (lacking the posterior neurocranium) and a second mandible. A consensus estimate of mass is ca. 26 kg.

T. brumpti itself is known around the Tur-

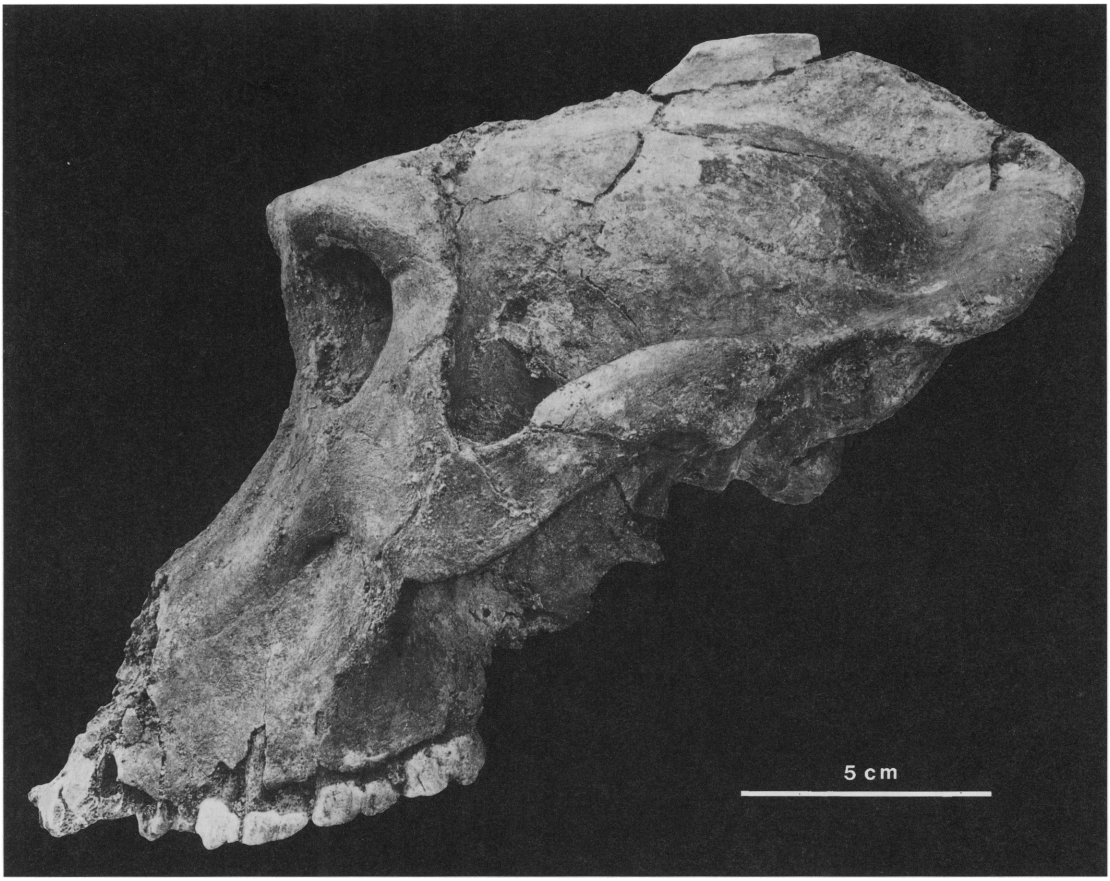

Fig. 12. Left lateral view of male cranium of *Theropithecus oswaldi leakeyi,* Bodo, Ethiopia.

kana Basin, from ca. 3.4–2.0 Ma. The two best-preserved male crania derive from the Omo Shungura Fm. (Submember C-6) and the West Turkana Nachukui Fm. (Upper Lomekwi Member), both dated ca. 2.7 Ma. Despite their similarities in general morphology (Eck and Jablonski, 1987; Leakey, 1993), the latter is slightly larger than the former. Mass estimates differ greatly: The Shungura male's mass is estimated at only half that of the West Turkana specimen (see fig. 13). This surprising result emphasizes the positively allometric nature of these cranial variables. The dental measurements averaged over all Turkana Basin specimens yield a male mass of 36 kg, which may be the best general estimate. Fleagle (1988) listed a mass estimate of 50 kg, presumably for an average male, but without details. The female cranial estimates (based mainly on subfamily models) suggest that the dental mean of 24 kg might be reduced to 21 kg in a consensus. Values for this species are so variable, that a closer approach is difficult, but it appears that sexual dimorphism is relatively low in any case. Krentz (1993) obtained postcranial estimates of ca. 43 kg for males and 25 kg for females.

The oldest known *Theropithecus* specimen is a single tooth (probably an m2; see Delson, 1993) from the Kalochoro Member of the Nachukui Fm. at Lothagam (previously Lothagam 3), dated ca. 3.7–3.5 Ma (Leakey et al., 1996). Its estimated mass depends upon the sex allocation, but the range falls closest to that of Makapan *T. darti,* larger than might be expected for an ancient population of the genus.

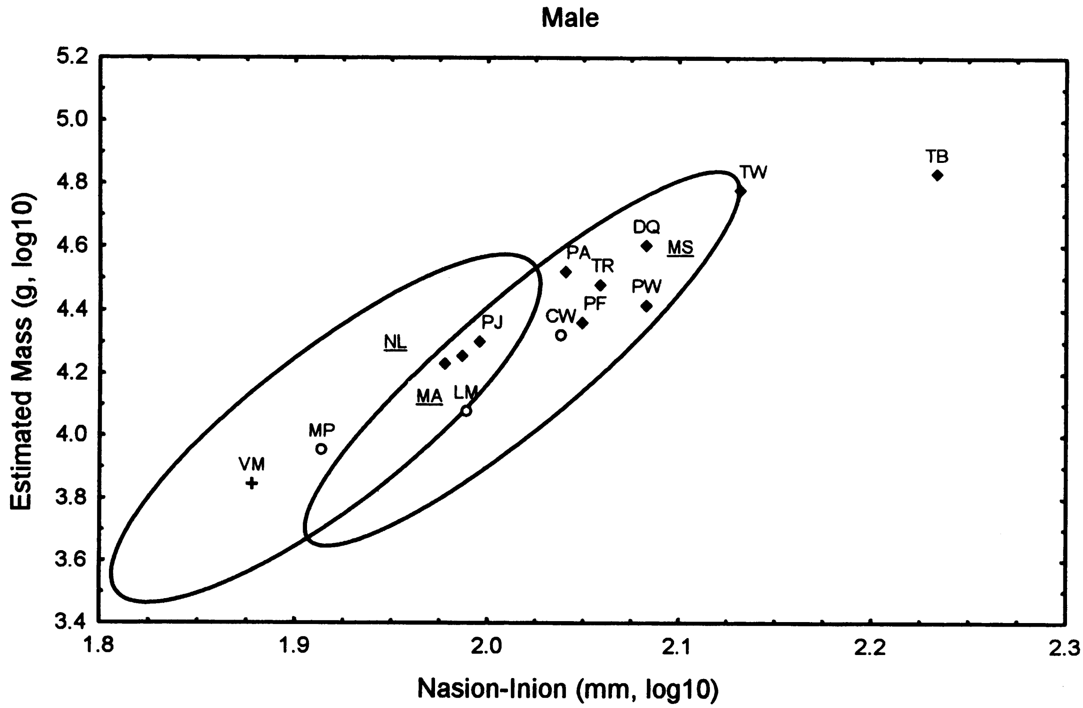

Fig. 13. Estimated mass in extinct cercopithecids compared to nasion-inion (neurocranial length), males only. Conventions as in figure 4. Taxon identifications as follows: CW, *Cercopithecoides williamsi,* South Africa; DQ, *Papio (Dinopithecus) quadratirostris,* Omo; LM, *Libypithecus markgrafi*; MA, *Macaca sylvanus*; MP, *Mesopithecus pentelicus*; MS, *Mandrillus sphinx*; NL, *Nasalis larvatus*; PA, *Paradolichopithecus arvernensis*; PF, *Parapapio* sp. indet., Kanapoi; PJ, *Parapapio* cf. *jonesi,* Hadar; PW, *Parapapio whitei*; TB, *Theropithecus oswaldi leakeyi,* Bodo (note that the mass estimate for this single cranium is based on other cranial variables: NAIN predicted a mass of over 300 kg [ca. 5.5 on the $\log_{10}$ scale], as discussed in the text). TR, *Theropithecus brumpti, Shungura cranium*; TW, *Theropithecus brumpti,* West Turkana cranium; VM, *Victoriapithecus macinnesi.*

VICTORIAPITHECINAE

The two earliest recognized genera of Old World monkeys are set off in this basal subfamily (or family, according to Benefit, 1993). Only family models have been used to estimate mass from the dentition of these taxa, in order not to violate the systematic-statistical basis of their construction. Both species of North African *Prohylobates* (dated ca. 17–15 Ma) are known only by worn and often fragmentary lower dentition. *P. tandyi* females suggest a mass of 7 kg, while the unsexed jaw of *P. simonsi* yields a mass estimate of 20 kg. It is most likely that this reflects a male value, for otherwise the species would have been huge, with males in the 30–40 kg range. Fleagle's (1988) estimates of 7 and 25 kg, respectively, are quite close to ours. Napier (1985, using the all-primate m2 length regression calculated by Kay and Simons, 1980) estimated the mass of *P. simonsi* at 19 kg. In his original description of *P. simonsi,* Delson (1979) indicated that no younger African cercopithecid had teeth as large until mid-Pliocene *Rhinocolobus* or *Paracolobus.* Our mass estimates for the seemingly smaller-toothed Late Miocene Menacer colobine and also the Early Pliocene Colobinae "species A", however, are 21 kg, which agrees with the scaling result discussed above that, at a given body size, colobine teeth are smaller than those of cercopithecines (see table 17).

Victoriapithecus macinnesi is by far the best known of the early cercopithecids, due especially to the recent analyses by Benefit

TABLE 17
Victoriapithecine Mass Estimates

	Postcranium		Dentition		Cranium	
	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%	Estimated mass	Est. mass ± 20%
Prohylobates tandyi Wadi Moghara						
Female						
Mean			7.0[F]			
Min			5.5[F]	5.5[F]		
Max			9.0[F]	8.5[F]		
Prohylobates simonsi Gebel Zelten						
Sex unknown						
Mean			20.0[F]			
Min			17.0[F]	16.0[F]		
Max			26.0[F]	24.0[F]		
Victoriapithecus macinnesi Maboko						
Sex unknown						
Mean			8.5[F]			
Min			6.5[F]	6.5[F]		
Max			10.5[F]	10.5[F]		
Male						
Mean					6.0[F]	
Min					5.5[F]	4.5[F]
Max					7.0[F]	7.5[F]

See notes for table 14.

and colleagues. This species from Maboko (Kenya, ca. 15 Ma) is now known by hundreds of teeth, numerous (mostly unpublished) postcranial elements and one beautifully preserved cranium (Benefit and McCrossin, 1997). The unsexed teeth yield a mass of 8.5 kg, in the range of smaller black-and-white colobus (*C. polykomos* or *C. guereza occidentalis* or *matschiei*) if dimorphism was low, or perhaps *Macaca assamensis* or *Semnopithecus entellus thersites* at a higher dimorphism level. This species mean value is high compared to the estimate of 3.5–5 kg that Harrison (1989) published for generally fragmentary postcranial elements on the basis of rough size comparisons (similarity to species of *Cercopithecus*). Fleagle (1988) published a mass of 7 kg for this species, but whether from dental or postcranial remains is not certain.

Benefit and McCrossin (1997) suggested that the teeth looked large compared to the size of the cranium they were describing, which might imply a strong degree of macrodonty for the species. The cranial estimates (NAIN higher, GLBA and NABA lower) are fairly close and average 6 kg, between the dental and (Harrison's) postcranial values (see fig. 13). Ignoring the latter, and assuming low sexual dimorphism, a consensus species mean mass might be close to 7 kg. This type of problem is expected for a taxon that lies outside the two subfamilies from which the estimation models were derived. The question of macrodonty requires a more detailed treatment of additional data.

The phyletic position of *Victoriapithecus* is under some discussion, but one suggestion that has been mooted is that it might already be near the base of the cercopithecine clade, rather than a basal stock for the family. Given that the cranium can be sexed as male, we applied the two subfamily male models to it in order to see what information this might provide. If it were a colobine skull, it would suggest a species mass of ca. 6.5 kg (each of the three models yielding value ca. 0.5 kg higher than the family models). But if treated as a cercopithecine, all three models produced similar, far lower estimates, ca. 2.5 kg! This appears to make sense, as the cercopithecine estimation line is transposed below that of colobines for several cranial variables (see fig. 3A).

DISCUSSION

The process of estimating body mass for fossil taxa is fraught with difficulties, many of which can be traced directly to inconsistencies of the estimates. An extended discussion of the relevant problems in estimation approach and application can be found in Smith (1996) and responses therein. From a review of this work and other recent contributions (e.g., Smith, 1993; Aiello and Wood, 1994; Rafferty et al., 1995; Konigsberg et al., 1998), it appears that the process of estimation has received greater scrutiny than has the application of estimates. In what follows, we briefly discuss some unresolved problems in both approach and application, focusing on the primate literature, and then we look at several aspects of our own data in more detail.

Some Theoretical and Methodological Questions

Selection of Variables

At present it is difficult, based on a priori reasoning, to determine which measurements are best used to estimate mass. However, in this study we find (from our known-mass test sample) that postcranial measures perform slightly better than dental measures, which are in turn better than cranial–based estimates. This is similar to the regional differences found in other primate groups (prosimians: Dagosto and Terranova, 1992; catarrhines: Rafferty et al., 1995; see also Aiello and Wood, 1994).

It is clear from these and other studies that cranial and dental features found to perform well in one group should not be assumed to perform similarly in others. For example, orbital dimensions preferred by Aiello and Wood, 1994 (primarily for pragmatic reasons related to the availability of fossil material) do not perform at all well when examined in cercopithecids (see above). In their study of mass estimation in fossil hominins, several measures of the orbit are identified as the best perfoming cranial estimators in selected anthropoids (using a *Callithrix*-to-*Gorilla* range) and hominoids (*Hylobates*-to-*Gorilla*), with estimation performance gauged by the standard error of the estimate. Their data are composed of measurements representing 4 New World monkey taxa, 13 taxa of Old World monkeys, and 6 hominoids; sex-specific species mean masses were taken from Harvey et al. (1987). The many problems associated with literature-based means are discussed above and in Smith and Jungers (1997). Moreover, the use of a range of taxa dominated by one very small and one very large form often results in a regression line anchored by those endpoints and less sensitive to the influence of all intermediate data. Finally, while we strongly advocate the empirical approach to estimator identification, we emphasize that reliable comparative data, with respect to the nature of the taxon mass values and to the choice of a proper reference group, is of fundamental importance. A sufficient test of estimator efficacy can only be based on known-mass samples, as it is impossible to examine accuracy in any other way.

It is possible that orbital measures do not perform well in our study of Old World monkeys (see figs. 3C–D, and 14), a group that dominates the Aiello and Wood comparative sample, for any of several reasons. For example, differences in scaling pattern across phylogenetic or functional subgroups of anthropoids may be at work here. Schultz (1940) and Ross (1995) have indicated that eye volume and orbital volume scale with slight negative allometry among anthropoid primates. The negative allometry in itself will not affect the predictive power of this variable, and the scaling patterns within lower taxonomic groups are not necessarily the same as that for all anthropoids. We do not accept that just noting the correlation between orbital volume and mass, as Kappelman (1996) did when recalculating data from Schultz (1940) to obtain an r value of 0.964, is sufficient reason to expect that the variable will prove to be a robust surrogate for mass. It is not straightforward to identify predictors in this way; rather, such a selection should be based on both exploratory and confirmatory analyses. Noting a high and significant correlation between a potential surrogate and mass is the first step; a proper test of the

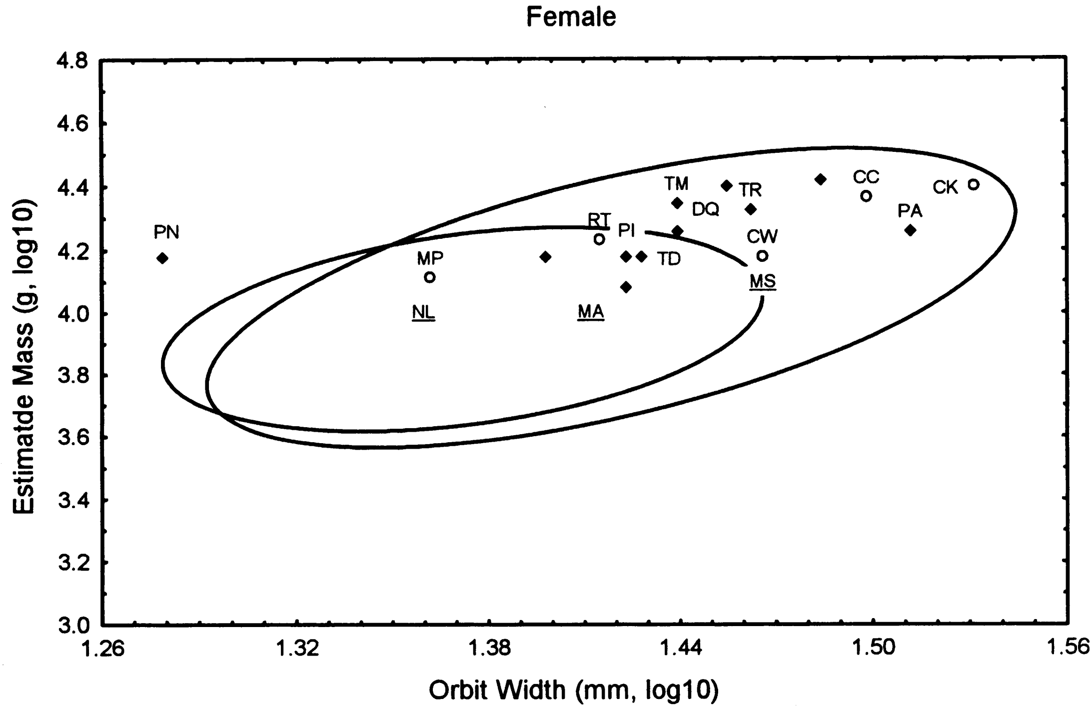

Fig. 14. Estimated mass in extinct cercopithecids compared to orbit width, females only. Conventions as in figure 4. Taxon identifications as follows: CC, *Cercopithecoides* cf. *williamsi* (large), Kromdraai B; CK, *Cercopithecoides kimeui,* Koobi Fora; CW, *Cercopithecoides williamsi,* Makapan and Sterkfontein; DQ, *Papio (Dinopithecus) quadratirostris,* Omo; MA, *Macaca sylvanus*; MP, *Mesopithecus pentelicus*; MS, *Mandrillus sphinx*; NL, *Nasalis larvatus*; PA, *Paradolichopithecus arvernensis*; PI, *Papio izodi,* Taung; PN, *Papio angusticeps,* Coopers; RT, *Rhinocolobus turkanaensis,* Turkana and Hadar; TD, *Theropithecus darti,* Hadar; TM, *Theropithecus darti,* Makapan; TR, *Theropithecus brumpti,* Turkana.

efficacy of the variable in an independent sample (as in the sample of taxa held out from the development of prediction equations above) or some other means of confirmation must follow.

Recall that there was no clear relationship between the value of a correlation (that is, among those that are significant and high) and prediction accuracy in the test sample examined above. Indeed, even enhanced accuracy in orbital–area measurement (Kappelman, 1996) does not ameliorate this situation. Kappelman indeed found that the area of the orbital aperture was highly correlated ($r = 0.987$) with literature-derived species mean mass in cercopithecoids and hominoids. However, no tests were presented for evaluating *accuracy* in that study: Different regions (femoral head vs. orbital measures) were compared based only on their *consistency* relative to masses from the literature (e.g. Fleagle, 1988).

From our analyses we can suggest that humeral and femoral dimensions may well be more broadly applicable than dental or cranial dimensions (see the section on interregional comparisons below). It is vitally important, however, to demonstrate the relationships between mass and the potential surrogate variables for the particular sample under investigation. Empirical verification of potential surrogates must be a part of any estimation routine. Estimates that are constructed without a test on a known-mass sample (as above, and following the suggestions of Smith, 1985) should be viewed with extreme caution.

The performance of any variable is contingent on the nature of the comparative sample. The choice of this sample is perhaps most deserving of close scrutiny. For the present work we were able to restrict our estimation models to the subfamily (by sex) level. This level of organization reflects the broad ecological and structural variation within the cercopithecids.

One such structural difference between cercopithecines and colobines relates to their diets, broadly frugivorous vs. folivorous. Colobines thus require digestive tract modifications that enhance the efficiency of their digestion (see, e.g., Fleagle, 1998). As a part of these special adaptations it is possible that these folivorous monkeys maintain a greater percentage of their body weight in their digestive tracts than their cercopithecine cousins. In order to directly assess the variation in mass composition between the two groups, and thereby examine the functional anatomy of mass distribution, we require additional data on the body and organ mass of Old World monkeys.

Kuhn (1964) and Jones (1970) briefly reported on stomach contents and mass in several cercopithecid taxa. These incomplete data indicate that approximately 8–12% of body mass is contained in the digestive tract of colobines, while cercopithecine tracts represent a similar or perhaps slightly smaller percentage of total mass. We require further data to offer a reasoned contrast of mean mass in these groups. Recall that several scaling differences were found above between the two subfamilies. These differences, which we tried to explain as resulting from functional (locomotor) or dietary adaptation, might instead reflect a more basic biological difference between the subfamilies relating to "excess" mass in the colobine gut. It is important to keep this possible difference in the biology of mass in mind when developing mass estimates or examining the functional anatomy of the skeleton.

Selection of Models

We employed OLS regression for estimation purposes. Comparisons between regression of mass on surrogate variable and surrogate variable on mass are important to undertake, especially if it is reasonable to expect that the fossil groups are lighter or heavier than the comparative sample. It appears that model selection is an important step in the estimation process, and we advocate the application of several model types to ensure that results are not model dependent. Konigsberg has provided an efficient means of applying several models simultaneously (see above). As is clear from the above analyses, taxa at the extreme ends of the modern distribution are particularly problematic. In the future, and especially for large and small taxa, we consider reporting estimates based on at least two models to be useful, or even necessary, if extrapolating beyond the comparative sample.

The Form of the Answer

A main feature of Smith's 1996 paper is an admonition that confidence or prediction intervals must be incorporated in the use of estimates. In the present study we devised an interval around the point estimate with respect to the extent of mass variation in living Old World monkeys. A rule of thumb first advocated by Dagosto and Terranova (1992) is to include a range of 20% around a mass estimate. This range, as opposed to an equation-derived confidence interval, can be altered to accommodate the amount of mass variation within the comparative sample. For example, if one is interested in estimating mass in taxa that fluctuate seasonally in mass (e.g., estivators or hibernators), then a larger percentage range should be employed. Certainly, the reporting of a mass estimate to the tenth of a gram (or even kilogram) is biologically and statistically inappropriate. Available databases of modern population masses are variable in depth and reliability. Even ours and that of Smith and Jungers (1997) are inadequate for numerous taxa, and few have ever been published. We expect this situation to steadily improve, for example, if workers such as Colyn (1994) would publish the full details of data that are now merely summarized.

It is implicit in the construction and reporting of the range that: (1) the true value is expected to lie within the range, and (2) derived calculations based on the estimates should also be based on a range. This view of the form of an answer to a mass estimation question requires that we focus more clearly on the types of questions that can be evaluated using a mass estimate. Broad comparisons are easily accomplished, while detailed comparative biomechanical or ecological hypotheses that require the use of a single value for mass must realistically be riddled with caveats.

Interregional Estimation Comparisons

We have compared the performance of the three anatomical regions in a sample of modern, known-mass taxa above (and see table 9). It was not straightforward to choose any one region as most accurate or consistent since the majority of taxa were estimated to within 20% of known mass by variables from each of the three regions. One general tendency (by no means universal or even consistent) is for estimates to be high in light taxa (mass under 10 kg) but low in heavier taxa (mass greater than 10 kg).

Among living colobine males, estimates derived from dental variables are usually higher than those from postcranial measures. Cranial estimators are poorly behaved, with no valid equations for subfamily by sex and only one for all colobines; the latter usually yields a low estimate, while the equations based on all cercopithecids provide high estimates. In general, the postcranial equations provide the most accurate estimates. In smaller taxa, estimates are usually high, while they are low in some of the larger taxa, but not in *Semnopithecus entellus,* where the median estimate is most accurate. The pattern is broadly similar for female colobines, with the postcranial and dental estimates close to each other, but lower than those from the cranium (family equations), except in *Nasalis,* where the cranial estimate is low. All estimates tend to be high compared to the "true" compiled mass, although the available estimates for *Semnopithecus* are highly accurate.

Turning to male cercopithecines, postcranial estimates are generally higher than those from the dentition, although the situation is reversed in *Theropithecus*; cranial estimates are variable compared to the others. In general the "true" mass lies between the postcranial and dental estimates and toward the low end of the range, even in some larger taxa. Among females, the postcranial estimates are higher than those derived from dental variables in smaller taxa, but this is reversed in the "baboons." Cranial estimates are higher than postcranial, except in *Macaca sylvanus.* The postcranial estimates appear most accurate, but there is much overlap among the regions.

Among the extinct colobines, estimates derived from dental variables are almost uniformly the highest, often showing some overlap with either postcranial or cranial estimates when available for the same sample. Preservational problems in *Rhinocolobus* are discussed above. The pattern of dental estimates being higher than cranial estimates is also common among cercopithecines, but there are many exceptions. Postcranial estimates, especially for males, are almost always higher than dental estimates, either with slight overlap (*Paradolichopithecus, Theropithecus* cf. *darti,* Olorgesailie *Theropithecus oswaldi*) or significant overlap (*Parapapio* cf. *jonesi,* Olduvai *Theropithecus oswaldi*). But in a few cases (Hadar female and all Kanjera *Theropithecus*), the subequal cranial and dental estimates were larger than those derived from the postcrania. Excluding cases where cranial and dental estimates were nearly identical, those from cranial variables were larger than those of dental origin in males of *Papio* (*Dinopithecus*) *quadratirostris, Theropithecus oswaldi* from Koobi Fora and Bodo,? *T. baringensis* and *T. brumpti* (although in the latter, different individuals may be involved). It must be recalled that our equations are based on a theoretical model of estimating mass for a sample, not an individual, and thus some stochastic variability is to be expected when single fossils are involved.

Paleobiological Applications of Our Estimates

Here we use the mass estimates in this study to examine patterns of sexual dimorphism, size change through time, and energetics in cercopithecid taxa. In addition, this compilation of mass estimates will most likely be used by future researchers interested in a variety of functional, ecological, or systematic questions. We strongly suggest that these applications be made with a complete understanding that a single value for a taxon is, at best, misleading. Derived variables, such as EQ, cannot be taken seriously unless they are constructed as ranges.

Sex Dimorphism

Values of sexual dimorphism in mass (M/F ratio) were calculated where possible. Many large taxa showed dimorphism in the 2:1 range, as might be expected from values for modern *Papio* subspecies, and the general tendency of large modern forms to show strong dimorphism. At least two of the larger colobines, however (*Dolichopithecus ruscinensis* and especially *Cercopithecoides williamsi*), had somewhat lower levels of mass dimorphism. A similar pattern of low dimorphism compared to modern species of equivalent male mass is even more common among the cercopithecines. In fact, only *Papio (Dinopithecus) quadratirostris, Olorgesailie Theropithecus* and? *Pararapio ado* have dimorphism values similar to living forms of equal (male) mass.

Evolution of Cercopithecid Mass Through Time

For each main group of cercopithecids, mean masses by sex (with a 20% range) were plotted against time for interesting fossil samples plus a selection of modern taxa to provide a baseline. In a few cases, fossil taxa were known from multiple site units and thus over a long time span; these are indicated by repeating the mean and range bar at the oldest and youngest time level (and at the mean). In general, the pattern observed is that of a relatively small-sized early member of the group, with both small and larger taxa at younger horizons.

For the Colobinae, this pattern is clearly observed (fig. 15). *Micropithecus tugenensis* and *Mesopithecus pentelicus* (points P and O) are comparable in mass to the smaller end of the modern range, but after ca. 4.5 Ma, several taxa (or lineages) appear at larger sizes. The three *Paracolobus* taxa (points K, I, and F) suggest a steady increase in body size through the Pliocene. Delson (1975, 1994) has suggested that European Pliocene *Mesopithecus monspessulanus* and *Dolichopithecus ruscinensis* (here points J and L) may represent descendants of *M. pentelicus* that underwent character displacement in both size and terrestriality; the offset in mass is reflected here. The well-known high diversity of Afrian Pliocene colobines in general is also seen in these plots.

European and North African papionins (fig. 16) are relatively rare, but they demonstrate long-term consistency of size in the taxa associated with the living *M. sylvanus.* The two temporal samples of male *Paradolichopithecus* (points E and G) project back to an early Pliocene form like *M. s. prisca* (point F).

The papionins of sub-Saharan Africa (other than *Theropithecus*) are more numerous, and again show a pattern of younger taxa with greater size diversity (fig. 17). The majority of points (I–O) represent samples of *Parapapio,* mainly from South Africa, documenting a moderate size range in the mid-Pliocene. The near identity of size in *Parapapio antiquus* and *Papio izodi* from Taung (points E and F) has been noted by Delson (1989) as making allocation of less complete specimens difficult. The long-ranging subspecies *P. h. robinsoni* of the modern species *Papio hamadryas* (points A and G) is comparable in mass to the larger living populations. The largest samples plotted here are placed in *Papio (Dinopithecus).* The Angolan population (H) appears slightly larger than the contemporaneous and long-ranging one from Omo (D), either of which might conceivably be ancestral to the "giant" Swartkrans sample (B).

The plot of *Theropithecus* samples (fig. 18) is perhaps the most interesting. Jolly (1972) was among the first to notice that the molars of this genus tended to increase in size concordantly with age. Delson (1983) plotted m3 anterior width (m3AW) against time for numerous individual specimens, revealing a similar trend. However, both Jolly and Delson indicated that the Kanjera sample was small in tooth size, but widely thought to be young (though Delson was aware of alternative age suggestions). Eck (1987, 1993) further discussed this question using sample means and considering Kanjera of

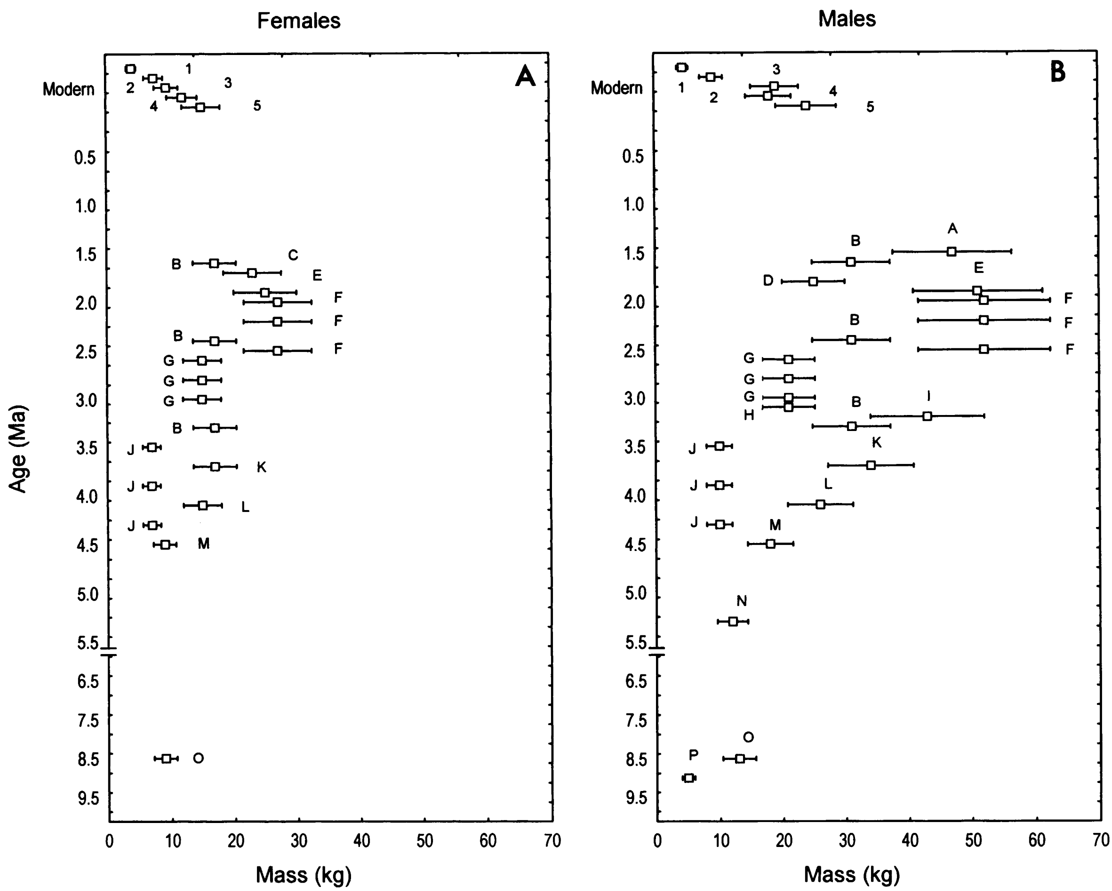

Fig. 15. Plot of mass through time for Colobinae: (**A**) females; (**B**) males. Double line (=) on age axis indicates change of scale. Boxes indicate sample means, bars indicate 20% range about the mean. Modern taxa: 1) *Procolobus verus*; 2) *Colobus guereza occidentalis*; 3) *Nasalis larvatus*; 4) *Pygathrix (Rhinopithecus) roxellana*; 5) *Semnopithecus entellus schistacea* (sensu stricto). Extinct taxa: (A) *Cercopithecoides kimeui* (Olduvai Bed II); (B) *Rhinocolobus turkanaensis* (Turkana Basin; specimens range in age between ca. 1.5 and 3.3 Ma, so the data are plotted three times to indicate this range); (C) *Cercopithecoides? williamsi,* "large variant" (Kromdraai); (D) ?*Cercopithecoides* cf. *williamsi* (Koobi Fora); (E) *Cercopithecoides kimeui* (Koobi Fora); (F) *Paracolobus mutiwa* (Turkana Basin; specimens range in age between ca. 2.0 and 2.5 Ma, so the data are plotted three times to indicate this range); (G) Cercopithecoides williamsi (Makapansgat and Sterkfontein Member 4; specimens range in age between ca. 2.6 and 3.0 Ma, so the data are plotted three times to indicate this range); (H) Colobinae indet. "species A" (Hadar and Leadu); (I) *Paracolobus chemeroni* (Chemeron loc. JM 90); (J) *Mesopithecus monspessulanus* (Pliocene localities; specimens range in age between ca. 3.5 and 4.3 Ma, so the data are plotted three times to indicate this range); (K) *Paracolobus* sp. (Laetoli); (L) *Dolichopithecus ruscinensis* (Perpignan); (M) *Colobinae* indet. cf. "species A" (Aramis); (N) *Libypithecus markgrafi* (Wadi Natrun); (O) *Mesopithecus pentelicus* (Pikermi); (P) *Microcolobus tugenensis* (Ngeringerowa).

comparable age to Swartkrans, while Leakey (1993) also commented on size change through time. Delson and Hoffstetter (1993) briefly noted the greater size of Olorgesailie teeth compared to those from Hopefield and Tighenif, and the even smaller (but younger) Thomas Quarry jaw.

The discussion above has documented ages for over a dozen samples of *T.* (*Theropithecus*), and the plots indicate a somewhat

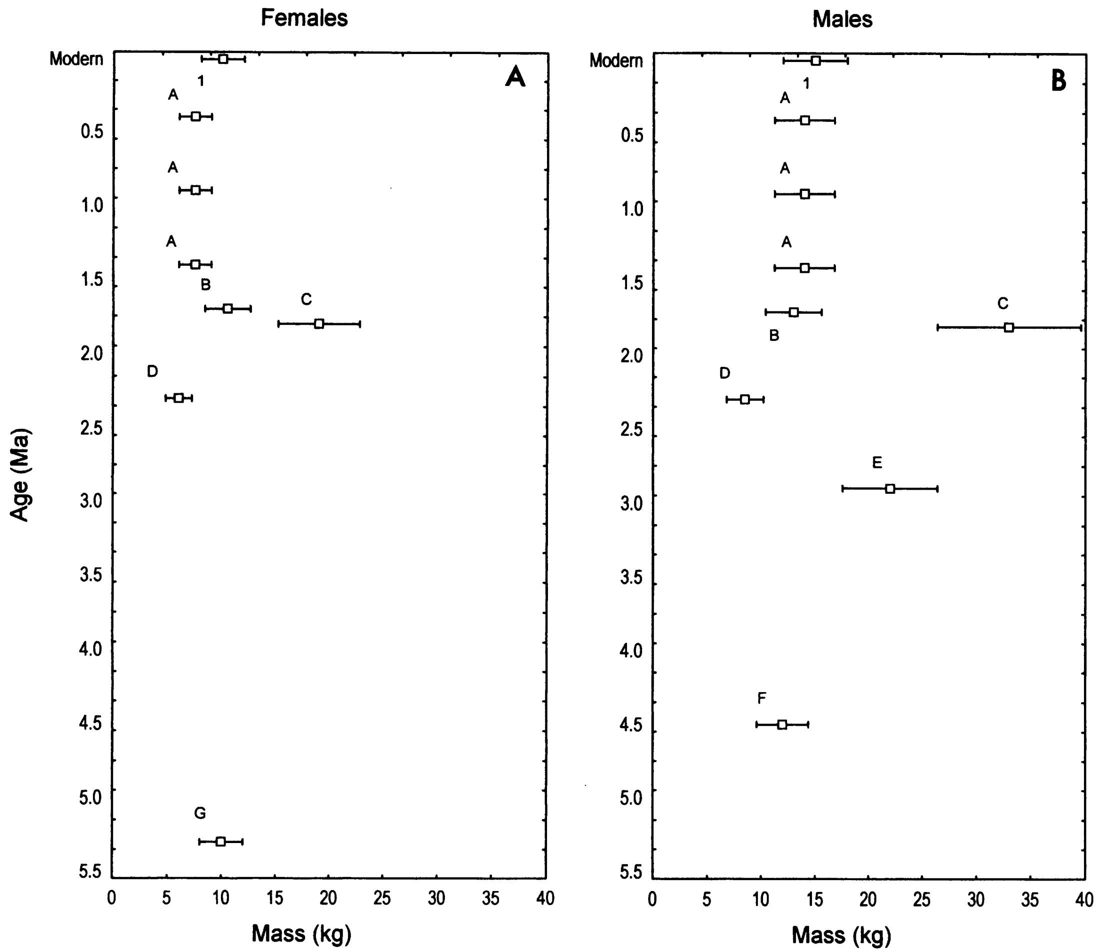

Fig. 16. Plot of mass through time for European and North African Cercopithecinae: (**A**) females; (**B**) males. Boxes indicate sample means, bars indicate 20% range about the mean. Modern taxa: 1) *Macaca sylvanus sylvanus.* Extinct taxa: (A) *Macaca sylvanus pliocena* (Pleistocene localities; specimens range in age between ca. 0.4 and 1.4 Ma, so the data are plotted three times to indicate this range); (B) *Macaca sylvanus florentina* (Valdarno); (C) *Paradolichopithecus arvernensis* (Graunceanu and Senèze); (D) *Macaca majori* (Capo Figari); (E) *Paradolichopithecus* sp. (Cova Bonica); (F) *Macaca sylvanus prisca* (Montpellier); (G) *Macaca libyca* (Wadi Natrun).

different pattern. Following some size increase within *T. darti* and on to early members of *T. o. oswaldi,* most samples (points A, B, D, G, I, J, and K) of that species (including some placed here in *T. o. leakeyi*) demonstrate near stasis in male mass from 2 to 0.4 Ma. Females are less well represented, but they are perhaps even more consistent through time. On the other hand, male samples from Olorgesailie and upper levels at Olduvai (points E, F, and H) suggest a separate trend, with increasing size from 1.5 to 0.7 Ma. Surprisingly, the single very large male cranium from Bodo (point C, 0.6 Ma) is intermediate in size between these two groups. It is not clear whether there is actually more than one phyletic lineage involved here (which might have implications for taxonomy) or just greater variability in size in the younger samples. Perhaps further analysis of samples from the Middle Aawsh and various Kenyan localities (S. Frost, dissertation in preparation) may clarify this question (but see also the next section).

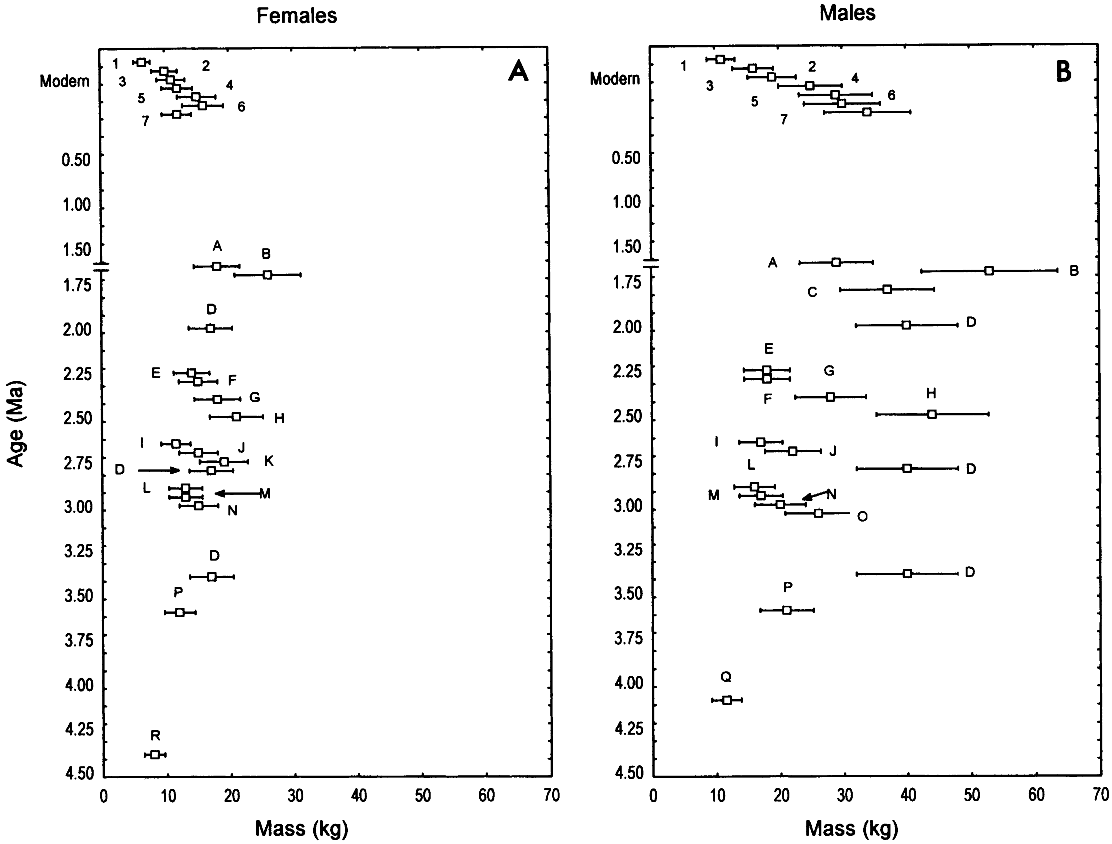

Fig. 17. Plot of mass through time for African Papionini other than *Theropithecus*: **(A)** females; **(B)** males. Double line (=) on age axis indicates change of scale. Boxes indicate sample means, bars 20% range about the mean. Modern taxa: (1) *Cercocebus torquatus atys*; (2) *Papio hamadryas kindae*; (3) *Papio hamadryas hamadryas*; (4) *Papio hamadryas cynocephalus*; (5) *Papio hamadryas ursinus*; (6) *Papio hamadryas anubis* ("larger"); (7) *Mandrillus sphinx*. Extinct taxa: **(A)** *Papio hamadryas robinsoni* (Swartkrans Member 1); (B) *Papio (Dinopithecus) ingens* (Swartkrans Member 1); (C) *Gorgopithecus major* (Kromdraai); (D) *Papio (Dinopithecus) quadratirostris* (Omo Shungura and Usno; specimens range in age between ca. 2.0 and 3.4 Ma, so the data are plotted three times to indicate this range); (E) *Parapapio antiquus* (Taung); (F) *Papio izodi* (Taung); (G) *Papio hamadryas robinsoni* (Sterkfontein Member 4 and Bolt's Farm); (H) *Papio (Dinopithecus) quadratirostris* (Leba); (I) *Parapapio jonesi* (Sterkfontein Member 4); (J) *Parapapio broomi* (Sterkfontein Member 4); (K) *Parapapio whitei* (Sterkfontein Member 4); (L) *Parapapio* cf. *jonesi* (Hadar); (M) *Parapapio jonesi* (Makapansgat); (N) *Parapapio broomi* (Makapansgat); (O) *Parapapio whitei* (Makapansgat); (P) ?*Parapapio ado* (Laetoli); (Q) ?*Parapapio* sp. indet. (Kanapoi); (R) ?*Parapapio* sp. indet. (Aramis).

In order to permit examination of the full range of cercopithecid mass evolution, a selection of the populations discussed above were plotted together with those of victoriapithecines (fig. 19). The persistence of low-mass taxa (at the left edge of the plot) from 17 Ma onward is clearly documented. This pattern is one of several that have been used to illustrate aspects of "Cope's Rule" (cf. Jablonski, 1996; Alroy, 1998). The large size of the early, presumably male *Prohylobates simonsi* (point AC) discussed above is also readily observed. Around 2 Ma, there were large taxa in all three African groups: *Paracolobus mutiwa* (point I), *Papio* (*Dinopithecus*) *ingens* (point E), and *Theropithecus oswaldi* (point F), but only the last of these either persisted or continued to increase in size.

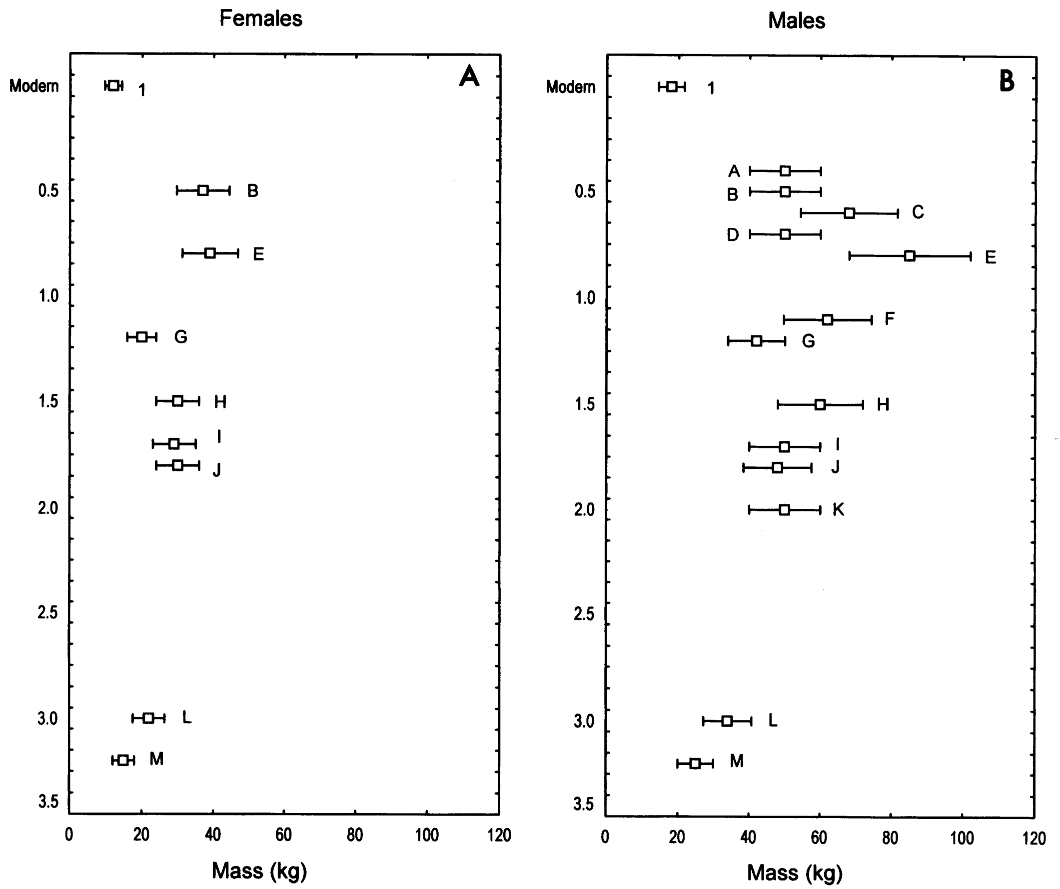

Fig. 18. Plot of mass through time for African *Theropithecus*: **(A)** females; **(B)** males. Boxes indicate sample means, bars 20% range about the mean. Modern taxa: (1) *Theropithecus gelada*. Extinct taxa: (A) *Theropithecus oswaldi leakeyi* (Thomas Quarry); (B) *T. o. leakeyi* (Hopefield); (C) *T. o. leakeyi* (Bodo); (D) *T. o. leakeyi* (Tighenif); (E) *T. o. leakeyi* (Olorgesailie); (F) *T. o. leakeyi* (Olduvai Bed IV); (G) *T. o. oswaldi* (Kanjera); (H) *T. o. oswaldi* (Olduvai Upper Bed II and Peninj); (I) *T. o. oswaldi* (Swartkrans Member 1); (J) *T. o. oswaldi* (Olduvai Bed I); (K) *T. o. oswaldi* (Koobi Fora Upper Burgi Member); (L) *T. darti* (Makapansgat); (M) *T.* cf. *darti* (Hadar).

Extinct Cercopithecid Mass and Energetics

At the start of this study, it was noted that part of the impetus to undertake it came from Dunbar's (1992) analysis of energetics in African Plio-Pleistocene "baboons." Basing his study on mass data from Fleagle (1988), Dunbar determined that *Dinopithecus ingens* was so large (77 kg) that it "must have" had a *Theropithecus*-like diet in order to have sustained large enough group sizes for survival in its local environment. He realized that its incisors were large, unlike those of *Theropithecus* species, and thus suggested a diet concentrating on plant underground storage organs. But he thought that the ecological factors controlling densities of such foodstuffs would be similar to those relevant to grasses, and thus postulated a geladalike rather than baboonlike pattern from which to model group size.

In addition to mass estimates for fossils, Dunbar accepted the results of several good analyses of paleoenvironment for the sites yielding them. He also assumed that a major climate change occurred around 2.5 Ma, with a great decrease in rainfall in Ethiopia for example, and he estimated additional climate parameters from other works he cited. It is beyond the scope of this study to recalculate all of the population sizes involved, but a few notes are possible.

The most important factor, of course, is the mass estimate itself. Dunbar recognized that this was at the heart of his analysis, but assumed that Fleagle (1988) was providing an average (mixed-sex) value for any species listed. We have noted above that there was no way to tell whether that was true, and in these cases Fleagle probably was estimating male mass only. Our estimate of average mass for *Papio* (*Dinopithecus*) *ingens* is close to 40 kg, while for *Gorgopithecus* it might be closer to 30–33 kg. (Recall that the female was poorly estimated.) Thus, Dunbar's group size estimate for the latter could better be applied to the former. Fifteen individuals still seems very low for a large, presumably terrestrial baboon, but it is marginally acceptable until other parameters can be recalculated. It is further interesting to note that *Paradolichopithecus* and *Procynocephalus* probably had average masses of ca. 26 kg. Given that they ranged as far north as 45°, this may have been a limit on their possible body size.

Dunbar extended his analysis to extinct *Theropithecus* populations in 1993. There, he derived mass estimates for Makapan *T. darti* and Olorgesailie *T. oswaldi* from Jolly (1972) and some extrapolation, resulting in average masses of 27.5 and 55 kg, respectively. Our average mass estimates for these samples would be 28 and 62 kg. Dunbar (1993) extensively discussed the restrictions on group (and body) size implied by these calculations. He suggested that the known sizes might well have been near the limit for large theropiths. (It is surprising that he did not return to the problems raised in his 1992 paper.) Given that decreases in temperature, or the availability of fresh water, would lead to reduction in group size, he noted that the East African sites yielding these fossils were mainly near bodies of water, as had Jolly (1972) before him.

But two other factors also affect group size for these animals: latitude and altitude. Recall that the other late and moderately large populations of *T. o. leakeyi* are from Hopefield (33°S) and Tighenif (35.5°N), with average mass ca. 43 kg; these sites are also located close to sea level. Here, perhaps, is the answer to the question asked above: Why were they smaller than their East African penecontemporaries? It may have been because they were living in environments that were marginal for large *Theropithecus*. And the intermediate mass of the Middle Awash population at Bodo might relate in turn to its low altitude and slightly more northerly latitude. This implies that the two-lineage model proposed above for *T. o. leakeyi* is unnecessary: The general pattern of size increase with time was merely curtailed at higher latitudes. Finally, it is worth investigating if environmental change over the past 3 Myr might also be at the root of this most characteristic phenomenon of *Theropithecus* evolution.

SUMMARY

In this work, we wished to estimate the mass of fossil cercopithecids based on predictor variables selected from the long bones, dentition, and skull. In addition, we studied the scaling of the variables with mass in extant taxa both as a guide to selection of estimators for the fossils and to better understand the biology of the group.

Data were gathered (almost entirely by the authors) on 35 variables from the postcranium (lengths and diameters of humerus and femur), dentition (lengths, anterior and posterior widths, and calculated areas of five molars), and cranium (six lengths and widths plus three measures of the orbit) in about 1500 individual cercopithecids (roughly half extant and half fossil). The extant sample includes 32 colobine and 33 cercopithecine taxa (distinguished at the specific to infrasubspecific level), usually with both sexes represented for each. Over 200 of the extant specimens had associated known mass, but an additional 1900+ individual mass values were compiled from primary and secondary sources to develop sex-specific taxon-mean values.

Bivariate relationships between each of the 35 variables and mass were determined (using Ordinary Least Squares regression) in a subset of taxa to obtain prediction equations. These were then tested on a smaller subset of taxa that had not been included in the pre-

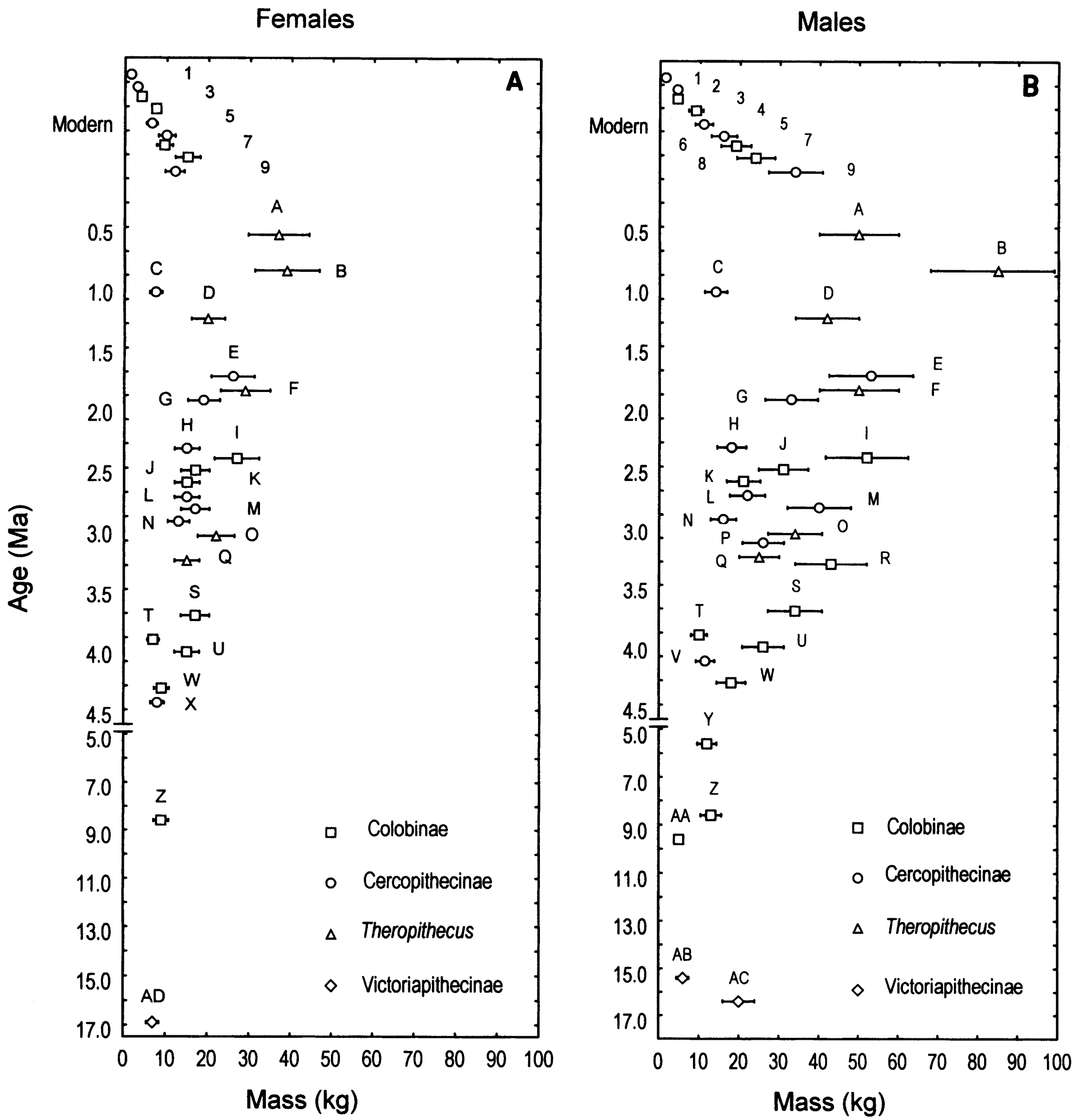

Fig. 19. Plot of mass through time for selected Cercopithecidae: (**A**) females; (**B**) males. Double line (=) on age axis indicates change of scale. Boxes indicate sample means, bars 20% range about the mean. Modern taxa: (1) *Miopithecus talapoin*; (2) *Cercopithecus ascanius schmidti*; (3) *Procolobus verus*; (4) *Colobus guereza occidentalis*; (5) *Cercocebus torquatus atys*; (6) *Papio hamadryas kindae*; (7) *Nasalis larvatus*; (8) *Semnopithecus entellus schistacea* (sensu stricto). (9) *Mandrillus sphinx*. Extinct taxa: (A) *Theropithecus oswaldi leakeyi* (Hopefield); (B) *T. o. leakeyi* (Olorgesailie); (C) *Macaca sylvanus pliocena* (European Pleistocene localities); (D) *Theropithecus oswaldi oswaldi* (Kanjera); (E) *Papio (Dinopithecus) ingens* (Swartkrans Member 1); (F) *Theropithecus oswaldi oswaldi* (Swartkrans Member 1); (G) *Paradolichopithecus arvernensis* (Graunceanu and Senèze); (H) *Papio izodi* (Taung); (I) *Paracolobus mutiwa* (Turkana Basin); (J) *Rhinocolobus turkanaensis* (Turkana Basin); (K) *Cercopithecoides williamsi* (Makapansgat and Sterkfontein Member 4; (L) *Parapapio broomi* (Sterkfontein Member 4); (M) *Papio (Dinopithecus) quadratirostris* (Omo Shungura and Usno); (N) *Parapapio* cf. *jonesi* (Hadar); (O) *T. darti* (Makapansgat); (P) *Parapapio whitei* (Makapansgat); (Q) *T.* cf. *darti* (Hadar); (R) *Paracolobus chemeroni* (Chemeron loc. JM 90); (S) *Paracolobus* sp. (Laetoli); (T)

vious step, in order to determine prediction accuracy, as judged by Mean Prediction Error. Each set of equations was separately calculated for seven taxon/sex samples: all cercopithecids, all colobines (or cercopithecines) and sex-specific subfamily groupings. The prediction equations were then recalculated on the total sample, so that the best-performing equations (four postcranial, six dental, and three cranial) for each of the seven taxon/sex samples could be utilized to estimate mass in fossil taxa. These "final" equations were tested on a subset of 20 extant taxa, where about 70% of the "predictions" fell within 20% of the compiled mass, the level of accuracy selected here as a target. Postcranial and dental variables yielded somewhat more accurate estimates than did cranial variables. For two extant taxa that had not been included in the equation development, because we only obtained their compiled mass values later in the project, estimates were extremely close to the known value and well within the 20% range.

The scaling of these variables with mass was examined in extant taxa using reduced major axis regression. Transposition of one subfamily relative to the other was the pervasive finding of the scaling analyses, and especially in the dentition and postcranium. These patterns are discussed with respect to general aspects of size and function. Additionally, the implications of scaling for mass estimation are explored.

We compared our results on modern taxa with previous estimation studies using a "wider net" to include either all primates or all "monkeys" in developing dentition-based prediction equations. The previous studies are generally less accurate than ours.

There are several method-related topics that can be summarized as a result of the preceding analyses. Assumptions made when applying an estimation model to a fossil taxon require the recognition of several sources of error. Estimation "errors" arise as a result of biological and statistical processes. Biological variation in mass occurs at both the individual and population levels. Variation in estimation performance can also be related to the choice of statistical treatment of the data.

The ability to determine prediction accuracy is restricted to samples composed of specimens with associated mass. We suggest, however, that carefully screened unassociated taxon means (our compiled mass) can be used without introducing a large amount of error. Similarly, extant taxa that are little-known represent excellent test cases for prediction accuracy, assuming, of course, that the appropriate data become available for a reasonable assessment of estimation performance. Lacking this, it is extremely important for validation of prediction performance in a test subsample of taxa (as above; see also Smith, 1985).

It is important to recognize the fact that individuals in natural populations vary in mass as a result of various processes and conditions (e.g., growth, sex, social status, season). One should not expect an estimation routine to yield more precise estimates than the underlying data upon which the estimation models are developed. The range of values in the comparative sample can be a guide to the range of estimates that should be expected from the estimation model. It is clear that a range of predicted values is more biologically informative (and statistically realistic) than a point estimate. From our data (and following Dagosto and Terranova, 1992), we determined that a range of ± 20% around the mean reasonably reflects population variation in Cercopithecidae.

It is troubling, on either theoretical or empirical grounds, to base the selection of a "good" predictor on any single descriptor of an equation (slope, intercept, correlation coefficient, mean square error, etc.). Although the choice of the estimator may be strongly

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Mesopithecus monspessulanus (Pliocene localities); (U) *Dolichopithecus ruscinensis* (Perpignan); (V) ?*Parapapio* sp. indet. (Kanapoi); (W) *Colobinae* indet. cf. "species A" (Aramis); (X) ?*Parapapio* sp. indet. (Aramis); (Y) *Libypithecus markgrafi* (Wadi Natrun); (Z) *Mesopithecus pentelicus* (Pikermi); (AA) *Microcolobus tugenensis* (Ngeringerowa); (AB) *Victoriapithecus macinnesi* (Maboko); (AC) *Prohylobates simonsi* (Gebel Zelten); (AD) *Prohylobates tandyi* (Wadi Moghara).

affected by the nature of the specimens under study, it is not straightforward to use just any preserved anatomy in estimation. Even when some region has been demonstrated to be reliably related to mass in one group, it does not follow that this region will be of use in all groups. Of course, controlling phylogenetic "noise" by restricting the groups under study will ameliorate this situation to a large extent. However, there are numerous documented differences between closely related primate groups, such as the subfamily differences in Old World monkeys (see also Jungers et al., 1998) or the pervasive differences among apes (e.g., Hens et al., 1998), so as to argue against wide-scale and taxonomically independent use of individual predictor variables.

A reasonable approach, given this situation, is to expect an "answer" to be in the form of a range (and not a single estimated value). It seems advisable to bound estimates with respect to the nature of the data used and life history features of the group under study. Here, we used 20% as a range, as it reflects the precision of the comparative data (based on both statistical and biological considerations).

Estimation routines, while becoming far more rigorous, must still be examined closely prior to wholesale acceptance of estimations. We have far to go in conceptualizing the problem of estimation: For example, it is far from clear how we may use theory, or a priori expectations, to select surrogate variables (but see Konigsberg et al., 1998). At present, empirical testing of estimation performance is our best option for identifying reliable predictors.

The highest-ranked equations were finally applied to 25 colobine, 64 cercopithecine and 3 victoriapithecine fossil taxa, using postcranial, dental, and cranial specimens from both sexes as far as possible. Comparisons were made to estimates by other authors for the same taxa. Estimates derived from the "classical calibration" approach of Konigsberg et al. (1998) were also calculated for five samples of *Theropithecus,* in order to test their suggestion that such predictions would be higher and thus more realistic for samples lying well beyond the range of the modern baseline. In such large-sized samples, the results were indeed higher (and generally less consistent) than estimates obtained from the approach we have developed here.

In several cases, elements representing two or all three body regions were available for the same population, and in most of these the predictions were quite similar across regions. As suggested previously, males of the largest population studied (*Theropithecus* from Olorgesailie, Kenya) may have averaged 85 kg, with some postcrania and the largest isolated teeth indicating a mass of 95 kg (or, absurdly, up to 160 kg, using classical calibration!). Other taxa, such as *Papio* (*Dinopithecus*) from Swartkrans (South Africa) were estimated here at far lower mass than predicted by other workers. The recently discovered male cranium of *Victoriapithecus macinnesi* (from Maboko, Kenya) yielded a mass estimate of 6 kg, in between values derived from the dentition and postcranium.

Papio hamadryas robinsoni from South Africa, as discussed previously, appears to date back to ca. 2.6 Ma, making it one of the longest-lived mammalian species still extant. Few living African bovids or suids, for example, have as long a range.

In the discussion, we considered how best to select variables for study in mass estimation analyses. For example, we are surprised at the successful use of orbital diameters and area by Aiello and Wood (1994) and Kappelman (1996), as these variables performed poorly in our sample. We also examined subfamily differences in digestive tract contribution to body mass, in case this factor might be related to the scaling differences discussed earlier. We emphasized the reporting of mass estimates as ranges rather than as single numbers.

Comparing estimates from the three body regions examined, it seems that postcranial estimates are usually most accurate among modern colobine males, while in females, the dental and postcranial estimates are close. Postcranial and dental estimates tend to bracket the "true" mass among living cercopithecines. In the fossils, dental estimates are usually higher than cranial, with postcranial generally higher than dental in cercopithecines, but lower in colobines.

Three aspects of cercopithecid paleobiology were examined in light of the mass estimates. Most extinct cercopithecines show a lower level of dimorphism than do modern taxa of equivalent male mass, probably because the females are being estimated too low. Cercopithecid mass change through time was graphed for colobines, macaques and *Paradolichopithecus,* African papionins, and *Theropithecus,* as well as for a selection of these samples together. Usually, a small early member of each clade is followed by a wider range of masses in younger time intervals. This pattern compares to recent studies of "Cope's Law." The *Theropithecus* plot agreed with previous assessments in revealing a gradual increase of size through time, but at the young end, the Olorgesailie (Kenya) sample is significantly larger than the two nearly contemporaneous populations from Hopefield (South Africa) or Tighenif (Algeria), with Bodo (Ethiopia) being intermediate. Might this indicate a lineage split in these late forms?

In two analyses of large extinct cercopithecine energetics, Dunbar evaluated the effect of mass and ecological parameters on group size, with "too small" size effectively indicating extinction. Assuming that *Dinopithecus ingens* had an average (mixed-sex) mass of 77 kg, Dunbar (1992) suggested that it could only have survived if it had a diet ecologically comparable to *Theropithecus.* Given our average mass estimate of only 40 kg, such a suggestion is unnecessary. The large Eurasian cercopithecines would be expected to have lower masses, as they are found as far north as 45°. Dunbar (1993) examined extinct *Theropithecus* populations in the same way, suggesting that it was unlikely that any attained masses much higher than the 62 kg average found here for Olorgesailie. But we noted that the populations from Hopefield and Tighenif had lower average mass (ca. 43 kg), suggesting that this lower mass might be related to the higher latitude and lower altitude of these sites. We further questioned whether the general pattern of gradual size increase with time across the whole genus might also be related to energetics.

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APPENDIX TABLE 1

Individual Cercopithecid Body Mass Values

The specimens are listed within subfamily alphabetically by genus, species, subspecies, and infrasubspecific group, if any, separated by sex; within taxon and sex, the specimens are listed in order of increasing mass. A blank subspecies column indicates a monotypic species. A question mark (?) following subspecies indicates that we have assigned that specimen to an infraspecific taxon on the basis of locality information but still have some doubts. The "Specimen reference" column includes the source institution (or individual) and specimen identification (catalog) number if known. Otherwise, reference information (a boldface number) for a publication or personal communication is provided, with some additional locating information from the reference (see list at end of table). If the institution can be reasonably well determined from published information, it is provided in parentheses. If the reference includes only a range of data, this table includes the maximum (max) or minimum (min) from the range; in some cases only one end of such a range is indicated, if catalog information is known for the other end. Mass is always provided in grams; when the original value was given in pounds, that number appears as well (conversion: g = 1000 × lb/2.2046).

					Mass	
Genus	Species	Subspecies	Specimen reference	Sex	g	lb
Colobus	*angolensis*	*angolensis*	**9**; min of 5	F	6400	
Colobus	*angolensis*	*angolensis*	**9**; max of 5	F	9150	
Colobus	*angolensis*	*angolensis*	**9**; min of 8	M	7600	
Colobus	*angolensis*	*angolensis*	**9**; max of 8	M	12600	
Colobus	*angolensis*	*palliatus*	NMNH 452617	F	9100	
Colobus	*angolensis*	*palliatus*	NMNH 452615	M	8730	
Colobus	*angolensis*	*palliatus*	NMNH 452618	M	8990	
Colobus	*angolensis*	*palliatus*	NMNH 452616	M	10590	
Colobus	*guereza*	*dodingae*	PCM Sudan-1	M	10433	23
Colobus	*guereza*	*gallarum*	MNHN-P 1972.352	F	6100	
Colobus	*guereza*	*gallarum*	MNHN-P 1972.350	F	8000	
Colobus	*guereza*	*gallarum*	MNHN-P 1972.353	F	8700	
Colobus	*guereza*	*gallarum*	MNHN-P 1972.348	M	9400	
Colobus	*guereza*	*guereza*	MNHN-P 1969.380	F	8200	
Colobus	*guereza*	*guereza*	MNHN-P 1969.379	F	9400	
Colobus	*guereza*	*guereza*	MNHN-P 1969.389	F	10100	
Colobus	*guereza*	*guereza*	STA AM 66	M	9750	
Colobus	*guereza*	*guereza*	MNHN-P 1969.382	M	10000	
Colobus	*guereza*	*guereza*	PCM 1964.2178	M	10886	24
Colobus	*guereza*	*guereza*	MNHN-P 1969.386	M	12400	
Colobus	*guereza*	*guereza*	MNHN-P 1969.378	M	13800	
Colobus	*guereza*	*guereza*	MNHN-P 1969.384	M	14400	
Colobus	*guereza*	*kikuyuensis*	NMNH 452641	F	9030	
Colobus	*guereza*	*kikuyuensis*	PCM 1972.134	M	7100	
Colobus	*guereza*	*kikuyuensis?*	KNM OM 3007	M	11025	
Colobus	*guereza*	*kikuyuensis*	NMNH 452619	M	11417	
Colobus	*guereza*	*matschiei*	NMNH 452642	F	6420	
Colobus	*guereza*	*matschiei*	PCM 1972.147	F	6500	
Colobus	*guereza*	*matschiei*	NMNH 452639	F	6810	
Colobus	*guereza*	*matschiei*	PCM 1972.148	F	7000	
Colobus	*guereza*	*matschiei*	PCM 1972.150	F	7005	
Colobus	*guereza*	*matschiei*	NMNH 452624	F	7355	
Colobus	*guereza*	*matschiei*	NMNH 452636	F	7480	
Colobus	*guereza*	*matschiei*	PCM 1972.138	F	7670	
Colobus	*guereza*	*matschiei*	PCM 277	F	7730	
Colobus	*guereza*	*matschiei*	PCM 355	F	7730	
Colobus	*guereza*	*matschiei*	NMNH 452631	F	7966	
Colobus	*guereza*	*matschiei*	PCM 221	F	8180	
Colobus	*guereza*	*matschiei*	PCM 435	F	8180	
Colobus	*guereza*	*matschiei*	NMNH 452632	F	8220	
Colobus	*guereza*	*matschiei?*	KNM OM 3012	F	8400	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Colobus	*guereza*	*matschiei*	NMNH 452634	F	9565	
Colobus	*guereza*	*matschiei?*	KNM OM 3015	F	9700	
Colobus	*guereza*	*matschiei*	PCM 1972.140	F	10230	
Colobus	*guereza*	*matschiei*	PCM 1972.144	M	8000	
Colobus	*guereza*	*matschiei*	PCM 278	M	8180	
Colobus	*guereza*	*matschiei*	NMNH 452637	M	8230	
Colobus	*guereza*	*matschiei*	PCM 1972.141	M	8900	
Colobus	*guereza*	*matschiei*	NMNH 452643	M	9030	
Colobus	*guereza*	*matschiei?*	KNM OM 7385	M	9100	
Colobus	*guereza*	*matschiei*	NMNH 452628	M	9230	
Colobus	*guereza*	*matschiei*	PCM 434	M	9320	
Colobus	*guereza*	*matschiei?*	KNM OM 3008	M	9520	
Colobus	*guereza*	*matschiei*	PCM 279	M	9540	
Colobus	*guereza*	*matschiei*	NMNH 452625	M	9900	
Colobus	*guereza*	*matschiei*	NMNH 452623	M	9920	
Colobus	*guereza*	*matschiei?*	KNM OM 3010	M	9930	
Colobus	*guereza*	*matschiei*	NMNH 452629	M	10180	
Colobus	*guereza*	*matschiei?*	KNM OM 3014	M	10270	
Colobus	*guereza*	*matschiei*	NMNH 452638	M	10670	
Colobus	*guereza*	*matschiei*	PCM 1972.145	M	10900	
Colobus	*guereza*	*matschiei*	PCM 356	M	11140	
Colobus	*guereza*	*matschiei*	NMNH 452635	M	11410	
Colobus	*guereza*	*matschiei*	PCM 1972.139	M	11790	
Colobus	*guereza*	*occidentalis*	Haddow UP 114	F	5443	12
Colobus	*guereza*	*occidentalis*	Haddow UP 29	F	5443	12
Colobus	*guereza*	*occidentalis*	Haddow UP 86	F	5443	12
Colobus	*guereza*	*occidentalis*	Haddow UP 114	F	5443	12
Colobus	*guereza*	*occidentalis*	BM(NH) 1928.9.8.1	F	5443	12
Colobus	*guereza*	*occidentalis*	Haddow P 170	F	5783	12.75
Colobus	*guereza*	*occidentalis*	Haddow P 139	F	5897	13
Colobus	*guereza*	*occidentalis*	Haddow UP 112	F	5897	13
Colobus	*guereza*	*occidentalis*	Haddow UP 113	F	6350	14
Colobus	*guereza*	*occidentalis*	Haddow P 180	F	6350	14
Colobus	*guereza*	*occidentalis*	Haddow P 221	F	6350	14
Colobus	*guereza*	*occidentalis*	Haddow UP 31	F	6350	14
Colobus	*guereza*	*occidentalis*	PCM 273	F	6350	14
Colobus	*guereza*	*occidentalis*	Haddow UP 99	F	6804	15
Colobus	*guereza*	*occidentalis*	Haddow P 145	F	6804	15
Colobus	*guereza*	*occidentalis*	Haddow P 328	F	6804	15
Colobus	*guereza*	*occidentalis*	Haddow UP 89	F	6804	15
Colobus	*guereza*	*occidentalis*	Haddow UP 111	F	6804	15
Colobus	*guereza*	*occidentalis*	NMNH 452633	F	6807	
Colobus	*guereza*	*occidentalis*	Haddow UP 149	F	7258	16
Colobus	*guereza*	*occidentalis*	Haddow P 69	F	7258	16
Colobus	*guereza*	*occidentalis*	Haddow P 314	F	7258	16
Colobus	*guereza*	*occidentalis*	PCM 279	F	7258	16
Colobus	*guereza*	*occidentalis*	Haddow P 167	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P 262	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow UP 85	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P 274	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P 307	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow UP 67	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow UP 103	F	7711	17

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Colobus	*guereza*	*occidentalis*	BM(NH) 1928.9.8.4	F	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P 313	F	8165	18
Colobus	*guereza*	*occidentalis*	Haddow UP 96	F	8165	18
Colobus	*guereza*	*occidentalis*	Haddow UP 102	F	8165	18
Colobus	*guereza*	*occidentalis*	PCM 248	F	8165	18
Colobus	*guereza*	*occidentalis*	BM(NH) 1928.9.8.3	F	8165	18
Colobus	*guereza*	*occidentalis*	BM(NH) 1951.533	F	8165	18
Colobus	*guereza*	*occidentalis*	Haddow P 264	F	8618	19
Colobus	*guereza*	*occidentalis*	BM(NH) 1928.9.8.2	F	8618	19
Colobus	*guereza*	*occidentalis*	Haddow P 181	F	9072	20
Colobus	*guereza*	*occidentalis*	Haddow P 268	F	9072	20
Colobus	*guereza*	*occidentalis*	Haddow UP 56	F	9072	20
Colobus	*guereza*	*occidentalis*	BM(NH) 1930.8.1.10	F	9072	20
Colobus	*guereza*	*occidentalis*	Haddow P 276	F	9526	21
Colobus	*guereza*	*occidentalis*	Haddow P 266	F	10433	23
Colobus	*guereza*	*occidentalis*	Haddow UP 55	F	10886	24
Colobus	*guereza*	*occidentalis*	Haddow P 176	M	6804	15
Colobus	*guereza*	*occidentalis*	Haddow P 156	M	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P 241	M	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P A 5	M	7711	17
Colobus	*guereza*	*occidentalis*	Haddow UP 88	M	7711	17
Colobus	*guereza*	*occidentalis*	Haddow UP 92	M	7711	17
Colobus	*guereza*	*occidentalis*	Haddow UP 106	M	7711	17
Colobus	*guereza*	*occidentalis*	Haddow P 265	M	8165	18
Colobus	*guereza*	*occidentalis*	Haddow P 179	M	8165	18
Colobus	*guereza*	*occidentalis*	Haddow P 288	M	8165	18
Colobus	*guereza*	*occidentalis*	Haddow UP 35	M	8165	18
Colobus	*guereza*	*occidentalis*	Haddow UP 59	M	8165	18
Colobus	*guereza*	*occidentalis*	Haddow UP 148	M	8165	18
Colobus	*guereza*	*occidentalis*	Haddow P 212	M	8618	19
Colobus	*guereza*	*occidentalis*	Haddow P 307	M	8618	19
Colobus	*guereza*	*occidentalis*	Haddow P 310	M	8618	19
Colobus	*guereza*	*occidentalis*	Haddow UP 28	M	8618	19
Colobus	*guereza*	*occidentalis*	BM(NH) 1926.11.18.2	M	8618	19
Colobus	*guereza*	*occidentalis*	Haddow P 161	M	8845	19.5
Colobus	*guereza*	*occidentalis*	Haddow P 172	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow P 209	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow P 217	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow P 311	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow UP 30	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow UP 107	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow UP 110	M	9072	20
Colobus	*guereza*	*occidentalis*	Haddow P 205	M	9072	20
Colobus	*guereza*	*occidentalis*	BM(NH) 1972.151	M	9300	
Colobus	*guereza*	*occidentalis*	Haddow P 218	M	9526	21
Colobus	*guereza*	*occidentalis*	Haddow P 289	M	9526	21
Colobus	*guereza*	*occidentalis*	Haddow UP 82	M	9526	21
Colobus	*guereza*	*occidentalis*	Haddow P 249	M	9526	21
Colobus	*guereza*	*occidentalis*	Haddow P 279	M	9526	21
Colobus	*guereza*	*occidentalis*	Haddow UP 94	M	9526	21
Colobus	*guereza*	*occidentalis*	Haddow P 148	M	9979	22
Colobus	*guereza*	*occidentalis*	Haddow P 280	M	9979	22
Colobus	*guereza*	*occidentalis*	Haddow UP 97	M	9979	22

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Colobus	*guereza*	*occidentalis*	BM(NH) 1972.152	M	10000	
Colobus	*guereza*	*occidentalis*	Haddow P 186	M	10433	23
Colobus	*guereza*	*occidentalis*	Haddow P 275	M	10433	23
Colobus	*guereza*	*occidentalis*	Haddow P 292	M	10433	23
Colobus	*guereza*	*occidentalis*	Haddow P 337	M	10433	23
Colobus	*guereza*	*occidentalis*	PCM 246	M	10433	23
Colobus	*guereza*	*occidentalis*	NMNH 452622	M	10650	
Colobus	*guereza*	*occidentalis*	Haddow P 220	M	10886	24
Colobus	*guereza*	*occidentalis*	Haddow P 267	M	11340	25
Colobus	*polykomos*	*dollmani*	BM(NH) 1956.343	F	6100	
Colobus	*polykomos*	*dollmani*	BM(NH) 1956.344	F	8500	
Colobus	*polykomos*	*dollmani*	BM(NH) 1955.379	M	9100	
Colobus	*polykomos*	*dollmani*	BM(NH) 1956.342	M	10000	
Colobus	*polykomos*	*polykomos*	NMNH 481789	F	6200	
Colobus	*polykomos*	*polykomos*	AIUG 1641	F	6600	
Colobus	*polykomos*	*polykomos*	BM(NH) 1956.346	F	6700	
Colobus	*polykomos*	*polykomos*	NMNH 481788	F	6800	
Colobus	*polykomos*	*polykomos*	NMNH 477321	F	6804	15
Colobus	*polykomos*	*polykomos*	NMNH 477320	F	7258	16
Colobus	*polykomos*	*polykomos*	**37**; Tiwai killed	F	7800	
Colobus	*polykomos*	*polykomos*	NMNH 481785	F	8000	
Colobus	*polykomos*	*polykomos*	AIUG 1753	F	8000	
Colobus	*polykomos*	*polykomos*	AIUG 1774	F	8000	
Colobus	*polykomos*	*polykomos*	AIUG 1850	F	8200	
Colobus	*polykomos*	*polykomos*	McGraw 94-11	F	8900	
Colobus	*polykomos*	*polykomos*	AIUG 1667	F	9000	
Colobus	*polykomos*	*polykomos*	**37**; Tiwai killed	F	9000	
Colobus	*polykomos*	*polykomos*	AIUG F 2530	F	9700	
Colobus	*polykomos*	*polykomos*	AIUG 1851	F	10000	
Colobus	*polykomos*	*polykomos*	AIUG B 1651	M	8000	
Colobus	*polykomos*	*polykomos*	AIUG 1629	M	9800	
Colobus	*polykomos*	*polykomos*	NMNH 481784	M	10000	
Colobus	*polykomos*	*polykomos*	**37**; Tiwai killed	M	10100	
Colobus	*polykomos*	*polykomos*	BM(NH) 1956.345	M	10100	
Colobus	*polykomos*	*polykomos*	NMNH 481791	M	10400	
Colobus	*polykomos*	*polykomos*	NMNH 481790	M	11400	
Colobus	*polykomos*	*polykomos*	AIUG 1639	M	11700	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.347	F	6200	
Colobus	*polykomos*	*vellerosus*	MRAC-T 23733	F	6600	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.352	F	7000	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.361	F	7000	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.355	F	7500	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.356	M	8000	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.358	M	8400	
Colobus	*polykomos*	*vellerosus*	BM(NH) 1956.349	M	9100	
Colobus	*satanas*		PCM, none listed	F	5000	
Colobus	*satanas*		**32**, p. 30; 1	F	6000	
Colobus	*satanas*		**27**; 3	F	6010	
Colobus	*satanas*		**27**; 1	F	6500	
Colobus	*satanas*		**27**; 2	F	8600	
Colobus	*satanas*		**32**, p. 30; 3	F	10000	
Colobus	*satanas*		PCM, none listed	M	9000	
Colobus	*satanas*		**32**; 2	M	11000	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Procolobus	*badius*	*badius*	USNM 481792	F	5000	
Procolobus	*badius*	*badius*	USNM 481798	F	5000	
Procolobus	*badius*	*badius*	AIUG 1916	F	5750	
Procolobus	*badius*	*badius*	BM(NH) 1956.374	F	6100	
Procolobus	*badius*	*badius*	BM(NH) 1956.364	F	6200	
Procolobus	*badius*	*badius*	AIUG 1914	F	6750	
Procolobus	*badius*	*badius*	AIUG 1938	F	6900	
Procolobus	*badius*	*badius*	AIUG 1755	F	7000	
Procolobus	*badius*	*badius*	AIUG 1939	F	7000	
Procolobus	*badius*	*badius*	BM(NH) 1956.365	F	7200	
Procolobus	*badius*	*badius*	McGraw 94-22	F	7200	
Procolobus	*badius*	*badius*	AIUG 1663	F	7250	
Procolobus	*badius*	*badius*	AIUG 1906	F	7250	
Procolobus	*badius*	*badius*	AIUG 1798	F	7300	
Procolobus	*badius*	*badius*	NMNH 477324	F	7400	
Procolobus	*badius*	*badius*	AIUG 1634	F	7400	
Procolobus	*badius*	*badius*	AIUG 1905	F	7400	
Procolobus	*badius*	*badius*	AIUG 1817	F	7800	
Procolobus	*badius*	*badius*	AIUG 1769	F	8000	
Procolobus	*badius*	*badius*	NMNH 477326	F	8200	
Procolobus	*badius*	*badius*	NMNH 481793	F	8200	
Procolobus	*badius*	*badius*	AIUG 1635	F	8200	
Procolobus	*badius*	*badius*	AIUG 1794	F	8500	
Procolobus	*badius*	*badius*	AIUG 1915	F	8500	
Procolobus	*badius*	*badius*	AIUG 1900	F	8500	
Procolobus	*badius*	*badius*	AIUG 1882	F	8700	
Procolobus	*badius*	*badius*	AIUG 1940	F	8700	
Procolobus	*badius*	*badius*	AIUG 1938	F	8700	
Procolobus	*badius*	*badius*	AIUG 1730	F	8900	
Procolobus	*badius*	*badius*	AIUG 1729	F	9000	
Procolobus	*badius*	*badius*	AIUG 1731	F	9100	
Procolobus	*badius*	*badius*	AIUG 1929	F	9100	
Procolobus	*badius*	*badius*	NMNH 481796	F	9400	
Procolobus	*badius*	*badius*	AIUG 1913	F	9500	
Procolobus	*badius*	*badius*	AIUG 1947	F	9500	
Procolobus	*badius*	*badius*	AIUG 1947	F	9500	
Procolobus	*badius*	*badius*	AIUG 1771	F	9950	
Procolobus	*badius*	*badius*	AIUG 1770	M	6400	
Procolobus	*badius*	*badius*	NMNH 481794	M	7000	
Procolobus	*badius*	*badius*	AIUG 1670	M	7500	
Procolobus	*badius*	*badius*	AIUG 1754	M	7700	
Procolobus	*badius*	*badius*	AIUG 1681	M	7900	
Procolobus	*badius*	*badius*	NMNH 481797	M	8000	
Procolobus	*badius*	*badius*	AIUG 1671	M	8000	
Procolobus	*badius*	*badius*	NMNH 477325	M	8200	
Procolobus	*badius*	*badius*	AIUG 1672	M	8500	
Procolobus	*badius*	*badius*	AIUG 1889	M	8700	
Procolobus	*badius*	*badius*	McGraw 94-15	M	8700	
Procolobus	*badius*	*badius*	NMNH 481795	M	8800	
Procolobus	*badius*	*badius*	AIUG 1680	M	9250	
Procolobus	*badius*	*badius*	AIUG 1881	M	9400	
Procolobus	*badius*	*badius*	McGraw 94-13	M	9500	
Procolobus	*badius*	*badius*	McGraw 94-14	M	9500	

APPENDIX TABLE 1
Continued

					Mass	
Genus	Species	Subspecies	Specimen reference	Sex	g	lb
Procolobus	*badius*	*badius*	AIUG 1883	M	9600	
Procolobus	*badius*	*kirki*	**35**, p. 32; min of 3	F	5100	
Procolobus	*badius*	*kirkii*	USNM 452646	F	5110	
Procolobus	*badius*	*kirki*	**35**, p. 32; mid of 3	F	5200	
Procolobus	*badius*	*kirki*	**35**, p. 32; max of 3	F	6100	
Procolobus	*badius*	*kirki*	**35**, p. 32; 1 of 1	M	5800	
Procolobus	*badius*	*langi*	**9**; min of 2	F	4400	
Procolobus	*badius*	*langi*	**9**; max of 2	F	6650	
Procolobus	*badius*	*langi*	**9**; 1 of 2	M	7650	
Procolobus	*badius*	*langi*	**9**; 2 of 2	M	7650	
Procolobus	*badius*	*oustaleti*	**9**; min of 2	F	7600	
Procolobus	*badius*	*oustaleti*	USNM 537781	F	7700	
Procolobus	*badius*	*oustaleti*	USNM 537782	F	7750	
Procolobus	*badius*	*oustaleti*	**9**; max of 2	F	8900	
Procolobus	*badius*	*oustaleti*	IRSN-B 21231	M	12000	
Procolobus	*badius*	*oustaleti*	MRAC-T 28595	M	12100	
Procolobus	*badius*	*oustaleti*	**9**; 1 of 1	M	12500	
Procolobus	*badius*	*parmientierorum*	**9**; min of 6	F	5550	
Procolobus	*badius*	*parmientierorum*	**9**; max of 6	F	8950	
Procolobus	*badius*	*parmientierorum*	**9**; 1 of 1	M	9200	
Procolobus	*badius*	*preussi*	PCM 259	F	7259	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28580	F	6000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 25586	F	6000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28576	F	7000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28763	F	7500	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28577	F	8000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28760	F	8000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28762	F	8000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28759	M	9000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28587	M	10000	
Procolobus	*badius*	*rufomitratus*	MRAC-T 28761	M	10000	
Procolobus	*badius*	*tephrosceles*	KNM OM 3017	F	6728	
Procolobus	*badius*	*tephrosceles*	BM(NH) 1972.133	M	7940	
Procolobus	*badius*	*tephrosceles*	NMNH 452664	M	8850	
Procolobus	*badius*	*tephrosceles*	Sarmiento, unnumbered	M	8900	
Procolobus	*badius*	*tephrosceles*	PCM 1971.2064	M	9400	
Procolobus	*badius*	*tephrosceles*	PCM 1971.2065	M	10500	
Procolobus	*badius*	*tephrosceles*	PCM 1930.8.1.4	M	10886	24
Procolobus	*badius*	*waldroni*	BM(NH) 1956.371	F	5500	
Procolobus	*badius*	*waldroni*	BM(NH) 1956.373	F	6000	
Procolobus	*badius*	*waldroni*	BM(NH) 1956.374	M	6300	
Procolobus	*badius*	*waldroni*	USNM 477323	M	6500	
Procolobus	*verus*		**4**; min of 5	F	2900	
Procolobus	*verus*		AIUG 1682	F	3550	
Procolobus	*verus*		NMNH 477327	F	3629	8
Procolobus	*verus*		AIUG 1922	F	4000	
Procolobus	*verus*		**37**; Tiwai killed	F	4000	
Procolobus	*verus*		**4**; max of 5	F	4100	
Procolobus	*verus*		NMNH 481800	F	4200	
Procolobus	*verus*		AIUG 2570	F	4200	
Procolobus	*verus*		AIUG 1788	F	4400	
Procolobus	*verus*		AIUG 1799	F	4700	
Procolobus	*verus*		AIUG 1661	F	4750	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Procolobus	*verus*		AIUG 1684	F	5000	
Procolobus	*verus*		AIUG 1777	F	5400	
Procolobus	*verus*		**4**; min of 7	M	3300	
Procolobus	*verus*		AIUG 1870	M	3950	
Procolobus	*verus*		NMNH 477329	M	4200	
Procolobus	*verus*		AIUG 1926	M	4200	
Procolobus	*verus*		NMNH 481802	M	4300	
Procolobus	*verus*		**37**; Tiwai killed	M	4300	
Procolobus	*verus*		**4**; max of 7	M	4400	
Procolobus	*verus*		NMNH 481801	M	4400	
Procolobus	*verus*		AIUG 1856	M	4500	
Procolobus	*verus*		AIUG 1901	M	4500	
Procolobus	*verus*		NMNH 477331	M	4536	10
Procolobus	*verus*		AIUG 1703	M	4600	
Procolobus	*verus*		**37**; Tiwai killed	M	4600	
Procolobus	*verus*		AIUG 1756	M	4700	
Procolobus	*verus*		AIUG 1738	M	4700	
Procolobus	*verus*		AIUG 1893	M	4700	
Procolobus	*verus*		AIUG 1911	M	4750	
Procolobus	*verus*		AIUG 1921	M	4750	
Procolobus	*verus*		AIUG 1748	M	4800	
Procolobus	*verus*		AIUG 2593 (or 2543?)	M	4900	
Procolobus	*verus*		NMNH 477330	M	5000	
Procolobus	*verus*		AIUG 1683	M	5150	
Procolobus	*verus*		AIUG 1946	M	5500	
Procolobus	*verus*		McGraw 94-7	M	5500	
Procolobus	*verus*		AIUG 1884	M	5700	
Nasalis	*larvatus*		NMNH 142222	F	7258	16
Nasalis	*larvatus*		MCZ 41556	F	7938	17.5
Nasalis	*larvatus*		MCZ 37326	F	8165	18
Nasalis	*larvatus*		MCZ 37340	F	8165	18
Nasalis	*larvatus*		MCZ 37342	F	8165	18
Nasalis	*larvatus*		NMNH 151817	F	8618	19
Nasalis	*larvatus*		MCZ 37343	F	8845	19.5
Nasalis	*larvatus*		MCZ 41554	F	8845	19.5
Nasalis	*larvatus*		MCZ 41562	F	9072	20
Nasalis	*larvatus*		**1**, p. 136; 12	F	9185	20.25
Nasalis	*larvatus*		NMNH 145325	F	9526	21
Nasalis	*larvatus*		MCZ 37338	F	9752	21.5
Nasalis	*larvatus*		**1**, p. 136; 10	F	9752	21.5
Nasalis	*larvatus*		MCZ 37339	F	9979	22
Nasalis	*larvatus*		**1**, p. 136; 14	F	9979	22
Nasalis	*larvatus*		MCZ 41560	F	10206	22.5
Nasalis	*larvatus*		**1**, p. 136; 13	F	10433	23
Nasalis	*larvatus*		FMNH 85918	F	10500	
Nasalis	*larvatus*		MCZ 37341	F	10660	23.5
Nasalis	*larvatus*		MCZ 37331	F	10886	24
Nasalis	*larvatus*		MCZ 37337	F	10886	24
Nasalis	*larvatus*		MCZ 41555	F	11340	25
Nasalis	*larvatus*		MCZ 41559	F	11340	25
Nasalis	*larvatus*		MCZ 37344	F	11794	26
Nasalis	*larvatus*		**1**, p. 136; 3	M	13268	29.25
Nasalis	*larvatus*		FMNH 68683	M	14050	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Nasalis	*larvatus*		MCZ 37325	M	14062	31
Nasalis	*larvatus*		FMNH 68682	M	16145	
Nasalis	*larvatus*		NMNH 142214	M	17237	38
Nasalis	*larvatus*		**1**, p. 136; 4	M	17237	38
Nasalis	*larvatus*		MCZ 37328	M	19278	42.5
Nasalis	*larvatus*		MCZ 37328	M	19278	42.5
Nasalis	*larvatus*		**1**, p. 136; 2	M	19391	42.75
Nasalis	*larvatus*		**1**, p. 136; 6	M	19958	44
Nasalis	*larvatus*		NMNH 142215	M	19958	44
Nasalis	*larvatus*		FMNH 85919	M	20000	
Nasalis	*larvatus*		NMNH 142219	M	20412	45
Nasalis	*larvatus*		MCZ 37327	M	20412	45
Nasalis	*larvatus*		MCZ 37329	M	20412	45
Nasalis	*larvatus*		MCZ 37330	M	20412	45
Nasalis	*larvatus*		MCZ 41557	M	20412	45
Nasalis	*larvatus*		**1**, p. 136; 7	M	20412	45
Nasalis	*larvatus*		NMNH 142218	M	20866	46
Nasalis	*larvatus*		MCZ 41563	M	20866	46
Nasalis	*larvatus*		**1**, p. 136; 1	M	20866	46
Nasalis	*larvatus*		**1**, p. 136; 8	M	20866	46
Nasalis	*larvatus*		NMNH 142220	M	21773	48
Nasalis	*larvatus*		**1**, p. 136; 9	M	21773	48
Nasalis	*larvatus*		ex-MCZ,[a] Field No. 366	M	23134	51
Nasalis	*larvatus*		NMNH 142217	M	23587	52
Nasalis	*larvatus*		MCZ 41561	M	23587	52
Nasalis	*larvatus*		**1**, p. 136; 6	M	23587	52
Nasalis (*Simias*)	*concolor*		NMNH 121661	F	6237	13.75
Nasalis (*Simias*)	*concolor*		NMNH 121658	F	7031	15.5
Nasalis (*Simias*)	*concolor*		NMNH 121901	F	7144	15.75
Nasalis (*Simias*)	*concolor*		BM(NH) 1904.5.4.2	F	7144	15.75
Nasalis (*Simias*)	*concolor*		NMNH 121660	M	8618	19
Nasalis (*Simias*)	*concolor*		NMNH 121663	M	8845	19.5
Nasalis (*Simias*)	*concolor*		NMNH 121659	M	9979	22
Presbytis	*comata*		FMNH F250	M	6800	
Presbytis	*frontata*	*frontata*	NMNH 151821	F	4082	9
Presbytis	*frontata*	*frontata*	NMNH 154361	F	4990	11
Presbytis	*frontata*	*frontata*	NMNH 151824	F	5443	12
Presbytis	*frontata*	*frontata*	NMNH 151820	F	5670	12.5
Presbytis	*frontata*	*frontata*	NMNH 151823	F	5897	13
Presbytis	*frontata*	*frontata*	NMNH 154362	F	6350	14
Presbytis	*frontata*	*frontata*	NMNH 154363	F	6350	14
Presbytis	*frontata*	*frontata*	NMNH 151822	F	6577	14.5
Presbytis	*frontata*	*frontata*	NMNH 151825	M	5557	12.25
Presbytis	*hosei*	*sabana*	MCZ 35621	F	6577	14.5
Presbytis	*hosei*	subsp. indet.	MCZ 37370	F	5557	12.25
Presbytis	*hosei*	subsp. indet.	FMNH F320	F	6750	
Presbytis	*hosei*	subsp. indet.	FMNH 68693	F	6800	
Presbytis	*hosei*	subsp. indet.	FMNH F3115	M	6000	
Presbytis	*hosei*	subsp. indet.	FMNH F3110	M	6000	
Presbytis	*hosei*	subsp. indet.	FMNH 85922	M	6000	
Presbytis	*hosei*	subsp. indet.	FMNH 85122	M	6000	
Presbytis	*hosei*	subsp. indet.	FMNH 68697	M	6000	
Presbytis	*hosei*	subsp. indet.	FMNH F3019	M	6500	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Presbytis	*hosei*	subsp. indet.	FMNH 85121	M	6500	
Presbytis	*melalophos*	*batuana*	NMNH 121809	F	4423	9.75
Presbytis	*melalophos*	*batuana*	NMNH 121804	F	5443	12
Presbytis	*melalophos*	*batuana*	NMNH 121807	F	6577	14.5
Presbytis	*melalophos*	*batuana*	NMNH 121805	F	6804	15
Presbytis	*melalophos*	*batuana*	NMNH 121811	F	7258	16
Presbytis	*melalophos*	*batuana*	NMNH 121808	F	7484	16.5
Presbytis	*melalophos*	*batuana*	NMNH 121899	M	5783	12.75
Presbytis	*melalophos*	*batuana*	NMNH 121810	M	6917	15.25
Presbytis	*melalophos*	*batuana*	NMNH 121806	M	7144	15.75
Presbytis	*melalophos*	*cana*	NMNH 122911	F	5783	12.75
Presbytis	*melalophos*	*cana*	NMNH 122914	F	5897	13
Presbytis	*melalophos*	*cana*	NMNH 122913	F	7598	16.75
Presbytis	*melalophos*	*cana*	NMNH 122916	F	7825	17.25
Presbytis	*melalophos*	*cana*	NMNH 122912	M	6010	13.25
Presbytis	*melalophos*	*cana*	NMNH 122915	M	6804	15
Presbytis	*melalophos*	*catemana*	NMNH 123148	F	5670	12.5
Presbytis	*melalophos*	*catemana*	NMNH 123149	F	6350	14
Presbytis	*melalophos*	*catemana*	NMNH 113175	M	5897	13
Presbytis	*melalophos*	*catemana*	NMNH 113173	M	6350	14
Presbytis	*melalophos*	*chrysomelas*	NMNH 142209	F	6917	15.25
Presbytis	*melalophos*	*chrysomelas*	NMNH 142207	M	5897	13
Presbytis	*melalophos*	*chrysomelas*	NMNH 142203	M	6350	14
Presbytis	*melalophos*	*chrysomelas*	NMNH 142204	M	6350	14
Presbytis	*melalophos*	*chrysomelas*	NMNH 142205	M	6350	14
Presbytis	*melalophos*	*chrysomelas*	NMNH 142208	M	7031	15.5
Presbytis	*melalophos*	*chrysomelas*	NMNH 142206	M	7144	15.75
Presbytis	*melalophos*	*femoralis*	NMNH 115500	M	5783	12.75
Presbytis	*melalophos*	*femoralis*	NMNH 86897	M	5897	13
Presbytis	*melalophos*	*femoralis*	NMNH 112709	M	6577	14.5
Presbytis	*melalophos*	*femoralis*	NMNH 112612	M	6691	14.75
Presbytis	*melalophos*	*melalophos*	NMNH 141150	F	5783	12.75
Presbytis	*melalophos*	*melalophos*	NMNH 141148	F	5897	13
Presbytis	*melalophos*	*melalophos*	NMNH 141152	F	6691	14.75
Presbytis	*melalophos*	*melalophos*	NMNH 141146	M	6124	13.5
Presbytis	*melalophos*	*melalophos*	NMNH 141149	M	6237	13.75
Presbytis	*melalophos*	*melalophos*	NMNH 141147	M	6691	14.75
Presbytis	*melalophos*	*melalophos*	NMNH 141151	M	6691	14.75
Presbytis	*melalophos*	*melalophos*	NMNH 144081	M	6691	14.75
Presbytis	*melalophos*	*melalophos*	NMNH 141153	M	7371	16.25
Presbytis	*melalophos*	*natunae*	NMNH 104843	F	4990	11
Presbytis	*melalophos*	*natunae*	NMNH 104845	F	5216	11.5
Presbytis	*melalophos*	*natunae*	NMNH 104846	F	5670	12.5
Presbytis	*melalophos*	*natunae*	NMNH 104847	M	4536	10
Presbytis	*melalophos*	*percura*	NMNH 144086	F	6577	14.5
Presbytis	*melalophos*	*percura*	NMNH 144084	F	6917	15.25
Presbytis	*melalophos*	*percura*	NMNH 144085	F	6917	15.25
Presbytis	*melalophos*	*percura*	NMNH 144087	F	7144	15.75
Presbytis	*melalophos*	*percura*	NMNH 115666	M	4536	10
Presbytis	*melalophos*	*percura*	NMNH 115664	M	4990	11
Presbytis	*melalophos*	*percura*	NMNH 144088	M	7144	15.75
Presbytis	*melalophos*	*percura*	NMNH 144083	M	7258	16
Presbytis	*melalophos*	*rhionis*	NMNH 115669	F	4082	9

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Presbytis	*melalophos*	*rhionis*	NMNH 115668	F	5443	12
Presbytis	*melalophos*	*rhionis*	NMNH 115665	F	6010	13.25
Presbytis	*melalophos*	*rhionis*	NMNH 115667	F	6350	14
Presbytis	*melalophos*	*robinsoni*	BM(NH) 1914.12.8.30	F	6464	14.25
Presbytis	*melalophos*	*robinsoni*	BM(NH) 1914.12.8.29	M	7031	15.5
Presbytis	*melalophos*	*robinsoni*	NMNH 124217	M	7258	16
Presbytis	*melalophos*	*robinsoni*	NMNH 124290	M	7258	16
Presbytis	*melalophos*	*robinsoni*	NMNH 124231	M	7598	16.75
Presbytis	*melalophos*	*siamensis*	Fleagle P17	F	6410	
Presbytis	*melalophos*	*siamensis*	Fleagle P24	F	6880	
Presbytis	*melalophos*	*siamensis*	Fleagle P23	F	7340	
Presbytis	*melalophos*	*siamensis*	Fleagle P22	M	6510	
Presbytis	*melalophos*	*siamensis*	Fleagle P14	M	6860	
Presbytis	*melalophos*	*sumatrana*	NMNH 114509	F	7825	17.25
Presbytis	*melalophos*	*sumatrana*	NMNH 114508	F	8051	17.75
Presbytis	*melalophos*	*sumatrana*	NMNH 114507	M	7371	16.25
Presbytis	*potenziani*		NMNH 121671	F	6010	13.25
Presbytis	*potenziani*		NMNH 121666	F	6804	15
Presbytis	*potenziani*		NMNH 121664	M	4536	10
Presbytis	*potenziani*		NMNH 121669	M	4990	11
Presbytis	*potenziani*		NMNH 121672	M	5443	12
Presbytis	*potenziani*		NMNH 121667	M	6804	15
Presbytis	*potenziani*		NMNH 121668	M	6804	15
Presbytis	*potenziani*		NMNH 121673	M	7144	15.75
Presbytis	*potenziani*		NMNH 121670	M	7258	16
Presbytis	*rubicunda*	*rubicunda*	ex-MCZ[a] Field No. 369	F	4536	10
Presbytis	*rubicunda*	*rubicunda*	MCZ 35609	F	4536	10
Presbytis	*rubicunda*	*rubicunda*	MCZ 37368	F	4536	10
Presbytis	*rubicunda*	*rubicunda*	MCZ 35718	F	4763	10.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35617	F	4990	11
Presbytis	*rubicunda*	*rubicunda*	MCZ 35650	F	5443	12
Presbytis	*rubicunda*	*rubicunda*	MCZ 35632	F	5443	12
Presbytis	*rubicunda*	*rubicunda*	MCZ 35702	F	5443	12
Presbytis	*rubicunda*	*rubicunda*	MCZ 35654	F	5670	12.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35648	F	5670	12.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35624	F	5897	13
Presbytis	*rubicunda*	*rubicunda*	MCZ 35570	F	5897	13
Presbytis	*rubicunda*	*rubicunda*	MCZ 35624	F	5897	13
Presbytis	*rubicunda*	*rubicunda*	MCZ 35664	F	5897	13
Presbytis	*rubicunda*	*rubicunda*	MCZ 35706	F	5897	13
Presbytis	*rubicunda*	*rubicunda*	MCZ 35679	F	6124	13.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35599	F	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35707	F	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35705	F	6577	14.5
Presbytis	*rubicunda*	*rubicunda*	NMNH 125158	F	6577	14.5
Presbytis	*rubicunda*	*rubicunda*	NMNH 145333	F	6917	15.25
Presbytis	*rubicunda*	*rubicunda*	MCZ 35639	F	7031	15.5
Presbytis	*rubicunda*	*rubicunda*	NMNH 125159	F	7258	16
Presbytis	*rubicunda*	*rubicunda*	NMNH 153791	F	7258	16
Presbytis	*rubicunda*	*rubicunda*	NMNH 153795	F	7711	17
Presbytis	*rubicunda*	*rubicunda*	MCZ 35601	M	5443	12
Presbytis	*rubicunda*	*rubicunda*	MCZ 35630	M	5443	12
Presbytis	*rubicunda*	*rubicunda*	MCZ 35596	M	5443	12

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Presbytis	*rubicunda*	*rubicunda*	MCZ 35667	M	5670	12.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35653	M	5670	12.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35638	M	5897	13
Presbytis	*rubicunda*	*rubicunda*	MCZ 35566	M	6124	13.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35573	M	6124	13.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35692	M	6124	13.5
Presbytis	*rubicunda*	*rubicunda*	NMNH 151826	M	6124	13.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35637	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35564	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35684	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35691	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35703	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	NMNH 145335	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	NMNH 154364	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	NMNH 154365	M	6350	14
Presbytis	*rubicunda*	*rubicunda*	MCZ 35713	M	6577	14.5
Presbytis	*rubicunda*	*rubicunda*	NMNH 153789	M	6691	14.75
Presbytis	*rubicunda*	*rubicunda*	NMNH 153792	M	6691	14.75
Presbytis	*rubicunda*	*rubicunda*	MCZ 35712	M	6804	15
Presbytis	*rubicunda*	*rubicunda*	NMNH 145336	M	6804	15
Presbytis	*rubicunda*	*rubicunda*	NMNH 153794	M	6804	15
Presbytis	*rubicunda*	*rubicunda*	NMNH 154366	M	6804	15
Presbytis	*rubicunda*	*rubicunda*	MCZ 35616	M	7031	15.5
Presbytis	*rubicunda*	*rubicunda*	MCZ 35698	M	7031	15.5
Presbytis	*rubicunda*	*rubicunda*	NMNH 145334	M	7371	16.25
Presbytis	*rubicunda*	*rubida*	NMNH 153790	F	7825	17.25
Presbytis	*thomasi*		NMNH 143549	F	6350	14
Presbytis	*thomasi*		NMNH 143555	F	6350	14
Presbytis	*thomasi*		NMNH 143557	F	6350	14
Presbytis	*thomasi*		NMNH 143551	F	8051	17.75
Presbytis	*thomasi*		NMNH 143560	M	6237	13.75
Presbytis	*thomasi*		NMNH 143561	M	6804	15
Presbytis	*thomasi*		NMNH 143559	M	7258	16
P. (*Rhinopithecus*)	*avunculus*		**28**; 1	F	7000	
P. (*Rhinopithecus*)	*avunculus*		**49**; UHVZ ?	F	8000	
P. (*Rhinopithecus*)	*avunculus*		**28**; 2	F	9000	
P. (*Rhinopithecus*)	*avunculus*		**28**; 3	F	9000	
P. (*Rhinopithecus*)	*avunculus*		**28**; 1 of 1	M	14500	
P. (*Rhinopithecus*)	*bieti*		**25**; adult	F	9000	
P. (*Rhinopithecus*)	*bieti*		**28**; no info	F	13800	
P. (*Rhinopithecus*)	*bieti*		KIZ 79621	F	15000	
P. (*Rhinopithecus*)	*bieti*		**25**; subadult	M	13000	
P. (*Rhinopithecus*)	*bieti*		**28**; no info	M	18000	
P. (*Rhinopithecus*)	*bieti*		**25**; anecdotal, >30	M	30000	
P. (*Rhinopithecus*)	*brelichi*		**25**; old emaciated	M	13250	
P. (*Rhinopithecus*)	*brelichi*		**25**; adult	M	15750	
P. (*Rhinopithecus*)	*roxellana*		**25**; Chen, 1989, 1	F	9500	
P. (*Rhinopithecus*)	*roxellana*		**25**; Chen, 1989, 2	F	12000	
P. (*Rhinopithecus*)	*roxellana*		**25**; Chen, 1989, 3	F	15400	
P. (*Rhinopithecus*)	*roxellana*		**25**; Qiu, 1981, 1	M	15500	
P. (*Rhinopithecus*)	*roxellana*		**25**; Chen, 1989	M	16200	
P. (*Rhinopithecus*)	*roxellana*		**25**; Liu, 1989, 1	M	16560	
P. (*Rhinopithecus*)	*roxellana*		**25**; Qiu, 1981, 2	M	16750	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
P. (Rhinopithecus)	*roxellana*		**28**; no info	M	17000	
P. (Rhinopithecus)	*roxellana*		**25**; Liu, 1989, 2	M	19000	
P. (Rhinopithecus)	*roxellana*		**25**; Qiu, 1981, 3	M	26500	
Pygathrix (P.)	*nemaeus*	*nemaeus*	NMNH 356574	F	8165	18
Pygathrix (P.)	*nemaeus*	*nemaeus*	NMNH 356577	M	10433	23
Pygathrix (P.)	*nemaeus*	*nemaeus*	NMNH 356576	M	11340	25
Pygathrix (P.)	*nemaeus*	*nigripes*	UHVZ 78.01.T7	F	8700	
Pygathrix (P.)	*nemaeus*	*nigripes*	**49**; UHVZ, none listed	M	11000	
Pygathrix (P.)	*nemaeus*	*nigripes*	UHVZ 78.01.T6	M	11100	
Semnopithecus	*entellus*	*achates*	BM(NH) 1914.11.18.12	F	7711	17
Semnopithecus	*entellus*	*achates*	**41**, p. 489	F	10206	22.5
Semnopithecus	*entellus*	*achates*	BM(NH) 1914.11.8.9	F	12247	27
Semnopithecus	*entellus*	*achates*	BM(NH) 1914.11.18.11	M	10319	22.75
Semnopithecus	*entellus*	*achates*	BM(NH) 1914.11.18.1	M	13608	30
Semnopithecus	*entellus*	*achates*	BM(NH) 1914.11.8.8	M	15876	35
Semnopithecus	*entellus*	*aeneas*	BM(NH) 1914.11.18.24	F	9979	22
Semnopithecus	*entellus*	*aeneas*	BM(NH) 1914.11.18.23	M	11567	25.5
Semnopithecus	*entellus*	*ajax*	BM(NH) 33.12.1.1	F	12701	28
Semnopithecus	*entellus*	*ajax*	BM(NH) 23.9.1.2	M	19505	43
Semnopithecus	*entellus*	*ajax*	BM(NH) 28.7.11.1	M	20412	45
Semnopithecus	*entellus*	*elissa*	BM(NH) 1914.11.18.16 or 17	F	8278	18.25
Semnopithecus	*entellus*	*elissa*	BM(NH) 1914.11.18.16 or 17	F	10433	23
Semnopithecus	*entellus*	*entellus*	**41**, p. 484; Midnapore	F	11340	25
Semnopithecus	*entellus*	*entellus*	**41**, p. 484; Midnapore	M	15876	35
Semnopithecus	*entellus*	*entellus/hypoleucos/ priam*	**35**, p. 76; min of 11	F	7711	17
Semnopithecus	*entellus*	*entellus/hypoleucos/ priam*	**35**, p. 76; max of 11	F	12247	27
Semnopithecus	*entellus*	*entellus/hypoleucos/ priam*	**35**, p. 76; min of 9	M	9072	20
Semnopithecus	*entellus*	*entellus/hypoleucos/ priam*	**35**, p. 76; max of 9	M	18144	40
Semnopithecus	*entellus*	*hector*	BM(NH) 1914.7.10.11	F	13154	29
Semnopithecus	*entellus*	*hector*	BM(NH) 1914.7.10.13	F	14062	[b] 31
Semnopithecus	*entellus*	*hector*	BM(NH) 1914.7.10.10	M	17237	38
Semnopithecus	*entellus*	*iulus*	BM(NH) 1914.11.18.7?	F	8392	18.5
Semnopithecus	*entellus*	*iulus*	BM(NH) 1914.11.18.6	M	9526	21
Semnopithecus	*entellus*	*priam*	BM(NH) 1930.11.1.10	F	8845	19.5
Semnopithecus	*entellus*	*priam*	BM(NH) 1933.7.29.1	M	16783	37
Semnopithecus	*entellus*	*schistacea*	BNHS 5143	F	11340	25
Semnopithecus	*entellus*	*schistacea*	BM(NH) 28.7.11.7	F	15909	35
Semnopithecus	*entellus*	*schistacea*	BM(NH) 15.9.1.6	F	17237	38
Semnopithecus	*entellus*	*schistacea*	NMNH 174083	M	23587	52
Semnopithecus	*entellus*	*thersites*	**35**, p. 76; min of 4	F	5455	12
Semnopithecus	*entellus*	*thersites*	BM(NH) 1915.3.1.9, 10 or 11	F	5897	13
Semnopithecus	*entellus*	*thersites*	BM(NH) 1915.3.1.9, 10 or 11	F	6804	15
Semnopithecus	*entellus*	*thersites*	**35**, p. 76; max of 4	F	8182	18
Semnopithecus	*entellus*	*thersites*	**42**, p. 115; max of 7	F	8618	19
Semnopithecus	*entellus*	*thersites*	**35**, p. 76; min of 8	M	7938	17.5
Semnopithecus	*entellus*	*thersites*	BM(NH) 1930.11.1.1	M	10886	24
Semnopithecus	*entellus*	*thersites*	BM(NH) 1915.3.1.12 or 13	M	11453	25.25
Semnopithecus	*entellus*	*thersites*	BM(NH) 1930.11.1.2	M	12500	
Semnopithecus	*entellus*	*thersites*	**35**; BM(NH) 1915.3.1.12 or 13	M	13381	29.5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 113174	F	4990	11
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 123037	F	5216	11.5
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 123070	F	5216	11.5
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 124711	F	5783	12.75
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 115673	F	6010	13.25
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 124712	F	6010	13.25
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 114160	F	6237	13.75
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 114513	F	6237	13.75
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 115674	F	6237	13.75
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 115672	F	6350	14
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 124971	F	6350	14
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 124713	F	6464	14.25
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 123036	F	6577	14.5
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 113071	F	6804	15
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 114514	F	7598	16.75
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 115670	M	6124	13.5
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 144371	M	6804	15
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 113170	M	6917	15.25
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 113171	M	7258	16
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 114516	M	7258	16
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 113070	M	8051	17.75
S. (*Trachypithecus*)	*cristata*	*cristata*	NMNH 124725	M	8165	18
S. (*Trachypithecus*)	*cristata*	*germaini*	**35**; BM(NH), see ref. p. 53	M	8626	
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35663	F	4990	11
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37674	F	4990	11
S. (*Trachypithecus*)	*cristata*	*ultima*	NMNH 154359	F	5216	11.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35607	F	5216	11.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35718	F	5216	11.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35597	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35610	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35636	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35675	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35682	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37668	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35688	F	5443	12
S. (*Trachypithecus*)	*cristata*	*ultima*?	MCZ 35669	F	5670	12.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35678	F	5670	12.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37669	F	5670	12.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37673	F	5670	12.5
S. (*Trachypithecus*)	*cristata*	*ultima*	**1**, p. 135; 1	F	5670	12.5
S. (*Trachypithecus*)	*cristata*	*ultima*?	MCZ 35603	F	5897	13
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35640	F	5897	13
S. (*Trachypithecus*)	*cristata*	*ultima*	NMNH 142213	F	6124	13.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35567	F	6124	13.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35618	F	6124	13.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35683	F	6124	13.5
S. (*Trachypithecus*)	*cristata*	*ultima*?	MCZ 35696	F	6350	14
S. (*Trachypithecus*)	*cristata*	*ultima*?	MCZ 35604	F	6350	14
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35605	F	6350	14
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35680	M	4990	11
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35595	M	5216	11.5
S. (*Trachypithecus*)	*cristata*	*ultima*	**1**, p. 135; 2	M	5216	11.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35583	M	5670	12.5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35690	M	5897	13
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35709	M	5897	13
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37675	M	5897	13
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35665	M	6124	13.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35762	M	6350	14
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35685	M	6350	14
S. (*Trachypithecus*)	*cristata*	*ultima*	NMNH 142212	M	6577	14.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35708	M	6577	14.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37665	M	6577	14.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37670	M	6577	14.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 37671	M	7031	15.5
S. (*Trachypithecus*)	*cristata*	*ultima?*	MCZ 35666	M	7484	16.5
S. (*Trachypithecus*)	*cristata*	*ultima*	MCZ 35672	M	7484	16.5
S. (*Trachypithecus*)	*cristata*	*ultima?*	MCZ 35671	M	7938	17.5
S. (*Trachypithecus*)	*francoisi*		UHVZ Ps 11	F	7200	
S. (*Trachypithecus*)	*francoisi*		**49**; max of 2	F	7500	
S. (*Trachypithecus*)	*francoisi*		**30**; KIZ 76102	F	8700	
S. (*Trachypithecus*)	*francoisi*		UHVZ Ps 47	M	5700	
S. (*Trachypithecus*)	*francoisi*		UHVZ 128	M	6500	
S. (*Trachypithecus*)	*francoisi*	[*francoisi*]	**31**	M	7600	
S. (*Trachypithecus*)	*francoisi*	[*leucocephalus*]	**30**; KIZ 76101	M	7700	
S. (*Trachypithecus*)	*francoisi*		**30**; KIZ 76105	M	8800	
S. (*Trachypithecus*)	*francoisi*	[*francoisi*]	**31**	M	9000	
S. (*Trachypithecus*)	*francoisi*	[*leucocephalus*]	**31**	M	9000	
S. (*Trachypithecus*)	*francoisi*		**30**; KIZ 77205	M	9450	
S. (*Trachypithecus*)	*geei*		ZIUH; 1 of 1	F	9500	
S. (*Trachypithecus*)	*geei*		ZIUH; min of 4	M	10000	
S. (*Trachypithecus*)	*geei*		ZSI 18727	M	10850	
S. (*Trachypithecus*)	*geei*		ZIUH; max of 4	M	12000	
S. (*Trachypithecus*)	*hatinhensis*		**5**	M	8000	
S. (*Trachypithecus*)	*obscura*	*carbo*	NMNH 104443	F	5443	12
S. (*Trachypithecus*)	*obscura*	*carbo*	NMNH 104444	M	8165	18
S. (*Trachypithecus*)	*obscura*	*carbo*	NMNH 123993	M	8505	18.75
S. (*Trachypithecus*)	*obscura*	*flavicauda*	NMNH 83259	F	4990	11
S. (*Trachypithecus*)	*obscura*	*flavicauda*	NMNH 83258	F	5443	12
S. (*Trachypithecus*)	*obscura*	*flavicauda*	BM(NH) ?1937.9.10.1	F	8392	18.5
S. (*Trachypithecus*)	*obscura*	*flavicauda*	FMNH 105686	F	6800	
S. (*Trachypithecus*)	*obscura*	*flavicauda*	NMNH 124205	F	7938	17.5
S. (*Trachypithecus*)	*obscura*	*flavicauda*	BM(NH) 1914.12.8.24 or 25	F	8392	18.5
S. (*Trachypithecus*)	*obscura*	*flavicauda*	BM(NH) 1914.12.8.24 or 25	F	8618	19
S. (*Trachypithecus*)	*obscura*	*flavicauda*	BM(NH) 1914.12.8.24 or 25	M	7031	15.5
S. (*Trachypithecus*)	*obscura*	*flavicauda*	BM(NH) 1914.12.8.27	M	7484	16.5
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.731	F	4990	11
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.706	F	5897	13
S. (*Trachypithecus*)	*obscura*	*obscura*	Fleagle P26	F	6340	
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.703	F	6350	14
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 112614	F	6691	14.75
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.705	F	6804	15
S. (*Trachypithecus*)	*obscura*	*obscura*	Fleagle P27	F	6850	
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.737	F	7031	15.5
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.736	F	7031	15.5
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.721	F	7938	17.5
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 105023	F	8845	19.5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.704	M	6804	15
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.734	M	6804	15
S. (*Trachypithecus*)	*obscura*	*obscura*	Fleagle P25	M	7200	
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.709	M	7258	16
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.729	M	7711	17
S. (*Trachypithecus*)	*obscura*	*obscura*	Fleagle P18	M	7960	
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.722	M	8165	18
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 115497	M	8165	18
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 115498	M	8392	18.5
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 124084	M	8618	19
S. (*Trachypithecus*)	*obscura*	*obscura*	BM(NH) 71.733	M	9072	20
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 124289	M	9072	20
S. (*Trachypithecus*)	*obscura*	*obscura*	NMNH 112613	M	9185	20.25
S. (*Trachypithecus*)	*obscura*	*sanctorum*	NMNH 104446	F	8165	18
S. (*Trachypithecus*)	*obscura*	*sanctorum*	NMNH 124113	M	10886	24
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105659	F	4150	
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105646	F	4300	
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105651	F	5800	
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105647	F	6250	
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105660	M	6100	
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105680	M	7100	
S. (*Trachypithecus*)	*obscura*	subsp. indet.	FMNH 105675	M	8700	
S. (*Trachypithecus*)	*phayrei*	*crepuscula*	BM(NH) 1924.9.2.14	F	7484	16.5
S. (*Trachypithecus*)	*phayrei*	*crepuscula*	BM(NH) 1924.9.2.9 or 10	M	6124	13.5
S. (*Trachypithecus*)	*phayrei*	*crepuscula*	BM(NH) 1924.9.2.9 or 10	M	7484	16.5
S. (*Trachypithecus*)	*phayrei*	*phayrei*	BM(NH) 1979.2347 (or below)	F	4763	10.5
S. (*Trachypithecus*)	*phayrei*	*phayrei*	BM(NH) 1937.9.10.13 (or above)	F	6804	15
S. (*Trachypithecus*)	*phayrei*	*phayrei*	BM(NH) 1914.7.19.5	F	7031	15.5
S. (*Trachypithecus*)	*phayrei*	*phayrei*	BM(NH) 1915.5.5.9 or 1936.9.10.12	M	7938	17.5
S. (*Trachypithecus*)	*phayrei*	*phayrei*	BM(NH) 1914.7.19.3 or 4	M	7938	17.5
S. (*Trachypithecus*)	*phayrei*	*shanica*	BM(NH) 1914.7.8.3 or 4	F	6804	15
S. (*Trachypithecus*)	*phayrei*	*shanica*	BM(NH) 1914.7.8.1 or 2	M	8618	19
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99732	F	4040	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99718	F	4500	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99713	F	5160	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99717	F	5800	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99697	F	6000	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	**35**, p. 66; min of 5	F	6356	14
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99700	F	6600	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99714	F	6700	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99733	F	6800	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	MCZ 38631	F	7031	15.5
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	**35**, p. 66; max of 5	F	7491	16.5
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	**35**, p. 66; min of 8	M	5675	12.5
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	MCZ 35922	M	7031	15.5
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99698	M	7400	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	FMNH 99730	M	8700	
S. (*Trachypithecus*)	*phayrei*	subsp. indet.	**35**, p. 66; max of 8	M	9080	20
S. (*Trachypithecus*)	*pileata*	*durga*	BMNH 1921.7.13.7	F	11340	25
S. (*Trachypithecus*)	*pileata*	*durga*	BMNH 1921.7.13.6	M	12247	27
S. (*Trachypithecus*)	*pileata*	*pileata*	**39**; 5	F	9500	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
S. (*Trachypithecus*)	*pileata*	*pileata*	**42**, p. 123; Jaintia	F	9752	21.5
S. (*Trachypithecus*)	*pileata*	*pileata*	**39**; 4	F	10000	
S. (*Trachypithecus*)	*pileata*	*pileata*	**39**; 3	F	10500	
S. (*Trachypithecus*)	*pileata*	*pileata*	**39**; 2	M	11500	
S. (*Trachypithecus*)	*pileata*	*pileata*	**39**; 1	M	14000	
S. (*Trachypithecus*)	*pileata*	*shortridgei*	BMNH 1915.5.5.11	F	9526	21
S. (*Trachypithecus*)	*pileata*	*shortridgei*	BMNH 1915.5.5.14	M	12701	28
S. (*Trachypithecus*)	*pileata*	*shortridgei*	BMNH 1915.5.5.10	M	13608	30
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**29**; 5	F	10886	24
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**42**, p. 148; Kukkal Shola	F	11340	25
S. (*Trachypithecus*)	*johnii*	subsp. indet.	ZSI 12099	F	11350	
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**42**, p. 148; Tinnevelly	M	9072	20
S. (*Trachypithecus*)	*johnii*	subsp. indet.	BMNH 1913.8.22.1	M	9760	
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**42**, p. 148; Kodaikanal 1	M	10886	24
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**29**; 1	M	11794	26
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**29**; 3	M	12247	27
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**29**; 2	M	13154	29
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**42**, p. 148; Kodaikanal 2	M	13154	29
S. (*Trachypithecus*)	*johnii*	subsp. indet.	**29**; 4	M	13608	30
S. (*Trachypithecus*)	*vetulus*	*monticola*	**35**, p. 72; 1 of 1	F	7484	16.5
S. (*Trachypithecus*)	*vetulus*	*monticola*	**35**, p. 72; min of 2	M	9072	20.0
S. (*Trachypithecus*)	*vetulus*	*monticola*	**35**, p. 72; max of 2	M	9752	21.5
S. (*Trachypithecus*)	*vetulus*	*vetulus*	**35**, p. 72; min of 2	F	4990	11.0
S. (*Trachypithecus*)	*vetulus*	*vetulus*	**35**, p. 72; max of 2	F	5216	11.5
S. (*Trachypithecus*)	*vetulus*	*vetulus*	**40**, p. 16; max of 9	F	5216	11.5
S. (*Trachypithecus*)	*vetulus*	*vetulus*	**35**, p. 72; 1 of 1	M	5670	12.5
S. (*Trachypithecus*)	*vetulus*	*vetulus*	**40**, p. 16; max of 7	M	7711	17.0
Cercopithecus	*aethiops*	*aethiops*	BMNH 1915.3.6.1	M	5216	11.5
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 251	F	2800	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 241	F	3300	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 238	F	3500	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 240	F	3500	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 244	F	3750	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 264	M	5200	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 247	M	5250	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 243	M	5300	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 265	M	5800	
Cercopithecus	*aethiops*	*arenarius*	Haddow UP 246	M	6000	
Cercopithecus	*aethiops*	*budgeti*	BMNH 1972.36	F	3900	
Cercopithecus	*aethiops*	*budgeti*	BMNH 1930.8.1.15	F	4536	10
Cercopithecus	*aethiops*	*budgeti*	BMNH 1951.531	M	6350	14
Cercopithecus	*aethiops*	*callidus*	BMNH 1972.27	F	4900	
Cercopithecus	*aethiops*	*callidus*	BMNH 1972.30	F	6400	
Cercopithecus	*aethiops*	*callidus*	BMNH 1972.31	M	3600	
Cercopithecus	*aethiops*	*callidus*	BMNH 1913.10.18.4	M	4082	9
Cercopithecus	*aethiops*	*callidus*	BMNH 1972.25	M	4700	
Cercopithecus	*aethiops*	*callidus*	BMNH 1972.24	M	6300	
Cercopithecus	*aethiops*	*centralis*	Haddow UP 150	F	2722	6
Cercopithecus	*aethiops*	*centralis*	Haddow UP 129	F	3175	7
Cercopithecus	*aethiops*	*centralis*	Haddow UP 157	F	3175	7
Cercopithecus	*aethiops*	*centralis*	NMNH 452593	F	3572	
Cercopithecus	*aethiops*	*centralis*	Haddow UP 115	F	3629	8
Cercopithecus	*aethiops*	*centralis*	Haddow UP 128	F	3629	8

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass	
					g	lb
Cercopithecus	*aethiops*	*centralis*	Haddow UP 152	F	3629	8
Cercopithecus	*aethiops*	*centralis*	Haddow UP 156	F	3629	8
Cercopithecus	*aethiops*	*centralis*	Haddow UP 167	F	3629	8
Cercopithecus	*aethiops*	*centralis*	Haddow UP 178	F	3629	8
Cercopithecus	*aethiops*	*centralis*	NMNH 452595	F	3875	
Cercopithecus	*aethiops*	*centralis*	Haddow UP 153	F	4082	9
Cercopithecus	*aethiops*	*centralis*	Haddow UP 146	F	4082	9
Cercopithecus	*aethiops*	*centralis*	Haddow UP 93	F	4536	10
Cercopithecus	*aethiops*	*centralis*	BMNH 1929.5.14.16	F	4536	10
Cercopithecus	*aethiops*	*centralis*	Haddow UP 131	M	4082	9
Cercopithecus	*aethiops*	*centralis*	Haddow UP 154	M	4536	10
Cercopithecus	*aethiops*	*centralis*	NMNH 452607	M	4780	
Cercopithecus	*aethiops*	*centralis*	NMNH 452599	M	4795	
Cercopithecus	*aethiops*	*centralis*	Haddow UP 176	M	5330	11.75
Cercopithecus	*aethiops*	*centralis*	Haddow UP 130	M	5443	12
Cercopithecus	*aethiops*	*centralis*	Haddow UP 151	M	5897	13
Cercopithecus	*aethiops*	*centralis*	NMNH 452591	M	5913	
Cercopithecus	*aethiops*	*centralis*	Haddow UP 177	M	6237	13.75
Cercopithecus	*aethiops*	*centralis*	Haddow UP 160	M	6350	14
Cercopithecus	*aethiops*	*johnstoni*	Haddow UP 215	F	2500	
Cercopithecus	*aethiops*	*johnstoni*	Haddow UP 236	F	2800	
Cercopithecus	*aethiops*	*johnstoni*	Haddow UP 235	M	4500	
Cercopithecus	*aethiops*	*matschiei*	BMNH 1964.2175	F	4082	9
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367894	F	3119	6.875
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 384044	F	3175	7
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367904	F	3260	7.1875
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 368572	F	3402	7.5
Cercopithecus	*aethiops*	*ngamiensis*	**46**; min of 30	F	3410	
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469932	F	3629	8
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367897	F	3686	8.125
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367915	F	3714	8.1875
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367903	F	3941	8.6875
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469926	F	3969	8.75
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367887	F	3997	8.8125
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367908	F	3997	8.8125
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367913	F	4309	9.5
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367911	F	4338	9.5625
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367901	F	4649	10.25
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469939	F	4990	11
Cercopithecus	*aethiops*	*ngamiensis*	**46**; max of 30	F	5220	
Cercopithecus	*aethiops*	*ngamiensis*	**46**; min of 29	M	3860	
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367910	M	4536	10
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469937	M	4876	10.75
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367900	M	4905	10.8125
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367907	M	5103	11.25
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469941	M	5216	11.5
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469931	M	5557	12.25
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367885	M	5812	12.8125
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367898	M	5954	13.125
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469938	M	6010	13.25
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367899	M	6180	13.625
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469930	M	6237	13.75
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 469934	M	6804	15

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Cercopithecus	*aethiops*	*ngamiensis*	NMNH 367896	M	6946	15.3125
Cercopithecus	*aethiops*	*ngamiensis*	**46**; max of 29	M	8000	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452602	F	3140	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452597	F	3155	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452609	F	3395	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452601	F	3825	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452605	F	4325	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452610	M	3777	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452596	M	3960	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 469905	M	4536	10
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452611	M	5185	
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 469907	M	5216	11.5
Cercopithecus	*aethiops*	*pygerythrus*	NMNH 452606	M	7404	
Cercopithecus	*aethiops*	*sabaeus*	**19**; min of 20	F	3400	
Cercopithecus	*aethiops*	*sabaeus*	PCM 1956.264	F	3700	
Cercopithecus	*aethiops*	*sabaeus*	**19**; max of 20	F	5900	
Cercopithecus	*aethiops*	*sabaeus*	**19**; min of 17	M	4700	
Cercopithecus	*aethiops*	*sabaeus*	PCM 1956.266	M	5000	
Cercopithecus	*aethiops*	*sabaeus*	NMNH 477293	M	6350	14
Cercopithecus	*aethiops*	*sabaeus*	**19**; max of 17	M	7000	
Cercopithecus	*aethiops*	*whytei*	NMNH 470263	M	5330	11.75
Cercopithecus	*ascanius*	*katangae*	**9**; min of 187	F	1800	
Cercopithecus	*ascanius*	*katangae*	**9**; max of 187	F	3950	
Cercopithecus	*ascanius*	*katangae*	**9**; min of 32	M	2200	
Cercopithecus	*ascanius*	*katangae*	**9**; max of 32	M	4900	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 161	F	1814	4
Cercopithecus	*ascanius*	*schmidti*	Haddow P 162	F	1814	4
Cercopithecus	*ascanius*	*schmidti*	Haddow P 168	F	1814	4
Cercopithecus	*ascanius*	*schmidti*	**9**; min of 55	F	2100	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 124	F	2268	5
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 117	F	2268	5
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 140	F	2268	5
Cercopithecus	*ascanius*	*schmidti*	Haddow P 157	F	2268	5
Cercopithecus	*ascanius*	*schmidti*	NMNH 452512	F	2478	
Cercopithecus	*ascanius*	*schmidti*	Haddow P 163	F	2495	5.5
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 13	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 24	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 162	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 438	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 61	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow P 154	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow P 235	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow P 237	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow P 291	F	2722	6
Cercopithecus	*ascanius*	*schmidti*	Haddow P 208	F	2948	6.5
Cercopithecus	*ascanius*	*schmidti*	Haddow P 236	F	2948	6.5
Cercopithecus	*ascanius*	*schmidti*	Haddow P 232	F	2948	6.5
Cercopithecus	*ascanius*	*schmidti*	NMNH 537774	F	3050	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 5	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 8	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 12	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 16	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 20	F	3175	7

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 105	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 159	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 170	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 4	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 160	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow P 227	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 60	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow P 153	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow P 222	F	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow P 309	F	3175	7
Cercopithecus	*ascanius*	*schmidti?*	KNM OM 2901	F?	3400	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 46	F	3402	7.5
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 11	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 51	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 3	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 45	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 239	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 199	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 243	F	3629	8
Cercopithecus	*ascanius*	*schmidti*	**9**; max of 55	F	3750	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 47	F	3856	8.5
Cercopithecus	*ascanius*	*schmidti*	**9**; min of 37	M	2950	
Cercopithecus	*ascanius*	*schmidti*	Haddow P 158	M	3175	7
Cercopithecus	*ascanius*	*schmidti*	Haddow P 175	M	3402	7.5
Cercopithecus	*ascanius*	*schmidti*	Haddow P 133	M	3402	7.5
Cercopithecus	*ascanius*	*schmidti*	Haddow P 141	M	3515	7.75
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 108	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 169	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 142	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 155	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 166	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 184	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 223	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 282	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 316	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 215	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 226	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 210	M	3629	8
Cercopithecus	*ascanius*	*schmidti*	Haddow P 219	M	3856	8.5
Cercopithecus	*ascanius*	*schmidti*	Haddow P 134	M	3969	8.75
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 7	M	4082	9
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 37	M	4082	9
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 120	M	4082	9
Cercopithecus	*ascanius*	*schmidti*	Haddow P 188	M	4082	9
Cercopithecus	*ascanius*	*schmidti*	Haddow P 296	M	4082	9
Cercopithecus	*ascanius*	*schmidti*	Haddow P 164	M	4082	9
Cercopithecus	*ascanius*	*schmidti*	Haddow P 247	M	4082	9
Cercopithecus	*ascanius*	*schmidti?*	KNM OM 2902	M?	4270	
Cercopithecus	*ascanius*	*schmidti*	NMNH 452516	M	4275	
Cercopithecus	*ascanius*	*schmidti*	Haddow P 234	M	4309	9.5
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 119	M	4536	10
Cercopithecus	*ascanius*	*schmidti*	Haddow P 187	M	4536	10
Cercopithecus	*ascanius*	*schmidti*	Haddow P 224	M	4536	10

APPENDIX TABLE 1
Continued

					Mass	
Genus	Species	Subspecies	Specimen reference	Sex	g	lb
Cercopithecus	*ascanius*	*schmidti*	Haddow P 238	M	4536	10
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 15	M	4536	10
Cercopithecus	*ascanius*	*schmidti*	**9**; max of 37	M	4750	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 6	M	4990	11
Cercopithecus	*ascanius*	*schmidti*	Haddow P 283	M	4990	11
Cercopithecus	*ascanius*	*schmidti*	Haddow P 297	M	4990	11
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 25	M	4990	11
Cercopithecus	*ascanius*	*schmidti*	Haddow P 196	M	4990	11
Cercopithecus	*ascanius*	*schmidti*	Haddow P 284	M	5443	12
Cercopithecus	*ascanius*	*schmidti*	NMNH 452517	M	5520	
Cercopithecus	*ascanius*	*schmidti?*	KNM OM 2900	M?	5730	
Cercopithecus	*ascanius*	*schmidti*	NMNH 452514	M	5775	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 26	M	5897	13
Cercopithecus	*ascanius*	*schmidti*	NMNH 452510	M	6235	
Cercopithecus	*ascanius*	*schmidti*	Haddow UP 53	M	6350	14
Cercopithecus	*campbelli*	*campbelli*	**38**, table 1; min of 9	F	2000	
Cercopithecus	*campbelli*	*campbelli*	**38**, table 1; max of 9	F	4500	
Cercopithecus	*campbelli*	*campbelli*	**38**, table 1; min of 10	M	3200	
Cercopithecus	*campbelli*	*campbelli*	**38**, table 2; Tiwai	M	4500	
Cercopithecus	*campbelli*	*campbelli*	**38**, table 1; max of 10	M	5500	
Cercopithecus	*campbelli*	*lowei*	NMNH 477303	F	1800	
Cercopithecus	*campbelli*	*lowei*	NMNH 450064	F	1814	4
Cercopithecus	*campbelli*	*lowei*	NMNH 477302	F	2000	
Cercopithecus	*campbelli*	*lowei*	NMNH 481765	F	2200	
Cercopithecus	*campbelli*	*lowei*	NMNH 477306	F	2268	5
Cercopithecus	*campbelli*	*lowei*	NMNH 481759	F	2300	
Cercopithecus	*campbelli*	*lowei*	NMNH 481767	F	2300	
Cercopithecus	*campbelli*	*lowei*	NMNH 481769	F	2400	
Cercopithecus	*campbelli*	*lowei*	NMNH 477298	F	2600	
Cercopithecus	*campbelli*	*lowei*	NMNH 481760	F	2600	
Cercopithecus	*campbelli*	*lowei*	NMNH 481768	F	2600	
Cercopithecus	*campbelli*	*lowei*	NMNH 481764	F	2800	
Cercopithecus	*campbelli*	*lowei*	NMNH 481763	F	3200	
Cercopithecus	*campbelli*	*lowei*	NMNH 465914	F	5000	
Cercopithecus	*campbelli*	*lowei*	NMNH 481756	M	3200	
Cercopithecus	*campbelli*	*lowei*	NMNH 477305	M	3200	
Cercopithecus	*campbelli*	*lowei*	NMNH 481755	M	3200	
Cercopithecus	*campbelli*	*lowei*	NMNH 481762	M	3200	
Cercopithecus	*campbelli*	*lowei*	NMNH 477296	M	4082	9
Cercopithecus	*campbelli*	*lowei*	NMNH 477297	M	4100	
Cercopithecus	*campbelli*	*lowei*	NMNH 477300	M	4200	
Cercopithecus	*campbelli*	*lowei*	NMNH 481757	M	4200	
Cercopithecus	*campbelli*	*lowei*	NMNH 481761	M	4200	
Cercopithecus	*campbelli*	*lowei*	NMNH 477307	M	4536	10
Cercopithecus	*campbelli*	*lowei*	NMNH 477304	M	4600	
Cercopithecus	*cephus*		Susman 85-8	F	2400	
Cercopithecus	*cephus*		Susman 85-13	F	2600	
Cercopithecus	*cephus*		**27**; 1	F	2900	
Cercopithecus	*cephus*		Susman 85-12	F	3000	
Cercopithecus	*cephus*		Susman 85-2	F	3900	
Cercopithecus	*cephus*		Susman 85-16	M	3350	
Cercopithecus	*cephus*		Susman 85-6	M	4150	
Cercopithecus	*denti*		**9**; min of 36	F	2000	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Cercopithecus	*denti*		**9**; max of 36	F	3700	
Cercopithecus	*denti*		**9**; min of 4	M	3550	
Cercopithecus	*denti*		**9**; max of 4	M	4950	
Cercopithecus	*diana*	*diana*	NMNH 481754	F	2500	
Cercopithecus	*diana*	*diana*	**38**, table 1; min of 11	F	2900	
Cercopithecus	*diana*	*diana*	NMNH 481749	F	3400	
Cercopithecus	*diana*	*diana*	NMNH 477295	F	3629	8
Cercopithecus	*diana*	*diana*	NMNH 481753	F	3800	
Cercopithecus	*diana*	*diana*	NMNH 481750	F	4000	
Cercopithecus	*diana*	*diana*	NMNH 481751	F	4000	
Cercopithecus	*diana*	*diana*	NMNH 481752	F	4000	
Cercopithecus	*diana*	*diana*	**38**, table 1; max of 11	F	4900	
Cercopithecus	*diana*	*diana?*	McGraw 94-1	F	5400	
Cercopithecus	*diana*	*diana*	**38**, table 1; min of 4	M	4000	
Cercopithecus	*diana*	*diana*	**37**; Tiwai killed	M	6000	
Cercopithecus	*diana*	*diana*	**38**, table 1; max of 4	M	6300	
Cercopithecus	*hamlyni*	*hamlyni*	**9**; min of 9	F	2600	
Cercopithecus	*hamlyni*	*hamlyni*	**9**; max of 9	F	4300	
Cercopithecus	*hamlyni*	*hamlyni*	**9**; min of 11	M	4350	
Cercopithecus	*hamlyni*	*hamlyni*	**9**; max of 11	M	7300	
Cercopithecus	*lhoesti*		**9**; min of 50	F	1750	
Cercopithecus	*lhoesti*		**9**; max of 50	F	5200	
Cercopithecus	*lhoesti*		**9**; min of 19	M	3250	
Cercopithecus	*lhoesti*		**9**; max of 19	M	8450	
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425426	F	2835	6.25
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425425	F	3062	6.75
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425424	F	3289	7.25
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425429	F	4876	10.75
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425427	F	5557	12.25
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425432	F	5557	12.25
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425421	F	5897	13
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425423	F	6010	13.25
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425422	M	4876	10.75
Cercopithecus	*mitis*	*erythrarchus*	NMNH 470262	M	8618	19
Cercopithecus	*mitis*	*erythrarchus*	NMNH 425428	M	9299	20.5
Cercopithecus	*mitis*	*kolbi*	NMNH 425568	F	3470	
Cercopithecus	*mitis*	*kolbi*	NMNH 452578	F	3590	
Cercopithecus	*mitis*	*kolbi*	NMNH 452581	F	4210	
Cercopithecus	*mitis*	*kolbi*	NMNH 425571	M	5750	
Cercopithecus	*mitis*	*kolbi*	NMNH 425570	M	5890	
Cercopithecus	*mitis*	*kolbi*	NMNH 452587	M	6555	
Cercopithecus	*mitis*	*kolbi*	NMNH 452574	M	7550	
Cercopithecus	*mitis*	*kolbi*	NMNH 452575	M	7630	
Cercopithecus	*mitis*	*kolbi*	NMNH 452586	M	8200	
Cercopithecus	*mitis*	*stuhlmanni*	**9**; min of 94	F	2250	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452531	F	3705	
Cercopithecus	*mitis*	*stuhlmanni?*	KNM OM 2886	F	4050	
Cercopithecus	*mitis*	*stuhlmanni?*	KNM OM 1978	F	4142	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452535	F	4303	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452540	F	4366	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452544	F	4680	
Cercopithecus	*mitis*	*stuhlmanni*	**9**; max of 94	F	5250	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452537	F	5414	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Cercopithecus	*mitis*	*stuhlmanni*	**9**; min of 41	M	3650	
Cercopithecus	*mitis*	*stuhlmanni?*	KNM OM 2879	M	4745	
Cercopithecus	*mitis*	*stuhlmanni*	Sarmiento, unnumbered	M	4900	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452536	M	6799	
Cercopithecus	*mitis*	*stuhlmanni?*	KNM OM 2796	M	7200	
Cercopithecus	*mitis*	*stuhlmanni*	**9**; max of 41	M	7800	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452538	M	7950	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452545	M	8440	
Cercopithecus	*mitis*	*stuhlmanni*	NMNH 452530	M	9510	
Cercopithecus	*mona*		NMNH 481758	F	2500	
Cercopithecus	*mona*		PCM CAM-II-56	M	4760	
Cercopithecus	*mona*		PCM CAM-II-57	M	5440	
Cercopithecus	*neglectus*		**9**; min of 62	F	2500	
Cercopithecus	*neglectus*		NMNH 537775	F	3050	
Cercopithecus	*neglectus*		**27**; 1	F	3550	
Cercopithecus	*neglectus*		**9**; 1 of 1	F	3750	
Cercopithecus	*neglectus*		NMNH 452522	F	3860	
Cercopithecus	*neglectus*		**34**, p. 92; min of 2	F	4100	
Cercopithecus	*neglectus*		KNM OM 2906	F	4200	
Cercopithecus	*neglectus*		**27**; 2	F	4305	
Cercopithecus	*neglectus*		KNM OM 2907	F	4390	
Cercopithecus	*neglectus*		NMNH 452520	F	4423	
Cercopithecus	*neglectus*		NMNH 452525	F	4460	
Cercopithecus	*neglectus*		**34**, p. 92; max of 2	F	4816	
Cercopithecus	*neglectus*		**9**; max of 62	F	4900	
Cercopithecus	*neglectus*		NMNH 452523	M	6310	
Cercopithecus	*neglectus*		KNM OM 2903	M	7000	
Cercopithecus	*neglectus*		NMNH 452524	M	7490	
Cercopithecus	*neglectus*		**34**, p. 92; min of 2	M	7850	
Cercopithecus	*neglectus*		**34**, p. 92; max of 2	M	8245	
Cercopithecus	*nictitans*	*martini*	NMNH 481773	M	4800	
Cercopithecus	*nictitans*	*martini*	NMNH 481771	M	6000	
Cercopithecus	*nictitans*	*martini*	NMNH 481770	M	6800	
Cercopithecus	*nictitans*	*nictitans*	**9**; min of 21	F	2650	
Cercopithecus	*nictitans*	*nictitans*	**27**; 1	F	3800	
Cercopithecus	*nictitans*	*nictitans*	**9**; max of 21	F	6100	
Cercopithecus	*nictitans*	*nictitans*	**9**; min of 17	M	4700	
Cercopithecus	*nictitans*	*nictitans*	PCM French Congo 144	M	7484	16.5
Cercopithecus	*nictitans*	*nictitans*	**9**; max of 17	M	8500	
Cercopithecus	*petaurista*	*buettikofferi*	**37**; Tiwai killed	F	2000	
Cercopithecus	*petaurista*	*buettikofferi*	**38**, table 1; min of 7	F	2300	
Cercopithecus	*petaurista*	*buettikofferi*	**37**; Tiwai killed	F	2400	
Cercopithecus	*petaurista*	*buettikofferi*	AIUG F 2572	F	3000	
Cercopithecus	*petaurista*	*buettikofferi*	AIUG A 574	F	3315	
Cercopithecus	*petaurista*	*buettikofferi*	**38**, table 1; max of 7	F	3800	
Cercopithecus	*petaurista*	*buettikofferi*	**38**, table 1; min of 13	M	3900	
Cercopithecus	*petaurista*	*buettikofferi*	**37**; Tiwai killed	M	4200	
Cercopithecus	*petaurista*	*buettikofferi*	**38**, table 1; max of 13	M	5000	
Cercopithecus	*petaurista*	*petaurista*	McGraw 98-4	M	5200	
Cercopithecus	*petaurista*	*petaurista*	McGraw 94-12	M	5900	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477313	F	2000	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 481774	F	2200	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477310	F	2268	5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477314	F	2600	
Cercopithecus	*petaurista*	subsp. indet.	**34**, p. 122; min of 5	F	2600	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477318	F	2700	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477316	F	2800	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477317	F	2800	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477319	F	3000	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 481781	F	3200	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 481778	F	3400	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477312	F	3500	
Cercopithecus	*petaurista*	subsp. indet.	**34**, p. 122; max of 5	F	3800	
Cercopithecus	*petaurista*	subsp. indet.	**34**, p. 122; min of 5	M	3400	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 477311	M	4082	9
Cercopithecus	*petaurista*	subsp. indet.				
Cercopithecus	*petaurista*	subsp. indet.	**34**, p. 122; max of 5	M	4500	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 481777	M	4800	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 481776	M	5000	
Cercopithecus	*petaurista*	subsp. indet.	NMNH 481780	M	5200	
Cercopithecus	*pogonias*	*grayi*	**9**; min of 4	F	2150	
Cercopithecus	*pogonias*	*grayi*?	NMNH 537779	F	3000	
Cercopithecus	*pogonias*	*grayi*	**9**; max of 4	F	3100	
Cercopithecus	*pogonias*	*grayi*	**9**; 1 of 1	M	3300	
Cercopithecus	*pogonias*	*grayi*?	NMNH 537778	M	4600	
Cercopithecus	*pogonias*	*nigripes*	**27**; 4	F	2793	
Cercopithecus	*pogonias*	*nigripes*	**27**; 1	F	2874	
Cercopithecus	*pogonias*	*nigripes*	**27**; 5	M	3030	
Cercopithecus	*pogonias*	*nigripes*	**27**; 6	M	3400	
Cercopithecus	*tantalus*	*marrensis*	**9**; min of 7	F	2800	
Cercopithecus	*tantalus*	*marrensis*	**9**; max of 7	F	4600	
Cercopithecus	*wolfi*	*wolfi*	**9**; min of 84	F	1800	
Cercopithecus	*wolfi*	*wolfi*	**9**; max of 84	F	3600	
Cercopithecus	*wolfi*	*wolfi*	**9**; min of 13	M	2450	
Cercopithecus	*wolfi*	*wolfi*	**9**; max of 13	M	4950	
Miopithecus	*talapoin*	*talapoin*	PCM Z-II-16	F	2000	
Miopithecus	*talapoin*	*talapoin*	PCM Z-V-24	F	2000	
Miopithecus	*talapoin*	*talapoin*	PCM Z-V-40	M	2500	
Miopithecus	*talapoin*	nov.	**27**; 5	F	1064	
Miopithecus	*talapoin*	nov.?	NMNH 397648	F	1268	
Miopithecus	*talapoin*	nov.	**27**; 1	F	1625	
Miopithecus	*talapoin*	nov.	**27**; 9	M	1045	
Miopithecus	*talapoin*	nov.	**32**, p. 47; 1	M	1400	
Miopithecus	*talapoin*	nov.	**27**; 7	M	1428	
Miopithecus	*talapoin*	nov.	**27**; 8	M	1435	
Miopithecus	*talapoin*	nov.	**32**, p. 47; 2	M	1500	
Allenopithecus	*nigroviridis*		MRAC-T 28771	F	3200	
Allenopithecus	*nigroviridis*		**9**; 1 of 1	F	3250	
Allenopithecus	*nigroviridis*		MRAC-T 28770	M	4450	
Allenopithecus	*nigroviridis*		MRAC-T 27993	M	5500	
Allenopithecus	*nigroviridis*		Susman 81-21	M	5500	
Allenopithecus	*nigroviridis*		MRAC-T 28645	M	7000	
Allenopithecus	*nigroviridis*		MRAC-T 28769	M	8200	
Erythrocebus	*patas*		**3**; 1 of 1	F	4000	
Erythrocebus	*patas*		**36**; min of 4	F	4082	9
Erythrocebus	*patas*		**24**; P5[c]	F	4400	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Erythrocebus	*patas*		AIUZ 1812	F	4900	
Erythrocebus	*patas*		**19**; min of 14	F	5400	
Erythrocebus	*patas*		**20**; 1 of 1	F	6000	
Erythrocebus	*patas*		**36**; max of 4	F	7100	
Erythrocebus	*patas*		**19**; max of 14	F	8000	
Erythrocebus	*patas*		**19**; min of 9	M	5400	
Erythrocebus	*patas*		**34**, p. 173; 1	M	7000	
Erythrocebus	*patas*		**24**; P1[c]	M	7460	
Erythrocebus	*patas*		**36**, p. 412; min of 3	M	7484	16.5
Erythrocebus	*patas*		**24**; P4[c]	M	7800	
Erythrocebus	*patas*		**24**; P6[c]	M	9280	
Erythrocebus	*patas*		**8**; 1 of 1	M	11340	25
Erythrocebus	*patas*		**20**	M	12000	
Erythrocebus	*patas*		**36**; max of 3	M	12600	
Erythrocebus	*patas*		**19**; max of 9	M	18000	
Lophocebus	*albigena*	*albigena*	**9**; min of 4	F	4700	
Lophocebus	*albigena*	*albigena*	**9**; max of 4	F	5250	
Lophocebus	*albigena*	*albigena*	**9**; min of 4	M	6100	
Lophocebus	*albigena*	*albigena*	**9**; max of 4	M	8350	
Lophocebus	*albigena*	*johnstoni?*	KNM OM 3002	F	3640	
Lophocebus	*albigena*	*johnstoni*	Haddow UP 146	F	3969	8.75
Lophocebus	*albigena*	*johnstoni*	Haddow P 213	F	4536	10
Lophocebus	*albigena*	*johnstoni*	Haddow UP 150	F	4536	10
Lophocebus	*albigena*	*johnstoni*	Haddow P 198	F	4876	10.75
Lophocebus	*albigena*	*johnstoni?*	KNM OM 3003	F	4905	
Lophocebus	*albigena*	*johnstoni*	Haddow P 132	F	4990	11
Lophocebus	*albigena*	*johnstoni*	Haddow P 214	F	4990	11
Lophocebus	*albigena*	*johnstoni*	Haddow P 118	F	4990	11
Lophocebus	*albigena*	*johnstoni*	**9**; min of 6	F	5050	
Lophocebus	*albigena*	*johnstoni*	Haddow UP 54	F	5443	12
Lophocebus	*albigena*	*johnstoni*	Haddow P 231	F	5443	12
Lophocebus	*albigena*	*johnstoni*	Haddow UP 122	F	5443	12
Lophocebus	*albigena*	*johnstoni*	PCM 1930.8.1.27	F	5443	12
Lophocebus	*albigena*	*johnstoni*	PCM 1972.22	F	5700	
Lophocebus	*albigena*	*johnstoni*	Haddow P 203	F	5897	13
Lophocebus	*albigena*	*johnstoni*	PCM 1972.20	F	5900	
Lophocebus	*albigena*	*johnstoni*	PCM Congo-237	F	6124	13.5
Lophocebus	*albigena*	*johnstoni*	Haddow UP 147	F	6237	13.75
Lophocebus	*albigena*	*johnstoni*	Haddow UP 125	F	6350	14
Lophocebus	*albigena*	*johnstoni*	NMNH 452498	F	6890	
Lophocebus	*albigena*	*johnstoni*	**9**; max of 6	F	7850	
Lophocebus	*albigena*	*johnstoni*	Haddow UP 52	F	8165	18
Lophocebus	*albigena*	*johnstoni*	**9**; min of 4	M	5700	
Lophocebus	*albigena*	*johnstoni*	Haddow P 246	M	5897	13
Lophocebus	*albigena*	*johnstoni*	PCM 1930.8.1.23	M	6804	15
Lophocebus	*albigena*	*johnstoni?*	KNM OM 3004	M	7150	
Lophocebus	*albigena*	*johnstoni*	Haddow UP 127	M	7258	16
Lophocebus	*albigena*	*johnstoni*	Haddow UP 134	M	7258	16
Lophocebus	*albigena*	*johnstoni*	Haddow UP 175	M	7258	16
Lophocebus	*albigena*	*johnstoni*	PCM 1930.8.1.25	M	7258	16
Lophocebus	*albigena*	*johnstoni*	PCM 1972.21	M	7500	
Lophocebus	*albigena*	*johnstoni*	Haddow UP 23	M	7711	17
Lophocebus	*albigena*	*johnstoni*	Haddow UP 126	M	7711	17

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Lophocebus	*albigena*	*johnstoni*	Haddow UP 135	M	7711	17
Lophocebus	*albigena*	*johnstoni*	PCM 1930.8.1.24	M	7711	17
Lophocebus	*albigena*	*johnstoni*	PCM Congo-236	M	8165	18
Lophocebus	*albigena*	*johnstoni*	Haddow P 286	M	8165	18
Lophocebus	*albigena*	*johnstoni*	Haddow UP 10	M	8165	18
Lophocebus	*albigena*	*johnstoni*	NMNH 452500	M	8360	
Lophocebus	*albigena*	*johnstoni*	NMNH 452502	M	8480	
Lophocebus	*albigena*	*johnstoni*	**9**; max of 4	M	8650	
Lophocebus	*albigena*	*zenkeri*	PCM Z-VII-4	F	6000	
Lophocebus	*albigena*	*zenkeri*	PCM Z-VII-5	F	6000	
Lophocebus	*albigena*	*zenkeri*	PCM Z-II-33	M	8000	
Lophocebus	*albigena*	*zenkeri*	PCM Z-II-44	M	8500	
Lophocebus	*albigena*	*zenkeri*	PCM Z-VII-3	M	8500	
Lophocebus	*albigena*	*zenkeri?*	PCM M-852	M	9000	
Lophocebus	*albigena*	*zenkeri*	PCM Z-VII-6	M	9000	
Lophocebus	*albigena*	*zenkeri*	PCM French Congo-140	M	9072	20
Lophocebus	*albigena*	*zenkeri*	PCM Z-VI-29	M	10000	
Lophocebus	*albigena*	*zenkeri*	PCM Z-VIII-19	M	10000	
Lophocebus	*albigena*	*albigena*	1	F	7250	
Lophocebus	*albigena*	*albigena*	2	M	7700	
Lophocebus	*aterrimus*	*aterrimus*	**9**; min of 4	F	4450	
Lophocebus	*aterrimus*	*aterrimus*	**9**; max of 4	F	6700	
Lophocebus	*aterrimus*	*aterrimus*	**9**; 1 of 1	M	7900	
Lophocebus	*aterrimus*	subsp. indet.	Susman 2	F	6000	
Lophocebus	*aterrimus*	subsp. indet.	Susman 3	F	6000	
Lophocebus	*aterrimus*	subsp. indet.	Susman 1	M	7000	
Lophocebus	*aterrimus*	subsp. indet.	MRAC-T 28767	M	7500	
Lophocebus	*aterrimus*	subsp. indet.	MRAC-T 28568	M	8000	
Lophocebus	*aterrimus*	subsp. indet.	MRAC-T 28573	M	8000	
Lophocebus	*aterrimus*	subsp. indet.	MRAC-T 28571	M	8650	
Cercocebus	*galeritus*	*agilis*	**9**; min of 2	F	4325	
Cercocebus	*galeritus*	*agilis*	**9**; max of 2	F	6200	
Cercocebus	*galeritus*	*agilis*	**9**; min of 2	M	9000	
Cercocebus	*galeritus*	*agilis*	**9**; max of 2	M	10000	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28778	F	4600	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28780	F	4600	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28779	F	5100	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28781	F	6100	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28774	M	8200	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28775	M	8700	
Cercocebus	*galeritus*	subsp. indet.	MRAC-T 28776	M	10200	
Cercocebus	*torquatus*	*atys*	**38**, table 1; min of 4	F	5600	
Cercocebus	*torquatus*	*atys*	NMNH 481746	F	6400	
Cercocebus	*torquatus*	*atys*	NMNH 481747	F	7000	
Cercocebus	*torquatus*	*atys*	McGraw 94-9	M	9500	
Cercocebus	*torquatus*	*atys*	NMNH 481748	M	10800	
Cercocebus	*torquatus*	*atys*	NMNH 477292	M	11400	
Cercocebus	*torquatus*	*atys*	NMNH 477291	M	12700	
Cercocebus	*torquatus*	*torquatus*	**32**, p. 48; 2	F	5800	
Cercocebus	*torquatus*	*torquatus*	**32**, p. 48; 5	M	8800	
Cercocebus	*torquatus*	*torquatus*	**32**, p. 48; 3	M	9900	
Cercocebus	*torquatus*	*torquatus*	PCM 1903.2.4.1	M	10800	
Cercocebus	*torquatus*	*torquatus*	**32**, p. 48; 1	M	11300	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Cercocebus	*torquatus*	*torquatus*	**32**, p. 48; 4	M	12500	
Cercocebus	*torquatus*	*torquatus*	PCM CAM I 18	M	17237	38
Mandrillus	*leucophaeus*		**32**, p. 56	M	20000[d]	
Mandrillus	*sphinx*		PCM Z-VII-21	F	10000	
Mandrillus	*sphinx*		**32**, p. 54; 3	F	11000[e]	
Mandrillus	*sphinx*		**32**, p. 54; text	F	11000	
Mandrillus	*sphinx*		PCM Z-V-26	F	12000	
Mandrillus	*sphinx*		**32**, p. 54; 2	F	12000	
Mandrillus	*sphinx*		**47**, graph p. 132; 6	F	12000	
Mandrillus	*sphinx*		**47**, graph p. 132; 7	F	12000	
Mandrillus	*sphinx*		**47**, graph p. 132; 8	F	14000	
Mandrillus	*sphinx*		PCM Z-VII-17	F	17000	
Mandrillus	*sphinx*		**32**, p. 54; 6	M	27000[d]	
Mandrillus	*sphinx*		**32**, p. 54; 9	M	28000[d]	
Mandrillus	*sphinx*		**32**, p. 54; text	M	30000	
Mandrillus	*sphinx*		**48**, p. 911; 13	M	33300	
Mandrillus	*sphinx*		**48**, p. 911; 15	M	33600	
Mandrillus	*sphinx*		**48**, p. 911; 18	M	34500	
Mandrillus	*sphinx*		**48**, p. 911; 9	M	34800	
Mandrillus	*sphinx*		**48**, p. 911; 14	M	37000	
Mandrillus	*sphinx*		**32**, p. 54; text	M	39000	
Mandrillus	*sphinx*		PCM Z-VIII-9	M	45000	
Papio	*hamadryas*	*anubis* "Ethiopian-small"	**26**; min of 92	F	9500	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 8	F	10433	23
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 36	F	10886	24
Papio	*hamadryas*	*anubis "neumanni"*	AMNH 161115	F	10886	24
Papio	*hamadryas*	*anubis "neumanni"*?	**43**; min of 23	F	10900	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 1	F	11567	25.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 9	F	11567	25.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 34	F	11567	25.5
Papio	*hamadryas*	*anubis "neumanni"*	**11**; min of 17, PHG group	F	11700	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 4	F	11794	26
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 14	F	11794	26
Papio	*hamadryas*	*anubis "neumanni"*	FSM 2595	F	11794	26
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384217	F	11794	26
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384222	F	11794	26
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 13	F	12247	27
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 452508	F	12358	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 16	F	12701	28
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384221	F	12701	28
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 38	F	12928	28.5
Papio	*hamadryas*	*anubis "neumanni"*	**11**; min of 10, WBY group	F	13000	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 3	F	13154	29
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384219	F	13154	29
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 2	F	13608	30
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 5	F	13608	30
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 35	F	13608	30
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 40	F	13608	30
Papio	*hamadryas*	*anubis "neumanni"*	**11**; min of 9, CRIP group	F	14000	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 15	F	14062	31
Papio	*hamadryas*	*anubis "neumanni"*	**11**; max of 17, PHG group	F	14100	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 12	F	14288	31.5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*anubis* "Ethiopian-small"	Jolly F1	F	14515	32
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 6	F	14515	32
Papio	*hamadryas*	*anubis "neumanni"*	BM(NH) 62.25	F	14515	32
Papio	*hamadryas*	*anubis* "Ethiopian-small"	Jolly F2	F	15876	35
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384224	F	16330	36
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384225	F	16330	36
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384235	F	16330	36
Papio	*hamadryas*	*anubis* "Ethiopian-small"	SAF AM II 154	F	17000	
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384227	F	17237	38
Papio	*hamadryas*	*anubis "neumanni"*?	**43**; max of 23	F	18000	
Papio	*hamadryas*	*anubis "neumanni"*	**11**; max of 10, WBY group	F	18000	
Papio	*hamadryas*	*anubis* "Ethiopian-small"	**26**; max of 92	F	18120	
Papio	*hamadryas*	*anubis "neumanni"*	**11**; max of 9, CRIP group	F	18200	
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384228	F	18598	41
Papio	*hamadryas*	*anubis* "Ethiopian-small"	**26**; min of 188	M	14100	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 24	M	15422	34
Papio	*hamadryas*	*anubis "neumanni"*	**11**; min of 5, WBY group	M	16500	
Papio	*hamadryas*	*anubis "neumanni"*	**11**; min of 9, PHG group	M	17900	
Papio	*hamadryas*	*anubis "neumanni"*	AMNH 161116	M	18144	40
Papio	*hamadryas*	*anubis "neumanni"*	FSM M12	M	18598	41
Papio	*hamadryas*	*anubis* "Ethiopian-small"	Jolly M1	M	19278	42.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 29	M	19732	43.5
Papio	*hamadryas*	*anubis "neumanni"*	FSM M42	M	19732	43.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 10	M	19958	44
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 11	M	19958	44
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 26	M	19958	44
Papio	*hamadryas*	*anubis "neumanni"*	FSM M3	M	20185	44.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 21	M	20412	45
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 23	M	20412	45
Papio	*hamadryas*	*anubis* "Ethiopian-small"	Jolly M2	M	20865	46
Papio	*hamadryas*	*anubis "neumanni"*	FSM M13	M	20866	46
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 22	M	21092	46.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 30	M	21092	46.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 17	M	21319	47
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 28	M	21319	47
Papio	*hamadryas*	*anubis "neumanni"*	AMNH 161117	M	21773	48
Papio	*hamadryas*	*anubis "neumanni"*	**11**; min of 4, CRIP group	M	21800	
Papio	*hamadryas*	*anubis "neumanni"*?	**43**; min of 54	M	21800	
Papio	*hamadryas*	*anubis "choras"*	BM(NH) 53.654	M	22000	
Papio	*hamadryas*	*anubis* "Ethiopian-small"	Jolly M3	M	22226	49
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 25	M	22226	49
Papio	*hamadryas*	*anubis "neumanni"*	FSM M10	M	22226	49
Papio	*hamadryas*	*anubis "neumanni"*	FSM M4	M	22680	50
Papio	*hamadryas*	*anubis "neumanni"*	FSM M5	M	22907	50.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 32	M	23134	51

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*anubis "neumanni"*	FSM M11	M	23134	51
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 18	M	23587	52
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 20	M	23587	52
Papio	*hamadryas*	*anubis "neumanni"*	FSM M1	M	23587	52
Papio	*hamadryas*	*anubis "neumanni"*	FSM M16	M	23587	52
Papio	*hamadryas*	*anubis "neumanni"*	FSM M27	M	23587	52
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384216	M	23587	52
Papio	*hamadryas*	*anubis "neumanni"*	FSM M9	M	23814	52.5
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384218	M	24041	53
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384220	M	24041	53
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 31	M	24268	53.5
Papio	*hamadryas*	*anubis* "Ethiopian-small"	Jolly M4	M	24494	54
Papio	*hamadryas*	*anubis "neumanni"*	FSM M14	M	24494	54
Papio	*hamadryas*	*anubis "neumanni"*	FSM M17	M	24494	54
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384230	M	24494	54
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384229	M	25402	56
Papio	*hamadryas*	*anubis "neumanni"*	**11**; max of 5, WBY group	M	26100	
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384234	M	26762	59
Papio	*hamadryas*	*anubis "neumanni"*	**11**; max of 4, CRIP group	M	27200	
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 33	M	27216	60
Papio	*hamadryas*	*anubis "neumanni"*	**11**; max of 9, PHG group	M	27800	
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384223	M	28804	63.5
Papio	*hamadryas*	*anubis "neumanni"*	**21**; 19	M	29030	64
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 162899	M	29030	64
Papio	*hamadryas*	*anubis "neumanni"*	NMNH 384233	M	29030	64
Papio	*hamadryas*	*anubis* "Ethiopian-small"	**26**; max of 188	M	29440	
Papio	*hamadryas*	*anubis "neumanni"*?	**43**; max of 54	M	32000	
Papio	*hamadryas*	*anubis*	NMNH 236975	F	14062	31
Papio	*hamadryas*	*anubis*	BM(NH) 14.3.8.2	F	14969	33
Papio	*hamadryas*	*anubis*	NMNH 236973	F	15422	34
Papio	*hamadryas*	*anubis*	NMNH 236974	F	15876	35
Papio	*hamadryas*	*anubis*	SAF MO 4 2	F	17900	
Papio	*hamadryas*	*anubis*	SAF AM 2 86	M	23000	
Papio	*hamadryas*	*anubis*	SAF BuU 72	M	25300	
Papio	*hamadryas*	*anubis*	BM(NH) 13.10.18.2	M	27216	60
Papio	*hamadryas*	*anubis*	BM(NH) 51.532	M	27216	60
Papio	*hamadryas*	*anubis*	SAF BuU 71	M	27500	
Papio	*hamadryas*	*anubis*	MNHN-P 4770	M	30000	
Papio	*hamadryas*	*anubis*	NMNH 236976	M	34474	76
Papio	*hamadryas*	*anubis*	MNHN-P 4646	M	35000	
Papio	*hamadryas*	*anubis*	SAF AMII 85	M	35000	
Papio	*hamadryas*	*anubis*	MNHN-P 4987	M	35500	
Papio	*hamadryas*	*anubis*	BM(NH) 13.10.18.3	M	37195	82
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	FSM M-24	M	20866	46
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	FSM M-21	M	21773	48
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	FSM M-22	M	22226	49
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	FSM M-25	M	22680	50

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	FSM M-20	M	23134	51
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	FSM M-23	M	26082	57.5
Papio	*hamadryas*	*anubis/hamadryas* (hybrid)	MNHN-P 4310	M	20000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7261/KK18	F	8800	
Papio	*hamadryas*	*cynocephalus*	UT-A 40	F	9979	22
Papio	*hamadryas*	*cynocephalus*	KNM OM 7275/KK17	F	10000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7256/KB29	F	10000	
Papio	*hamadryas*	*cynocephalus*	UT-A 56	F	10433	23
Papio	*hamadryas*	*cynocephalus*	KNM OM 3190	F	10450	
Papio	*hamadryas*	*cynocephalus*	UT-A 61	F	10886	24
Papio	*hamadryas*	*cynocephalus*	KNM OM 7399	F	11000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7285/MD8	F	11000	
Papio	*hamadryas*	*cynocephalus*	UT-A 34	F	11340	25
Papio	*hamadryas*	*cynocephalus*	KNM OM 7311/MD6	F	11400	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7264/KB31	F	11400	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7248/KB23	F	11400	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7262/KB21	F	11500	
Papio	*hamadryas*	*cynocephalus*	UT-A 1	F	11567	25.5
Papio	*hamadryas*	*cynocephalus*	UT-A 33a	F	11794	26
Papio	*hamadryas*	*cynocephalus*	KNM OM 7276/	F	12000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7255/KB2	F	12000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7245/KK12	F	12200	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7242/DG3	F	12400	
Papio	*hamadryas*	*cynocephalus*	NMNH 384215	F	12474	27.5
Papio	*hamadryas*	*cynocephalus*	KNM OM 7413	F	12500	
Papio	*hamadryas*	*cynocephalus*	UT-A 66	F	12928	28.5
Papio	*hamadryas*	*cynocephalus*	KNM OM 7277/KB34	F	13000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7254/KK11	F	13000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7383	F	13500	
Papio	*hamadryas*	*cynocephalus*	UT-A 27	F	13608	30
Papio	*hamadryas*	*cynocephalus*	KNM OM 7501	F	14000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7386	F	14000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7241/KB12	F	14000	
Papio	*hamadryas*	*cynocephalus*	UT-A 64	F	14062	31
Papio	*hamadryas*	*cynocephalus*	KNM OM 7243/KB1	F	14500	
Papio	*hamadryas*	*cynocephalus*	UT-A 4	F	15649	34.5
Papio	*hamadryas*	*cynocephalus*	NMNH 384210	F	15876	35
Papio	*hamadryas*	*cynocephalus*	KNM OM 7408	F	16000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7402	F	17500	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7381	M	17000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7267/TR1	M	18000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7404	M	18500	
Papio	*hamadryas*	*cynocephalus*	FSM M32	M	18824	41.5
Papio	*hamadryas*	*cynocephalus*	FSM M26	M	19051	42
Papio	*hamadryas*	*cynocephalus*	FSM M39	M	19732	43.5
Papio	*hamadryas*	*cynocephalus*	KNM OM 7253/MD9	M	20000	
Papio	*hamadryas*	*cynocephalus*	NMNH 452509	M	20100	
Papio	*hamadryas*	*cynocephalus*	FSM M19	M	20412	45
Papio	*hamadryas*	*cynocephalus*	UT-A 43	M	20412	45
Papio	*hamadryas*	*cynocephalus*	KNM OM 7274/KK10	M	20800	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*cynocephalus*	KNM OM 7239/KB43	M	20800	
Papio	*hamadryas*	*cynocephalus*	FSM M38	M	20866	46
Papio	*hamadryas*	*cynocephalus*	KNM OM 7412	M	21000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7281/MD10	M	21000	
Papio	*hamadryas*	*cynocephalus*	FSM M30	M	21319	47
Papio	*hamadryas*	*cynocephalus*	UT-A 49	M	21319	47
Papio	*hamadryas*	*cynocephalus*	UT-A 42	M	21319	47
Papio	*hamadryas*	*cynocephalus*	UT-A 35	M	21319	47
Papio	*hamadryas*	*cynocephalus*	KNM OM 7419	M	21500	
Papio	*hamadryas*	*cynocephalus*	FSM M28	M	21546	47.5
Papio	*hamadryas*	*cynocephalus*	FSM M29	M	21773	48
Papio	*hamadryas*	*cynocephalus*	KNM OM 7284/KB4	M	21800	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7247/KB9	M	22300	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7249/KK5	M	22500	
Papio	*hamadryas*	*cynocephalus*	FSM M40	M	22680	50
Papio	*hamadryas*	*cynocephalus*	UT-A 47	M	22680	50
Papio	*hamadryas*	*cynocephalus*	UT-A 48	M	22680	50
Papio	*hamadryas*	*cynocephalus*	KNM OM 7240/DG9	M	23000	
Papio	*hamadryas*	*cynocephalus*	FSM M34	M	23134	51
Papio	*hamadryas*	*cynocephalus*	FSM M7	M	23134	51
Papio	*hamadryas*	*cynocephalus*	NMNH 452507	M	23134	51
Papio	*hamadryas*	*cynocephalus*	UT-A 52	M	23134	51
Papio	*hamadryas*	*cynocephalus*	UT-A 60	M	23134	51
Papio	*hamadryas*	*cynocephalus*	UT-A 41	M	23134	51
Papio	*hamadryas*	*cynocephalus*	KNM OM 7251/KK2	M	23200	
Papio	*hamadryas*	*cynocephalus*	BM(NH) 66.491	M	23587	52
Papio	*hamadryas*	*cynocephalus*	KNM OM 7280/MD11	M	23800	
Papio	*hamadryas*	*cynocephalus*	UT-A 63	M	23814	52.5
Papio	*hamadryas*	*cynocephalus*	KNM OM 7286/KK6	M	24000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7273/KB5	M	24200	
Papio	*hamadryas*	*cynocephalus*	FSM M35	M	24721	54.5
Papio	*hamadryas*	*cynocephalus*	NMNH 384211	M	24948	55
Papio	*hamadryas*	*cynocephalus*	KNM OM 7486	M	25000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7271/KB3	M	25000	
Papio	*hamadryas*	*cynocephalus*	KNM OM 7272/KK1	M	25000	
Papio	*hamadryas*	*cynocephalus*	FSM M33	M	25855	57
Papio	*hamadryas*	*cynocephalus*	FSM M36	M	26309	58
Papio	*hamadryas*	*cynocephalus*	KNM OM 7250/MG10	M	26500	
Papio	*hamadryas*	*cynocephalus*	FSM M31	M	26762	59
Papio	*hamadryas*	*cynocephalus*	KNM OM 7269/DG5	M	27900	
Papio	*hamadryas*	*cynocephalus*	FSM M37	M	28577	63
Papio	*hamadryas*	*cynocephalus*	UT-A 50	M	28577	63
Papio	*hamadryas*	*cynocephalus*	UT-A 9	M	30845	68
Papio	*hamadryas*	*cynocephalus*	KNM OM 7398	M	31000	
Papio	*hamadryas*	*hamadryas*	**43**; min of 13	F	9500	
Papio	*hamadryas*	*hamadryas*	**26**; min of 2	F	10000	
Papio	*hamadryas*	*hamadryas*	SAF HA VIII.39	F	11750	
Papio	*hamadryas*	*hamadryas*	**26**; max of 2	F	13180	
Papio	*hamadryas*	*hamadryas*	**43**; max of 13	F	13500	
Papio	*hamadryas*	*hamadryas*	**26**; min of 36	M	15500	
Papio	*hamadryas*	*hamadryas*	SAF HA VIII.41	M	17600	
Papio	*hamadryas*	*hamadryas*	**43**; min of 7	M	18250	
Papio	*hamadryas*	*hamadryas*	SAF HA 8 40	M	18750	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*hamadryas*	PCM [26]	M	19505	43
Papio	*hamadryas*	*hamadryas*	SAF HA 8 3	M	19600	
Papio	*hamadryas*	*hamadryas*	MNHN-P 4235	M	20000	
Papio	*hamadryas*	*hamadryas*	MNHN-P 4486	M	20250	
Papio	*hamadryas*	*hamadryas*	SAF HA VIII.4	M	20750	
Papio	*hamadryas*	*hamadryas*	AIUZ 9283	M	21100	
Papio	*hamadryas*	*hamadryas*	SAF HA 8 83	M	24000	
Papio	*hamadryas*	*hamadryas*	43; max of 7	M	24000	
Papio	*hamadryas*	*hamadryas*	26; max of 36	M	25370	
Papio	*hamadryas*	*hamadryas*	MNHN-P 4133	M	30350	
Papio	*hamadryas*	*kindae*	10; XIX	F	9000	
Papio	*hamadryas*	*kindae*	10; XXIV	F	9400	
Papio	*hamadryas*	*kindae*	10; XVI	F	10000	
Papio	*hamadryas*	*kindae*	10; XXV	F	11000	
Papio	*hamadryas*	*kindae*	10; XXI	M	15000	
Papio	*hamadryas*	*kindae*	MNHN-P SMY 14/68	M	15422	34
Papio	*hamadryas*	*kindae*	10; XXII	M	16000	
Papio	*hamadryas*	*kindae*	10; XV	M	16500	
Papio	*hamadryas*	*kindae*	BM(NH) 67.1658	M	17237	38
Papio	*hamadryas*	*ursinus*	2; 3	F	11200	
Papio	*hamadryas*	*ursinus*	6; 16	F	12200	
Papio	*hamadryas*	*ursinus*	33; B25	F	12270	
Papio	*hamadryas*	*ursinus*	33; B58	F	12270	
Papio	*hamadryas*	*ursinus*	33; B87	F	12270	
Papio	*hamadryas*	*ursinus*	33; B95	F	12270	
Papio	*hamadryas*	*ursinus*	6; 6	F	12700	
Papio	*hamadryas*	*ursinus*	6; 8	F	12700	
Papio	*hamadryas*	*ursinus*	33; B45	F	12730	
Papio	*hamadryas*	*ursinus*	33; B52	F	12730	
Papio	*hamadryas*	*ursinus*	6; 7	F	12800	
Papio	*hamadryas*	*ursinus*	6; 22	F	13100	
Papio	*hamadryas*	*ursinus*	33; B9	F	13180	
Papio	*hamadryas*	*ursinus*	2; 7	F	13200	
Papio	*hamadryas*	*ursinus*	6; 11	F	13200	
Papio	*hamadryas*	*ursinus*	6; 13	F	13400	
Papio	*hamadryas*	*ursinus*	6; 14	F	13600	
Papio	*hamadryas*	*ursinus*	6; 17	F	13600	
Papio	*hamadryas*	*ursinus*	33; B41	F	13640	
Papio	*hamadryas*	*ursinus*	33; B55	F	13640	
Papio	*hamadryas*	*ursinus*	33; B90	F	13640	
Papio	*hamadryas*	*ursinus*	33; B19	F	13860	
Papio	*hamadryas*	*ursinus*	6; 4	F	13900	
Papio	*hamadryas*	*ursinus*	NMNH 367880	F	14062	31
Papio	*hamadryas*	*ursinus*	33; B69	F	14090	
Papio	*hamadryas*	*ursinus*	33; B89	F	14090	
Papio	*hamadryas*	*ursinus*	33; B98	F	14090	
Papio	*hamadryas*	*ursinus*	6; 3	F	14100	
Papio	*hamadryas*	*ursinus*	6; 10	F	14100	
Papio	*hamadryas*	*ursinus*	2; 15	F	14500	
Papio	*hamadryas*	*ursinus*	6; 5	F	14500	
Papio	*hamadryas*	*ursinus*	33; B30	F	14550	
Papio	*hamadryas*	*ursinus*	33; B81	F	14550	
Papio	*hamadryas*	*ursinus*	SAF 153 67	F	14742	32.5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*ursinus*	6; 25	F	14800	
Papio	*hamadryas*	*ursinus*	Susman	F	15000	
Papio	*hamadryas*	*ursinus*	33; B28	F	15000	
Papio	*hamadryas*	*ursinus*	6; 2	F	15000	
Papio	*hamadryas*	*ursinus*	6; 21	F	15000	
Papio	*hamadryas*	*ursinus*	2; 11	F	15100	
Papio	*hamadryas*	*ursinus*	6; 1	F	15100	
Papio	*hamadryas*	*ursinus*	6; 9	F	15100	
Papio	*hamadryas*	*ursinus*	6; 15	F	15400	
Papio	*hamadryas*	*ursinus*	33; B59	F	15450	
Papio	*hamadryas*	*ursinus*	6; 12	F	15500	
Papio	*hamadryas*	*ursinus*	NMNH 367879	F	15507	34.1875
Papio	*hamadryas*	*ursinus*	2; 4	F	15700	
Papio	*hamadryas*	*ursinus*	6; 20	F	15800	
Papio	*hamadryas*	*ursinus*	7; ST	F	15900	
Papio	*hamadryas*	*ursinus*	33; B65	F	16020	
Papio	*hamadryas*	*ursinus*	6; 19	F	16200	
Papio	*hamadryas*	*ursinus*	33; B71	F	16360	
Papio	*hamadryas*	*ursinus*	33; B82	F	16360	
Papio	*hamadryas*	*ursinus*	6; 23	F	16400	
Papio	*hamadryas*	*ursinus*	6; 26	F	16600	
Papio	*hamadryas*	*ursinus*	33; B43	F	16640	
Papio	*hamadryas*	*ursinus*	Susman	F	17000	
Papio	*hamadryas*	*ursinus*	2; 16	F	17100	
Papio	*hamadryas*	*ursinus*	33; B14	F	17270	
Papio	*hamadryas*	*ursinus*	2; 12	F	17500	
Papio	*hamadryas*	*ursinus*	33; B97	F	17730	
Papio	*hamadryas*	*ursinus*	6; 24	F	18200	
Papio	*hamadryas*	*ursinus*	6; 18	F	18300	
Papio	*hamadryas*	*ursinus*	33; B67	F	20450	
Papio	*hamadryas*	*ursinus*	2; 8	F	20500	
Papio	*hamadryas*	*ursinus*	2; 17	M	20500	
Papio	*hamadryas*	*ursinus*	7; DV	M	21600	
Papio	*hamadryas*	*ursinus*	7; HL	M	21800	
Papio	*hamadryas*	*ursinus*	2; 1	M	21800	
Papio	*hamadryas*	*ursinus*	33; B26	M	25000	
Papio	*hamadryas*	*ursinus*	6; 27	M	25800	
Papio	*hamadryas*	*ursinus*	33; B22	M	25910	
Papio	*hamadryas*	*ursinus*	2; 9	M	26200	
Papio	*hamadryas*	*ursinus*	33; B62	M	26360	
Papio	*hamadryas*	*ursinus*	33; B88	M	26360	
Papio	*hamadryas*	*ursinus*	2; 18	M	26400	
Papio	*hamadryas*	*ursinus*	2; 5	M	26800	
Papio	*hamadryas*	*ursinus*	33; B36	M	26820	
Papio	*hamadryas*	*ursinus*	33; B38	M	26820	
Papio	*hamadryas*	*ursinus*	2; 13	M	27000	
Papio	*hamadryas*	*ursinus*	33; B32	M	27730	
Papio	*hamadryas*	*ursinus*	Susman	M	28000	
Papio	*hamadryas*	*ursinus*	FMNH 98095	M	28123	62
Papio	*hamadryas*	*ursinus*	33; B4	M	28180	
Papio	*hamadryas*	*ursinus*	33; B27	M	28180	
Papio	*hamadryas*	*ursinus*	SAF 213 67	M	28577	63
Papio	*hamadryas*	*ursinus*	33; B20	M	28640	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Papio	*hamadryas*	*ursinus*	33; B35	M	28640	
Papio	*hamadryas*	*ursinus*	33; B64	M	28640	
Papio	*hamadryas*	*ursinus*	33; B42	M	29090	
Papio	*hamadryas*	*ursinus*	33; B86	M	29090	
Papio	*hamadryas*	*ursinus*	33; B93	M	29090	
Papio	*hamadryas*	*ursinus*	33; B1	M	29550	
Papio	*hamadryas*	*ursinus*	2; 2	M	29700	
Papio	*hamadryas*	*ursinus*	33; B16	M	29980	
Papio	*hamadryas*	*ursinus*	Susman	M	30000	
Papio	*hamadryas*	*ursinus*	33; B21	M	30000	
Papio	*hamadryas*	*ursinus*	33; B47	M	30000	
Papio	*hamadryas*	*ursinus*	33; B72	M	30450	
Papio	*hamadryas*	*ursinus*	33; B92	M	30450	
Papio	*hamadryas*	*ursinus*	33; B31	M	30540	
Papio	*hamadryas*	*ursinus*	33; B49	M	30910	
Papio	*hamadryas*	*ursinus*	33; B53	M	31140	
Papio	*hamadryas*	*ursinus*	2; 10	M	31500	
Papio	*hamadryas*	*ursinus*	BM(NH) 55.1131	M	31752	70
Papio	*hamadryas*	*ursinus*	33; B78	M	32270	
Papio	*hamadryas*	*ursinus*	33; B73	M	32500	
Papio	*hamadryas*	*ursinus*	33; B75	M	32730	
Papio	*hamadryas*	*ursinus*	2; 14	M	33500	
Papio	*hamadryas*	*ursinus*	NMNH 469923	M	33566	74
Papio	*hamadryas*	*ursinus*	2; 6	M	34100	
Papio	*hamadryas*	*ursinus*	6; 28	M	35000	
Theropithecus	*gelada*		MNHN-P 4105	F	9000	
Theropithecus	*gelada*		MNHN-P 4107	F	11000	
Theropithecus	*gelada*		MNHN-P 4099	F	12000	
Theropithecus	*gelada*		MNHN-P 4374	F	13800	
Theropithecus	*gelada*		SAF DB 9/55	F	13800	
Theropithecus	*gelada*		SAF DB 9 60	M	16500	
Theropithecus	*gelada*		MNHN-P 4372	M	20250	
Macaca	*arctoides*	*arctoides*	FMNH 99367	F	6020	
Macaca	*arctoides*	*arctoides*	17	F	7500	
Macaca	*arctoides*	*arctoides*	17	F	8500	
Macaca	*arctoides*	*arctoides*	17	F	9100	
Macaca	*arctoides*	*arctoides*	FMNH 105682	M	9900	
Macaca	*arctoides*	*arctoides*	17	M	10100	
Macaca	*arctoides*	*arctoides*	17	M	10200	
Macaca	*arctoides*	*arctoides*	17	M	11000	
Macaca	*arctoides*	*arctoides*	17	M	14000	
Macaca	*arctoides*	*arctoides*	17	M	15000	
Macaca	*arctoides*	*arctoides*	17	M	15500	
Macaca	*arctoides*	*melanota*	NMNH 111966	F	8505	18.75
Macaca	*arctoides*	*melanota*	FMNH 105683	M	10200	
Macaca	*assamensis*	*assamensis*	15; (FMNH)	F	4860	
Macaca	*assamensis*	*assamensis*	15; (FMNH)	F	6200	
Macaca	*assamensis*	*assamensis*	15; (FMNH)	F	6600	
Macaca	*assamensis*	*assamensis*	15; (FMNH)	F	6800	
Macaca	*assamensis*	*assamensis*	MCZ 37710	M	7938	17.5
Macaca	*assamensis*	*assamensis*	FMNH 99622	M	8500	
Macaca	*assamensis*	*assamensis*	FMNH 99631	M	8700	
Macaca	*assamensis*	*assamensis*	15; BM(NH) 1937.3.4.10 or 11	M	10433	23

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*assamensis*	*assamensis*	**15**	M	13000	
Macaca	*assamensis*	*assamensis*	**15**	M	14500	
Macaca	*assamensis*	*assamensis*	**15**	M	15000	
Macaca	*assamensis*	*pelops*	**15**	F	7000	
Macaca	*assamensis*	*pelops*	**15**	F	7900	
Macaca	*assamensis*	*pelops*	**15**	F	8600	
Macaca	*assamensis*	*pelops*	**15**	M	10400	
Macaca	*assamensis*	*pelops*	**15**	M	10900	
Macaca	*assamensis*	*pelops*	**15**; BM(NH) 1915.9.1.3?	M	11340	25
Macaca	*assamensis*	*pelops*	**15**	M	12400	
Macaca	*assamensis*	*pelops*	**15**; BM(NH) 1915.9.1.2?	M	12700	28
Macaca	*fascicularis*		NMNH 344989	F	2350	
Macaca	*fascicularis*		MCZ 35693	F	2495	5.5
Macaca	*fascicularis*		**44**; min of 11	F	2500	
Macaca	*fascicularis*		MCZ 35652	F	2700	
Macaca	*fascicularis*		MCZ 35658	F	2722	6
Macaca	*fascicularis*		MCZ 35727	F	2722	6
Macaca	*fascicularis*		ANSP 20219	F	2722	6
Macaca	*fascicularis*		FMNH 68702	F	2830	
Macaca	*fascicularis*		MCZ 37352	F	2835	6.25
Macaca	*fascicularis*		NMNH 114561	F	2835	6.25
Macaca	*fascicularis*		NMNH 121869	F	2948	6.5
Macaca	*fascicularis*		NMNH 121874	F	2948	6.5
Macaca	*fascicularis*		FMNH 99661	F	2950	
Macaca	*fascicularis*		MCZ 35626	F	3175	7
Macaca	*fascicularis*		MCZ 37663	F	3175	7
Macaca	*fascicularis*		MCZ 35694	F	3175	7
Macaca	*fascicularis*		MCZ 37348	F	3175	7
Macaca	*fascicularis*		MCZ 35765	F	3200	
Macaca	*fascicularis*		FMNH 68700	F	3210	
Macaca	*fascicularis*		MCZ 35634	F	3400	
Macaca	*fascicularis*		CTNRC ? (ex FMNH 99665)	F	3430	
Macaca	*fascicularis*		MCZ 37347	F	3515	7.75
Macaca	*fascicularis*		FMNH 99659	F	3560	
Macaca	*fascicularis*		**44**; max of 11	F	3600	
Macaca	*fascicularis*		IEBR 1532	F	3600	
Macaca	*fascicularis*		MCZ 35724	F	3629	8
Macaca	*fascicularis*		NMNH 121513	F	3742	8.25
Macaca	*fascicularis*		NMNH 83274	F	3742	8.25
Macaca	*fascicularis*		FMNH 105654	F	3750	
Macaca	*fascicularis*		SICONBREC 1225	F	3750	
Macaca	*fascicularis*		FMNH 140938	F	3800	
Macaca	*fascicularis*		FMNH 99658	F	3800	
Macaca	*fascicularis*		NMNH 123990	F	3856	8.5
Macaca	*fascicularis*		NMNH 151830	F	3856	8.5
Macaca	*fascicularis*		SICONBREC 1586	F	3930	
Macaca	*fascicularis*		MCZ 37349	F	3969	8.75
Macaca	*fascicularis*		NMNH 114165	F	3969	8.75
Macaca	*fascicularis*		NMNH 114166	F	3969	8.75
Macaca	*fascicularis*		NMNH 144679	F	4000	
Macaca	*fascicularis*		**40**; BM(NH) 1914.12.8.17	F	4082	9
Macaca	*fascicularis*		AMNH 54677	F	4082	9
Macaca	*fascicularis*		NMNH 141145	F	4082	9

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*fascicularis*		ZRC 4-021	F	4082	9
Macaca	*fascicularis*		MCZ 37350	F	4309	9.5
Macaca	*fascicularis*		NMNH 114162	F	4423	9.75
Macaca	*fascicularis*		FMNH 99644	F	4720	
Macaca	*fascicularis*		**40**; BM(NH) 1914.12.8.16	F	4763	10.5
Macaca	*fascicularis*		**34**; p. 13; max of 3	F	4763	10.5
Macaca	*fascicularis*		NMNH 111898	F	5100	
Macaca	*fascicularis*		BNHS 5072	F	5443	12
Macaca	*fascicularis*		NMNH 115675	M	3402	7.5
Macaca	*fascicularis*		NMNH 101744	M	3515	7.75
Macaca	*fascicularis*		NMNH 143583	M	3515	7.75
Macaca	*fascicularis*		MCZ 35695	M	3600	
Macaca	*fascicularis*		NMNH 121836	M	3629	8
Macaca	*fascicularis*		NMNH 114409	M	3742	8.25
Macaca	*fascicularis*		MCZ 35673	M	3856	8.5
Macaca	*fascicularis*		**44**; min of 15	M	3900	
Macaca	*fascicularis*		MCZ 35571	M	3900	
Macaca	*fascicularis*		NMNH 114410	M	3969	8.75
Macaca	*fascicularis*		SICONBREC 1475	M	4250	
Macaca	*fascicularis*		MCZ 35629	M	4309	9.5
Macaca	*fascicularis*		MCZ 35701	M	4309	9.5
Macaca	*fascicularis*		MCZ 35608	M	4309	9.5
Macaca	*fascicularis*		**34**; p. 13; min of 3	M	4309	9.5
Macaca	*fascicularis*		NMNH 101639	M	4309	9.5
Macaca	*fascicularis*		NMNH 124970	M	4423	9.75
Macaca	*fascicularis*		NMNH 143582	M	4423	9.75
Macaca	*fascicularis*		MCZ 35656	M	4536	10
Macaca	*fascicularis*		MCZ 35736	M	4536	10
Macaca	*fascicularis*		NMNH 113169	M	4536	10
Macaca	*fascicularis*		NMNH 115676	M	4536	10
Macaca	*fascicularis*		NMNH 121872	M	4536	10
Macaca	*fascicularis*		NMNH 124710	M	4536	10
Macaca	*fascicularis*		NMNH 124969	M	4536	10
Macaca	*fascicularis*		NMNH 114506	M	4649	10.25
Macaca	*fascicularis*		NMNH 115677	M	4649	10.25
Macaca	*fascicularis*		MCZ 35755	M	4763	10.5
Macaca	*fascicularis*		MCZ 35729	M	4763	10.5
Macaca	*fascicularis*		NMNH 123991	M	4763	10.5
Macaca	*fascicularis*		NMNH 121871	M	4876	10.75
Macaca	*fascicularis*		NMNH 144419	M	4876	10.75
Macaca	*fascicularis*		NMNH 151831	M	4876	10.75
Macaca	*fascicularis*		MCZ 35613	M	4990	11
Macaca	*fascicularis*		MCZ 35612	M	4990	11
Macaca	*fascicularis*		MCZ 37414	M	4990	11
Macaca	*fascicularis*		NMNH 121803	M	4990	11
Macaca	*fascicularis*		NMNH 121870	M	4990	11
Macaca	*fascicularis*		NMNH 114505	M	5216	11.5
Macaca	*fascicularis*		NMNH 121868	M	5216	11.5
Macaca	*fascicularis*		NMNH 282628	M	5300	
Macaca	*fascicularis*		IEBR L.311	M	5300	
Macaca	*fascicularis*		NMNH 114560	M	5330	11.75
Macaca	*fascicularis*		NMNH 124863	M	5330	11.75
Macaca	*fascicularis*		NMNH 125102	M	5330	11.75

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*fascicularis*		NMNH 521839	M	5400	
Macaca	*fascicularis*		MCZ 35681	M	5443	12
Macaca	*fascicularis*		MCZ 35619	M	5443	12
Macaca	*fascicularis*		NMNH 114163	M	5443	12
Macaca	*fascicularis*		NMNH 114559	M	5443	12
Macaca	*fascicularis*		NMNH 125101	M	5443	12
Macaca	*fascicularis*		NMNH 141371	M	5443	12
Macaca	*fascicularis*		FMNH 99651	M	5480	
Macaca	*fascicularis*		FMNH 140939	M	5600	
Macaca	*fascicularis*		MCZ 35677	M	5897	13
Macaca	*fascicularis*		NMNH 114168	M	5897	13
Macaca	*fascicularis*		NMNH 141372	M	5897	13
Macaca	*fascicularis*		NMNH 83272	M	5897	13
Macaca	*fascicularis*		**44**; max of 15	M	5900	
Macaca	*fascicularis*		NMNH 104854	M	6010	13.25
Macaca	*fascicularis*		FMNH 99642	M	6100	
Macaca	*fascicularis*		NMNH 114169	M	6124	13.5
Macaca	*fascicularis*		NMNH 151829	M	6237	13.75
Macaca	*fascicularis*		NMNH 114248	M	6350	14
Macaca	*fascicularis*		NMNH 121512	M	6350	14
Macaca	*fascicularis*		NMNH 156291	M	6350	14
Macaca	*fascicularis*		FMNH 105689	M	6600	
Macaca	*fascicularis*		NMNH 114167	M	6804	15
Macaca	*fascicularis*		SICONBREC 100	M	7540	
Macaca	*fascicularis*		NMNH 114164	M	7711	17
Macaca	*fascicularis*		NMNH 144678	M	7711	17
Macaca	*fascicularis*		NMNH 111795	M	8165	18
Macaca	*fascicularis*		**40**; BM(NH) 1914.12.8.15	M	8278	18.25
Macaca	*fascicularis*		NMNH 111801	M	9526	21
Macaca	*fascicularis*		**18**; Kohlbrugge, p. 280	M	12000	
Macaca	*fuscata*		**23**; Glance, min	F	6350[f]	
Macaca	*fuscata*		**23**; Chonpe, min	F	6600[f]	
Macaca	*fuscata*		**23**; Kujiro, min	F	6650[f]	
Macaca	*fuscata*		**23**; Deko, min	F	6890[f]	
Macaca	*fuscata*		**23**; Midori, min	F	7000[f]	
Macaca	*fuscata*		**23**; Petit-Mon, min	F	7300	
Macaca	*fuscata*		**23**; Shiro, min	F	7400[f]	
Macaca	*fuscata*		**23**; Kin, min	F	7650	
Macaca	*fuscata*		**23**; Matsu, min	F	7680	
Macaca	*fuscata*		**23**; Meme, min	F	7900[f]	
Macaca	*fuscata*		**23**; Kan, min	F	8100[f]	
Macaca	*fuscata*		**23**; Russe, min	F	8150	
Macaca	*fuscata*		**23**; Mol, min	F	8680	
Macaca	*fuscata*		**23**; Opless, min	F	8750	
Macaca	*fuscata*		**23**; Peruka, min	F	8850	
Macaca	*fuscata*		**23**; Ai, min	F	9010	
Macaca	*fuscata*		**23**; Momo, min	F	9380	
Macaca	*fuscata*		**23**; Deko, max	F	9400	
Macaca	*fuscata*		**23**; Kusha, min	F	9500	
Macaca	*fuscata*		**23**; Midori, max	F	9700	
Macaca	*fuscata*		**23**; Matsu, max	F	9750	
Macaca	*fuscata*		**23**; Rakushi, min	F	10200	
Macaca	*fuscata*		**23**; Shiro, max	F	10700	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*fuscata*		23; Russe, max	F	10750	
Macaca	*fuscata*		23; Nose, min	F	11230	
Macaca	*fuscata*		23; Petit-Mon, max	F	11600	
Macaca	*fuscata*		23; Glance, max	F	11610	
Macaca	*fuscata*		23; Kin, max	F	11650	
Macaca	*fuscata*		23; Kujiro, max	F	11740	
Macaca	*fuscata*		23; Chonpe, max	F	11750	
Macaca	*fuscata*		23; Momo, max	F	12030	
Macaca	*fuscata*		23; Meme, max	F	12800	
Macaca	*fuscata*		23; Ai, max	F	13350	
Macaca	*fuscata*		23; Opless, max	F	13520	
Macaca	*fuscata*		23; Rakushi, max	F	13750	
Macaca	*fuscata*		23; Peruka, max	F	14150	
Macaca	*fuscata*		23; Kan, max	F	14950	
Macaca	*fuscata*		23; Kusha, max	F	15550	
Macaca	*fuscata*		23; Mol, max	F	15600	
Macaca	*fuscata*		23; Nose, max	F	16300	
Macaca	*fuscata*		23; Y, min	M	8200	
Macaca	*fuscata*		23; Z, min	M	8500	
Macaca	*fuscata*		23; Goku, min	M	9450	
Macaca	*fuscata*		23; X, min	M	9800	
Macaca	*fuscata*		23; Kokinta, min (1960)	M	10250	
Macaca	*fuscata*		23; Shan, min	M	10910	
Macaca	*fuscata*		23; Zao, min	M	11600	
Macaca	*fuscata*		23; Azuma, min	M	11960	
Macaca	*fuscata*		12; 4	M	12000	
Macaca	*fuscata*		23; Goku, max	M	12900	
Macaca	*fuscata*		23; Kokinta, max	M	13340	
Macaca	*fuscata*		23; Z, max	M	13460	
Macaca	*fuscata*		23; Lincoln, min	M	13500	
Macaca	*fuscata*		12; 5	M	13700	
Macaca	*fuscata*		23; Shan, max	M	13750	
Macaca	*fuscata*		23; X, max	M	14850	
Macaca	*fuscata*		23; Gongen, max	M	14900[g]	
Macaca	*fuscata*		23; Zao, max	M	15000	
Macaca	*fuscata*		23; Y, max	M	15000	
Macaca	*fuscata*		23; Riki, min	M	15150	
Macaca	*fuscata*		23; Azuma, max	M	15950	
Macaca	*fuscata*		23; Riki, max	M	17000	
Macaca	*fuscata*		23; Lincoln, max	M	18000	
Macaca	*fuscata*		12; 6	M	20500	
Macaca	*maura*		34, p. 9; 1 of 1	M	5954[h]	
Macaca	*mulatta*		FMNH 99668	F	3000	
Macaca	*mulatta*		IZCAS 04990	F	3600	
Macaca	*mulatta*		IZCAS 10304	F	3900	
Macaca	*mulatta*		BM(NH) 1921.7.9.4	F	4200	9.25
Macaca	*mulatta*		ZSI 12088	F	4309	9.5
Macaca	*mulatta*		BNHS 5106	F	4310	9.5
Macaca	*mulatta*		BM(NH) 1931.1.11.21	F	4540	10
Macaca	*mulatta*		BNHS 5089	F	4540	10
Macaca	*mulatta*		BNHS 5097	F	4540	10
Macaca	*mulatta*		SCIEA 89	F	4750	
Macaca	*mulatta*		BM(NH) 1914.7.19.2	F	4760	10.5

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*mulatta*		IEBR 48	F	4800	
Macaca	*mulatta*		IEBR 733(833)/5	F	4800	
Macaca	*mulatta*		BM(NH) 1931.1.11.26	F	4990	11
Macaca	*mulatta*		BNHS 5098	F	4990	11
Macaca	*mulatta*		KIZ 03179	F	5000	
Macaca	*mulatta*		KIZ 76320	F	5000	
Macaca	*mulatta*		SCIEA 2155	F	5020	
Macaca	*mulatta*		IEBR 32	F	5200	
Macaca	*mulatta*		BM(NH) 1915.9.1.1	F	5220	11.5
Macaca	*mulatta*		IZCAS 25233	F	5300	
Macaca	*mulatta*		BNHS 5085	F	5440	12
Macaca	*mulatta*		KIZ 59200	F	5500	
Macaca	*mulatta*		SIZ 00001	F	5500	
Macaca	*mulatta*		UHVZ 08/3.20.72	F	5850	
Macaca	*mulatta*		BM(NH) 1914.7.10.5	F	5900	13
Macaca	*mulatta*		BM(NH) 1931.1.11.30	F	5900	13
Macaca	*mulatta*		SIZ 00002	F	6500	
Macaca	*mulatta*		BM(NH) 1914.7.10.3	F	6580	14.5
Macaca	*mulatta*		KIZ 76318	F	7000	
Macaca	*mulatta*		BNHS 5113	F	7030	15.5
Macaca	*mulatta*		IZCAS 19186	F	8250	
Macaca	*mulatta*		NMNH 173812	F	9979	22
Macaca	*mulatta*		NMNH 356979	M	4010	
Macaca	*mulatta*		IZCAS 23020	M	5000	
Macaca	*mulatta*		**18**; Dao 1985, no. 98	M	5100	
Macaca	*mulatta*		IZCAS 15054	M	5300	
Macaca	*mulatta*		UHVZ 01/3.61.40	M	6000	
Macaca	*mulatta*		BM(NH) 1931.1.11.22	M	6124	13.5
Macaca	*mulatta*		FMNH 99669	M	6200	
Macaca	*mulatta*		SCIEA 2150	M	6400	
Macaca	*mulatta*		IZCAS 19554	M	6510	
Macaca	*mulatta*		BM(NH) 1914.7.19.1	M	6804	15
Macaca	*mulatta*		BM(NH) 1915.5.5.6	M	6804	15
Macaca	*mulatta*		IZCAS 20218	M	7350	
Macaca	*mulatta*		FDCG C 0014	M	7400	
Macaca	*mulatta*		BM(NH) 1921.7.9.3	M	7484	16.5
Macaca	*mulatta*		ZSI 12091	M	7484	16.5
Macaca	*mulatta*		BM(NH) 1931.1.11.7	M	7711	17
Macaca	*mulatta*		BM(NH) 1914.7.10.4	M	7938	17.5
Macaca	*mulatta*		IEBR 560	M	8200	
Macaca	*mulatta*		UHVZ 26/3.19.71	M	8500	
Macaca	*mulatta*		FMNH 35448	M	8730	
Macaca	*mulatta*		BM(NH) 1914.7.10.1	M	9979	22
Macaca	*mulatta*		BM(NH) 1914.7.10.2	M	10433	23
Macaca	*mulatta*		PCM T4/2 (skin)	M	10900	
Macaca	*mulatta*		ZMNH 633	M	12000	
Macaca	*mulatta*		NMNH 173813	M	12701	28
Macaca	*mulatta*		NMNH 20120	M	14062	31
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	F	4400	
Macaca	*nemestrina*	*leonina*	**13**; (NMNH)	F	4600[i]	
Macaca	*nemestrina*	*leonina*	BM(NH) 1914.12.8.20	F	4649	10.25
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	F	4650	
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	F	4710	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	F	4960	
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	F	5480	12.00
Macaca	*nemestrina*	*leonina*	NMNH 124022	F	5557	12.25
Macaca	*nemestrina*	*leonina*	**13**; (NMNH)	F	5700	12.50
Macaca	*nemestrina*	*leonina*	NMNH 104439	M	5330	11.75
Macaca	*nemestrina*	*leonina*	NMNH 104440	M	6237	13.75
Macaca	*nemestrina*	*leonina*	NMNH 104441	M	6237	13.75
Macaca	*nemestrina*	*leonina*	NMNH 124230	M	6350	14
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	M	8100	
Macaca	*nemestrina*	*leonina*	BM(NH) 1914.12.8.19	M	8165	18
Macaca	*nemestrina*	*leonina*	**13**; (FMNH)	M	8500	
Macaca	*nemestrina*	*leonina*	NMNH 124023	M	9072	20
Macaca	*nemestrina*	*nemestrina*?	MCZ 35697	F	5216	11.5
Macaca	*nemestrina*	*nemestrina*	MCZ 35687	F	5443	12
Macaca	*nemestrina*	*nemestrina*	FMNH 105658	F	5450	
Macaca	*nemestrina*	*nemestrina*	MCZ 35631	F	5670	12.5
Macaca	*nemestrina*	*nemestrina*?	MCZ 35598	F	6350	14
Macaca	*nemestrina*	*nemestrina*	NMNH 123146	F	6350	14
Macaca	*nemestrina*	*nemestrina*	MCZ 35602	F	6350	14
Macaca	*nemestrina*	*nemestrina*	MCZ 35649	F	6804	15
Macaca	*nemestrina*	*nemestrina*	NMNH 114503	F	7258	16
Macaca	*nemestrina*	*nemestrina*	NMNH 141144	F	7258	16
Macaca	*nemestrina*	*nemestrina*	NMNH 114502	F	7598	16.75
Macaca	*nemestrina*	*nemestrina*	**1**, p. 134; 2	F	8165	18
Macaca	*nemestrina*	*nemestrina*	NMNH 123144	M	8618	19
Macaca	*nemestrina*	*nemestrina*	MCZ 35670	M	9979	22
Macaca	*nemestrina*	*nemestrina*	**1**, p. 134; 1	M	10886	24
Macaca	*nemestrina*	*nemestrina*	NMNH 123143	M	10886	24
Macaca	*nemestrina*	*nemestrina*	NMNH 143585	M	10886	24
Macaca	*nemestrina*	*nemestrina*	NMNH 145330	M	10886	24
Macaca	*nemestrina*	*nemestrina*	NMNH 154367	M	10886	24
Macaca	*nemestrina*	*nemestrina*	NMNH 144094	M	11000	24.25
Macaca	*nemestrina*	*nemestrina*	PCM 1955.1503	M	11340	25
Macaca	*nemestrina*	*nemestrina*	NMNH 143548	M	11794	26
Macaca	*nemestrina*	*nemestrina*	NMNH 123145	M	12247	27
Macaca	*nemestrina*	*nemestrina*	NMNH 141143	M	13608	30
Macaca	*nemestrina*	*pagensis*	NMNH 121653	F	4500	
Macaca	*radiata*	*radiata*	**22**; 145	F	2930	
Macaca	*radiata*	*radiata*	**42**, p. 41; min of 2	F	3175	7
Macaca	*radiata*	*radiata*	**22**; 138	F	3410	
Macaca	*radiata*	*radiata*	**22**; 138	F	3520	
Macaca	*radiata*	*radiata*	**22**; 144	F	3570	
Macaca	*radiata*	*radiata*	**14**	F	3630	
Macaca	*radiata*	*radiata*	**14**	F	3630	
Macaca	*radiata*	*radiata*	**22**; 148	F	3660	
Macaca	*radiata*	*radiata*	**14**	F	3860	
Macaca	*radiata*	*radiata*	**22**; 134	F	3930	
Macaca	*radiata*	*radiata*	**22**; 136	F	4040	
Macaca	*radiata*	*radiata*	**14**	F	4160	
Macaca	*radiata*	*radiata*	**14**	F	4160	
Macaca	*radiata*	*radiata*	**22**; 135	F	4420	
Macaca	*radiata*	*radiata*	**14**	F	4990	
Macaca	*radiata*	*radiata*	**14**	M	5440	

APPENDIX TABLE 1
Continued

					Mass	
Genus	Species	Subspecies	Specimen reference	Sex	g	lb
Macaca	*radiata*	*radiata*	**22**; L16	M	5670	
Macaca	*radiata*	*radiata*	**42**, p. 41; max of 2	M	5897	13
Macaca	*radiata*	*radiata*	**14**	M	5900	
Macaca	*radiata*	*radiata*	**22**; L 11	M	6450	
Macaca	*radiata*	*radiata*	**22**; L20	M	6480	
Macaca	*radiata*	*radiata*	**22**; L14	M	6520	
Macaca	*radiata*	*radiata*	**14**	M	6580	
Macaca	*radiata*	*radiata*	**22**; L12	M	6820	
Macaca	*radiata*	*radiata*	**22**; L19	M	6890	
Macaca	*radiata*	*radiata*	**22**; L18	M	6960	
Macaca	*radiata*	*radiata*	**22**; L15	M	7000	
Macaca	*radiata*	*radiata*	**14**	M	7260	
Macaca	*radiata*	*radiata*	**14**	M	8850	
Macaca	*silenus*		**36**	M	6750	
Macaca	*sinica*	*"aurifrons"*	**40**, p. 9; min of 2	F	2495	
Macaca	*sinica*	*"aurifrons"*	**40**, p. 9; max of 2	F	4309	
Macaca	*sinica*		**34**, p. 27; min of 5	M	3289	
Macaca	*sinica*	*"aurifrons"*	**40**, p. 9; min of 2	M	4082	
Macaca	*sinica*		BM(NH) 1915.3.1.1 or 2	M	4536	
Macaca	*sinica*		BM(NH) 1915.3.1.3?	M	4763	
Macaca	*sinica*	*"aurifrons"*	**40**, p. 9; max of 2	M	4763	
Macaca	*sinica*	*"aurifrons"*	**40**, p. 7; large male	M	5443	
Macaca	*sinica*	*"aurifrons"*	BM(NH) 1915.3.1.1 or 2	M	5443	
Macaca	*sylvanus*		**45**; 1012	F	8000	
Macaca	*sylvanus*		NMNH 476783	F	8200	
Macaca	*sylvanus*		NMNH 476786	F	9000	
Macaca	*sylvanus*		**45**; 1018	F	9000	
Macaca	*sylvanus*		**45**; 1020	F	9000	
Macaca	*sylvanus*		NMNH 476782	F	9800	
Macaca	*sylvanus*		4 NMNH 76787	F	10000	
Macaca	*sylvanus*		**45**; 1004	F	10000	
Macaca	*sylvanus*		**45**; 1006	F	10000	
Macaca	*sylvanus*		**45**; 1014	F	10000	
Macaca	*sylvanus*		**45**; 1022	F	10000	
Macaca	*sylvanus*		**45**; 1030	F	10000	
Macaca	*sylvanus*		**45**; 1040	F	10000	
Macaca	*sylvanus*		**45**; 1032	F	11000	
Macaca	*sylvanus*		**45**; 1034	F	11000	
Macaca	*sylvanus*		**45**; 1036	F	11000	
Macaca	*sylvanus*		**45**; 1038	F	11000	
Macaca	*sylvanus*		**45**; 1028	F	12000	
Macaca	*sylvanus*		NMNH 476781	M	8600	
Macaca	*sylvanus*		NMNH 476791	M	10000	
Macaca	*sylvanus*		**45**; 1007	M	10000	
Macaca	*sylvanus*		**45**; 1015	M	12000	
Macaca	*sylvanus*		**45**; 1055	M	12000	
Macaca	*sylvanus*		**45**; 1095	M	12000	
Macaca	*sylvanus*		**45**; 1031	M	13000	
Macaca	*sylvanus*		**45**; 1043	M	13000	
Macaca	*sylvanus*		**45**; 1105	M	13000	
Macaca	*sylvanus*		**45**; 1071	M	13000	
Macaca	*sylvanus*		**45**; 1005	M	14000	
Macaca	*sylvanus*		**45**; 1009	M	14000	

APPENDIX TABLE 1
Continued

Genus	Species	Subspecies	Specimen reference	Sex	Mass g	Mass lb
Macaca	*sylvanus*		45; 1011	M	14000	
Macaca	*sylvanus*		45; 1013	M	14000	
Macaca	*sylvanus*		45; 1017	M	14000	
Macaca	*sylvanus*		45; 1019	M	14000	
Macaca	*sylvanus*		45; 1087	M	14000	
Macaca	*sylvanus*		45; 1099	M	14000	
Macaca	*sylvanus*		45; 1021	M	15000	
Macaca	*sylvanus*		45; 1025	M	15000	
Macaca	*sylvanus*		45; 1027	M	15000	
Macaca	*sylvanus*		45; 1029	M	15000	
Macaca	*sylvanus*		45; 1035	M	15000	
Macaca	*sylvanus*		45; 1037	M	15000	
Macaca	*sylvanus*		45; 1091	M	15000	
Macaca	*sylvanus*		45; 1063	M	15000	
Macaca	*sylvanus*		45; 1079	M	16000	
Macaca	*sylvanus*		45; 1089	M	16000	
Macaca	*sylvanus*		45; 1093	M	16000	
Macaca	*sylvanus*		45; 1103	M	16000	
Macaca	*sylvanus*		45; 1107	M	16000	
Macaca	*sylvanus*		45; 1001	M	16500	
Macaca	*sylvanus*		45; 1051	M	17000	
Macaca	*sylvanus*		45; 1045	M	18000	
Macaca	*sylvanus*		45; 1057	M	18000	
Macaca	*thibetana*		50; min of 15 winter	F	9000	
Macaca	*thibetana*		50; max of 15 winter	F	13000	
Macaca	*thibetana*		50; min of 13 autumn	F	14000	
Macaca	*thibetana*		50; max of 13 autumn	F	21500	
Macaca	*thibetana*		50; min of 14 winter	M	11500	
Macaca	*thibetana*		16; 1	M	15000	
Macaca	*thibetana*		50; min of 15 autumn	M	16000	
Macaca	*thibetana*		16; 2	M	17500	
Macaca	*thibetana*		50; max of 14 winter	M	20000	
Macaca	*thibetana*		50; max of 15 autumn	M	25000	

[a] Specimen transferred to another institution not indicated on its catalog card.

[b] Pocock indicated 39 lb, but Napier listed maximum as 31, and 39 would be too high for a female; it is possible that 39 lb refers to 1914.7.10.12, a male listed by Pocock without mass.

[c] Semi-free-ranging individuals (at U.S. primate centers)

[d] Subadult individual?; its mass appears low compared with others.

[e] Female with infant.

[f] Counted only mass for 1959 and 1960, because 1958 max was below 9000 g and occurred in December, suggesting that growth had not ceased.

[g] Only two values were given: 14700 and 14900; only max is used here.

[h] "Gutted."

[i] It is possible that this specimen is the same as that in the next entry, because Fooden combined several localities. However, because he also rounded off mass listings it would be expected that 4649 g would have been given as 4650 g (see next line) rather than 4600 g, suggesting that the BM(NH) specimen was not included in his 1975 list.

Notes continue on next page

APPENDIX TABLE 1
Continued

References to published sources of mass data are listed below; item numbers correspond to bold numbers in the table. Page or table number(s) are given here if possible, but in some cases (refs. 1, 32, 34, 35, 38, and 40) mass values occur throughout the source, and the relevant page numbers are provided in the table.

1. Banks, 1931.
2. Barrett and Henzi, 1997: 436.
3. Bauchot and Stephan, 1969: 238.
4. Booth, 1957: 422.
5. Brandon-Jones, 1995, tables 3, 4.
6. Bulger and Hamilton, 1987: 646.
7. Byrne et al., 1989, table II.
8. Chism, J., personal commun. to M. Cords.
9. Colyn, 1994, table 1.
10. Compère, 1971: 472.
11. Eley et al., 1989, table IV.
12. Fooden, 1971: 306.
13. Fooden, 1975: 114.
14. Fooden, 1981: 3.
15. Fooden, 1982: 10.
16. Fooden, 1983: 7.
17. Fooden, 1990: 620.
18. Fooden, J., personal commun. to ED.
19. Galat-Luong et al., 1996: 93.
20. Gautier-Hion, 1975, table 1.
21. Gest and Siegel, 1983 (data provided by M. Siegel; see also McGill et al., 1960, and Snow and Vice, 1965, on source of animals).
22. Hartman, 1938: 468.
23. Hazama, 1964, tables 1 and 2. Highest and lowest values listed for each animal over three years given, except that no values were used for a year in which the maximum mass for a male did not exceed 12 kg (or 9 kg for a female) and in which the minimum was early in the year and the maximum in December, thus indicating that growth was still in progress. These animals were partly provisioned but living in nearly natural habitat conditions.
24. Hurov, 1987: 299.
25. Jablonski and Pan, 1995: 258.
26. Jolly, C. J. and J. Phillips-Conroy, commun. to ED.
27. Jones, 1970, table 1.
28. Kirkpatrick, 1998, appendix.
29. Leigh, 1926.
30. Li and Ma, 1980 (fide ref. 5).
31. Ma et al., 1989, table 1.
32. Malbrant and Maclatchy, 1949.
33. McConnell et al., 1974, table 2.
34. Napier, 1981 [specimens in BM(NH); some located via Pocock references].
35. Napier, 1985 [specimens in BM(NH); some located via Pocock references].
36. Napier and Napier, 1967, pp. 406, 412.
37. Oates, J. F., personal commun. to ED (animals discussed in ref. 38).
38. Oates et al., 1990.
39. Oboussier and Maydell, 1959: 107.
40. Phillips, 1935.
41. Pocock, 1928.
42. Pocock, 1939 [this and above cross-referenced to Napier's lists (refs 34 and 35) of BM(NH) specimens unless otherwise indicated].
43. Popp, 1983: 203.
44. Rodman, 1991: 362.
45. Scheffrahn, W., personal commun. to ED.
46. Skinner and Smithers, 1990: 155.
47. Wickings and Dixon, 1992a, Graph p. 132.
48. Wickings and Dixon, 1992b, table p. 911.
49. Willis, 1995, table 2.6, pp. 58–59 (and personal commun. to ED).
50. Zhao, 1994, table 1.

APPENDIX TABLE 2
Mean Cercopithecid Body Mass Values (in g)

			Females				Males			
Genus	Species	Subspecies	N	Mean	Min	Max	N	Mean	Min	Max
Colobus	*angolensis*	*angolensis*	2	10100	6400	9150	2	10100	7600	12600
Colobus	*angolensis*	*palliatus*	1	9100	—	—	3	9437	8730	10590
Colobus	*guereza*	*dodingae*	—	—	—	—	1	10433	—	—
Colobus	*guereza*	*gallarum*	3	7600	6100	8700	1	9400	—	—
Colobus	*guereza*	*guereza*	3	9233	8200	10100	6	11873	9750	14400
Colobus	*guereza*	*kikuyuensis*	1	9030	—	—	3	9847	7100	11417
Colobus	*guereza*	*matschiei*	18	7897	6420	10230	20	9758	8000	11790
Colobus	*guereza*	*occidentalis*	46	7423	5443	10886	46	9087	6804	11340
Colobus	*polykomos*	*dollmani*	2	7300	6100	8500	2	9550	9100	10000
Colobus	*polykomos*	*polykomos*	16	7935	6200	10000	8	10188	8000	11700
Colobus	*polykomos*	*vellerosus*	5	6860	6200	7500	3	8500	8000	9100
Colobus	*satanas*		6	7018	5000	10000	2	10000	9000	11000
Procolobus	*badius*	*badius*	37	7839	5000	9950	17	8391	6400	9600
Procolobus	*badius*	*kirki*	4	5378	5100	6100	1	5800	—	—
Procolobus	*badius*	*langi*	2	5525	4400	6650	2	7650	7650	7650
Procolobus	*badius*	*oustaleti*	4	7988	7600	8900	3	12200	12000	12500
Procolobus	*badius*	*parmientier-orum*	2	7250	5550	8950	1	5800	—	—
Procolobus	*badius*	*preussi*	1	7259	—	—	—	—	—	—
Procolobus	*badius*	*rufomitratus*	7	7214	6000	8000	3	9667	9000	10000
Procolobus	*badius*	*tephrosceles*	1	6728	—	—	6	9413	7940	10886
Procolobus	*badius*	*waldroni*	2	5750	5500	6000	2	6400	6300	6500
Procolobus	*verus*		13	4218	2900	5400	25	4637	3300	5700
Nasalis	*larvatus*		24	9637	7258	11794	28	19758	13268	23587
Nasalis (*Simias*)	*concolor*		4	6889	6237	7144	3	9148	8618	9979
Presbytis	*comata*		—	—	—	—	1	6800	—	—
Presbytis	*frontata*	*frontata*	8	5670	4082	6577	1	5557	—	—
Presbytis	*hosei*	*sabana*	1	6577	—	—	—	—	—	—
Presbytis	*hosei*	subsp. indet.	3	6369	5557	6800	7	6143	6000	6500
Presbytis	*melalophos*	*batuana*	6	6332	4423	7484	3	6615	5783	7144
Presbytis	*melalophos*	*cana*	4	6776	5783	7825	2	6407	6010	6804
Presbytis	*melalophos*	*catemana*	2	6010	5670	6350	2	6124	5897	6350
Presbytis	*melalophos*	*chrysomelas*	1	6917	—	—	6	6521	5897	7144
Presbytis	*melalophos*	*femoralis*	—	—	—	—	4	6237	5783	6691
Presbytis	*melalophos*	*melalophos*	3	6124	5783	6691	6	6634	6124	7371
Presbytis	*melalophos*	*natunae*	3	5292	4990	5670	1	4536	—	—
Presbytis	*melalophos*	*percura*	4	6889	6577	7144	4	5982	4536	7258
Presbytis	*melalophos*	*rhionis*	4	5472	4082	6350	—	—	—	—
Presbytis	*melalophos*	*robinsoni*	1	6464	—	—	4	7286	7031	7598
Presbytis	*melalophos*	*siamensis*	3	6877	6410	7340	2	6685	6510	6860
Presbytis	*melalophos*	*sumatrana*	2	7938	7825	8051	1	7371	—	—
Presbytis	*potenziani*		2	6407	6010	6804	7	5939	4536	7258
Presbytis	*rubicunda*	*rubicunda*	25	5947	4536	7711	28	6338	5443	7371
Presbytis	*rubicunda*	*rubida*	1	7825	—	—	—	—	—	—
Presbytis	*thomasi*		4	6776	6350	8051	3	6766	6237	7258
Pygathrix (*Rhino-pithecus*)	*avunculus*		4	8250	7000	9000	1	14500	—	—
Pygathrix (*Rhino-pithecus*)	*bieti*		3	12600	9000	15000	3	20333	13000[a]	30000[b]
Pygathrix (*Rhino-pithecus*)	*brelichi*		—	—	—	—	2	14500	13250	15750
Pygathrix (*Rhino-pithecus*)	*roxellana*		3	12300	9500	15400	7	18216	15500	26500

APPENDIX TABLE 2
Continued

			Females				Males			
Genus	Species	Subspecies	N	Mean	Min	Max	N	Mean	Min	Max
Pygathrix (Pygathrix)	*nemaeus*	*nemaeus*	1	8165	—	—	2	10886	10433	11340
Pygathrix (Pygathrix)	*nemaeus*	*nigripes*	1	8700	—	—	2	11050	11000	11100
Semnopithecus	*entellus*	*achates*	3	10055	7711	12247	3	13268	10319	15876
Semnopithecus	*entellus*	*aeneas*	1	9979	—	—	1	11567	—	—
Semnopithecus	*entellus*	*ajax*	1	12701			2	19959	19505	20412
Semnopithecus	*entellus*	*elissa*	2	9356	8278	10433	—	—	—	—
Semnopithecus	*entellus*	*entellus*	1	11340			1	15876	—	—
Semnopithecus	*entellus*	*entellus/hypoleucos/priam*	2	9979	7711	12247	2	13608	9072	18144
Semnopithecus	*entellus*	*hector*	2	13608	13154	14062	1	17237	—	—
Semnopithecus	*entellus*	*iulus*	1	8392	—	—	1	9526	—	—
Semnopithecus	*entellus*	*priam*	1	8845	—	—	1	16783	—	—
Semnopithecus	*entellus*	*schistacea*	3	14829	11340	17237	1	23587	—	—
Semnopithecus	*entellus*	*thersites*	5	6991	5455	8618	5	11232	7938	13381
S. (Trachypithecus)	*cristata*	*cristata*	15	6139	4990	7598	7	7225	6124	8165
S. (Trachypithecus)	*cristata*	*germaini*	—	—	—	—	1	8626	—	—
S. (Trachypithecus)	*cristata*	*ultima*	26	5670	4990	6350	18	6325	4990	7938
S. (Trachypithecus)	*francoisi*		3	7800	7200	8700	8	7969	5700	9450
S. (Trachypithecus)	*geei*		1	8700	—	—	3	10950	10000	12000
S. (Trachypithecus)	*hatinhensis*		—	—	—	—	1	8000	—	—
S. (Trachypithecus)	*obscura*	*carbo*	1	5443	—	—	2	8335	8165	8505
S. (Trachypithecus)	*obscura*	*flavicauda*	7	6868	4990	8618	2	7258	7031	7484
S. (Trachypithecus)	*obscura*	*obscura*	11	6797	4990	8845	13	8031	6804	9185
S. (Trachypithecus)	*obscura*	*sanctorum*	1	8165	—	—	1	10886	—	—
S. (Trachypithecus)	*obscura*	subsp. indet.	4	5125	4150	6250	3	7300	6100	8700
S. (Trachypithecus)	*phayrei*	*crepuscula*	1	7484	—	—	2	6804	6124	7484
S. (Trachypithecus)	*phayrei*	*phayrei*	3	6199	4763	7031	2	7938	7938	7938
S. (Trachypithecus)	*phayrei*	*shanica*	1	6804	—	—	1	8618	—	—
S. (Trachypithecus)	*phayrei*	subsp. indet.	10	5899	4040	7031	5	7577	5675	9080
S. (Trachypithecus)	*pileata*	*durga*	1	11340	—	—	1	12247	—	—
S. (Trachypithecus)	*pileata*	*pileata*	4	9938	9500	10500	2	12750	11500	14000
S. (Trachypithecus)	*pileata*	*shortridgei*	1	9526	—	—	2	13154	12701	13608
S. (Trachypithecus)	*johnii*		3	11192	10886	11350	8	11709	9072	13608
S. (Trachypithecus)	*vetulus*	*monticola*	1	7484	—	—	2	9412	9072	9752
S. (Trachypithecus)	*vetulus*	*vetulus*	3	5141	4990	5216	2	6690.5	5670	7711
Cercopithecus	*aethiops*	*aethiops*	—	—	—	—	1	5216	—	—
Cercopithecus	*aethiops*	*arenarius*	5	3370	2800	3750	5	5510	5200	6000
Cercopithecus	*aethiops*	*budgeti*	2	4218	3900	4536	1	6350	—	—
Cercopithecus	*aethiops*	*callidus*	2	5650	4900	6400	4	4671	3600	6300
Cercopithecus	*aethiops*	*centralis*	15	3702	2722	4536	10	5336	4082	6350
Cercopithecus	*aethiops*	*johnstoni*	2	2650	2500	2800	1	4500	—	—
Cercopithecus	*aethiops*	*matschiei*	1	4082	—	—	—	—	—	—
Cercopithecus	*aethiops*	*ngamiensis*	17	3930	3119	5220	15	5733	3860	8000
Cercopithecus	*aethiops*	*pygerythrus*	5	3568	3140	4325	6	5013	3777	7404
Cercopithecus	*aethiops*	*sabaeus*	3	4333	3400	5900	4	5763	4700	7000
Cercopithecus	*aethiops*	*whytei*	—	—	—	—	1	5330	—	—
Cercopithecus	*ascanius*	*katangae*	2	2875	1800	3950	2	3550	2200	4900
Cercopithecus	*ascanius*	*schmidti*	49	2968	1814	3856	47	4310	2950	6350
Cercopithecus	*campbelli*	*campbelli*	2	3250	2000	4500	3	3750	1800	5500
Cercopithecus	*campbelli*	*lowei*	14	2563	1800	5000	11	3883	3200	4600
Cercopithecus	*cephus*		5	2960	2400	3900	2	3750	3350	4150

APPENDIX TABLE 2
Continued

			Females				Males			
Genus	Species	Subspecies	N	Mean	Min	Max	N	Mean	Min	Max
Cercopithecus	*denti*		2	2850	2000	3700	2	4250	3550	4950
Cercopithecus	*diana*	*diana*	10	3853	2500	5400	3	5433	4000	6300
Cercopithecus	*hamlyni*	*hamlyni*	2	3450	2600	4300	2	5825	4350	7300
Cercopithecus	*lhoesti*		2	3475	1750	5200	2	5850	3250	8450
Cercopithecus	*mitis*	*erythrarchus*	8	4635	2835	6010	3	7598	4876	9299
Cercopithecus	*mitis*	*kolbi*	3	3757	3470	4210	6	6929	5750	8200
Cercopithecus	*mitis*	*stuhlmanni*	9	4240	2250	5414	9	6777	3650	9510
Cercopithecus	*mona*		1	2500	—	—	2	5100	4760	5440
Cercopithecus	*neglectus*		13	4023	2500	4900	5	7379	6310	8245
Cercopithecus	*nictitans*	*martini*	—	—	—	—	3	5867	4800	6800
Cercopithecus	*nictitans*	*nictitans*	3	4183	2650	6100	3	6895	4700	8500
Cercopithecus	*petaurista*	*buettikofferi*	10	2832	2000	3800	8	4548	3900	5200
Cercopithecus	*petaurista*	*petaurista*	7	2710	2000	3500	2	5550	5200	5900
Cercopithecus	*petaurista*	subsp. indet.	2	3200	2600	3800	2	3950	3400	4500
Cercopithecus	*pogonias*	*grayi*	3	2750	2150	3100	2	3950	3300	4600
Cercopithecus	*pogonias*	*nigripes*	2	2834	2793	2874	2	3215	3030	3400
Cercopithecus	*tantalus*	*marrensis*	2	3700	2800	4600	—	—	—	—
Cercopithecus	*wolfi*	*wolfi*	2	2700	1800	3600	2	3700	2450	4950
Miopithecus	*talapoin*		2	2000	2000	2000	1	2500	—	—
Miopithecus	*talapoin*	nov.	3	1319	1064	1625	5	1362	1045	1500
Allenopithecus	*nigroviridis*		2	3225	3200	3250	5	6130	4450	8200
Erythrocebus	*patas*		8	5485	4000	8000	10	9836	5400	18000
Lophocebus	*albigena*	*albigena*	2	4975	4700	5250	2	7225	6100	8350
Lophocebus	*albigena*	*johnstoni*	23	5538	3640	8165	19	7522	5700	8650
Lophocebus	*albigena*	*zenkeri*	2	6000	6000	6000	8	9009	8000	10000
Lophocebus	*albigena*	*albigena*	1	7250	—	—	1	7700	—	—
Lophocebus	*aterrimus*	*aterrimus*	2	5575	4450	6700	1	7900	—	—
Lophocebus	*aterrimus*	subsp. indet.	2	6000	6000	6000	5	7830	7000	8650
Cercocebus	*galeritus*	*agilis*	2	5263	4325	6200	2	9500	9000	10000
Cercocebus	*galeritus*	subsp. indet.	4	5100	4600	6100	3	9033	8200	10200
Cercocebus	*torquatus*	*atys*	3	6333	5600	7000	4	11100	9500	12700
Cercocebus	*torquatus*	*torquatus*	1	5800			6	11756	8800	17237
Mandrillus	*leucophaeus*						1	20000		
Mandrillus	*sphinx*		9	12333	10000	17000	10	34220	27000	45000
							or 8[c]	35900	30000	45000
Papio	*hamadryas*	*anubis* "small"	44	13787	9500	18598	53	23475	18598	32000
Papio	*hamadryas*	*anubis*	5	15646	14062	17900	11	30673	23000	37195
Papio	*hamadryas*	*anubis/cynocephalus* (hybrid)	—	—	—	—	6	22793	20866	26082
Papio	*hamadryas*	*anubis/hamadryas* (hybrid)	—	—	—	—	1	20000	—	—
Papio	*hamadryas*	*cynocephalus*	36	12448	8800	17500	55	22957	17000	31000
Papio	*hamadryas*	*hamadryas*	5	11586	9500	13500	14	21073	15500	30350
Papio	*hamadryas*	*kindae*	4	9850	9000	11000	5	16032	15000	17237
Papio	*hamadryas*	*ursinus*	65	14822	11200	20500	47	28655	20500	35000
Theropithecus	*gelada*		5	11920	9000	13800	2	18375	16500	20250
Macaca	*arctoides*	*arctoides*	4	7780	6020	9100	7	12243	9900	15500
Macaca	*arctoides*	*melanota*	1	8506	—	—	1	10200	—	—
Macaca	*assamensis*	*assamensis*	4	6115	4860	6800	7	11153	7938	15000
Macaca	*assamensis*	*pelops*	3	7833	7000	8600	5	11548	10400	12700
Macaca	*fascicularis*		50	3588	2350	5443	75	5335	3402	12000

APPENDIX TABLE 2
Continued

			Females				Males			
Genus	Species	Subspecies	N	Mean	Min	Max	N	Mean	Min	Max
Macaca	*fuscata*		40	10348	6350	16300	24	13320	8200	20500
Macaca	*maura*		—	—	—	—	1	5954[d]	—	—
Macaca	*mulatta*		33	5339	3000	9979	26	7889	4010	14062
Macaca	*nemestrina*	*leonina*	9	4967	4400	5700	8	7249	5330	9072
Macaca	*nemestrina*	*nemestrina*	12	6493	5216	8165	12	11085	8618	13608
Macaca	*nemestrina*	*pagensis*	1	4500	—	—	—	—	—	—
Macaca	*radiata*	*radiata*	14	3851	2930	4990	13	6678	5440	8850
Macaca	*silenus*		—	—	—	—	1	6570	—	—
Macaca	*sinica*		2	3402	2495	4309	7	5040	3289	8000
Macaca	*sylvanus*		18	9944	8000	12000	35	14231	8600	18000
Macaca	*thibetana*		4	14375	9000	21500	6	17500	11500	25000

Mean values in this table are derived from data presented in appendix table 1.
[a] Subadult individual.
[b] Anecdotal value.
[c] If two lowest-mass males are removed as being probably subadult.
[d] Gutted.

APPENDIX TABLE 3
Humeral and Femoral Measurements (in mm) Used to Estimate Mass of Fossil Cercopithecids

Taxon	Sex	HL	HAP	HTR	FL	FAP	FTR
Paracolobus chemeroni Chemeron	Male	259.0	17.7	21.0	270.0	23.0	20.9
Cercopithecoides? cf. *williamsi* Koobi Fora	Male	215.0	18.5	18.0	—	—	—
Mesopithecus pentelicus Pikermi	Male?	149.6	12.9	13.4	190.0	13.3	13.8
Mesopithecus pentelicus Pikermi	Female?	139.8	10.4	9.0	167.0	—	—
Dolichopithecus ruscinensis Perpignan	Male	—	—	—	—	18.7	18.2
Dolichopithecus ruscinensis Perpignan	Male?	220.0	18.6	18.25	220.5	16.8	17.6
Dolichopithecus ruscinensis Perpignan	Female?	—	14.6	14.2	—	12.8	13.2
Macaca sylvanus sylvanus? Ain Mefta	(?Male)	169.1	12.8	15.7	—	—	—
Macaca sylvanus pliocena Zlaty Kun	Male?	—	12.4	14.2	—	—	—
Paradolichopithecus arvernensis Graunceanu	(?Male)	236e	20.0	16.1	—	18.9	19.5
Parapapio cf. *jonesi* Hadar	Male?	—	16.7	19.5	—	16.5	18.0
Theropithecus cf. *darti* Hadar	Male?	—	17.5	17.0	—	—	—
Theropithecus cf. *darti* Hadar	Female	—	13.1	14.9	—	—	—
Theropithecus oswaldi oswaldi Kanjera	Male?	—	20.0	17.5	—	18.0	—
Theropithecus oswaldi oswaldi Kanjera	Female?	—	16.0	13.0	—	17.0	16.0
Theropithecus oswaldi oswaldi Olduvai FLK I	?Male	264.0	25.0	25.0	—	—	—
Theropithecus oswaldi leakeyi? Olduvai MCK II	Male	277.0	30.2	22.0	284.0	25.7	25.4
Theropithecus oswaldi leakeyi Olorgesailie	Male?	—	26.0	—	—	29.0	26.0
Theropithecus oswaldi leakeyi Olorgesailie	Female?	275.0	—	—	232.0	23.0	20.0

Sex determined as indicated in text ("Male?" is more likely a male than is "?Male"), except that "(?Male)" indicates that bones of unknown sex were identified as male after analysis of mass estimates, as discussed in text. "e" indicates estimate based on incomplete specimen. Sources of data and variable abbreviations indicated in text and table 1.

APPENDIX TABLE 4

Measurements (in mm) of Lower Tooth Dental Variables Used to Estimate Mass of Fossil Cercopithecids

Taxon	Sex	m1AW	m1PW	m1L	m1AR	m2AW	m2PW	m2L	m2AR	m3AW	m3PW	m3L	m3AR
Microcolobus tugenensis	?Male	4.10	4.20	5.30	22.00	4.50	4.80	5.20	24.18	4.30	4.20	6.10	25.93
Colobine sp. "A" Leadu/Hadar	Male	6.55	6.70	8.55	56.64	7.20	7.45	8.90	65.16	7.40	7.60	11.40	85.42
Colobine cf. sp. "A" Aramis	Male	—	—	8.00	—	—	—	—	—	—	—	—	88.34
Colobus? flandrini	Unk.	—	—	—	—	7.70	7.50	9.20	69.92	—	7.30	10.70	—
Rhinocolobus turkanaensis Omo/Hadar	Male	6.70	7.03	9.57	65.65	8.18	8.35	11.00	90.91	8.70	8.67	14.33	128.18
Rhinocolobus turkanaensis Omo/Hadar	Female	6.70	6.70	9.50	63.65	7.75	7.75	10.20	80.05	8.50	8.33	14.07	118.95
Paracolobus chemeroni	Male	7.40	8.40	11.50	90.85	9.00	9.60	12.60	117.18	9.70	9.90	16.10	157.78
Paracolobus mutiwa	Male	—	—	—	—	—	—	—	—	10.20	9.60	18.20	180.18
Paracolobus mutiwa	(?Male)	—	—	—	—	8.60	8.90	13.30	116.38	—	—	—	—
Paracolobus? sp. Laetoli	Male	—	7.40	9.65	34.41	8.50	9.10	11.40	103.17	9.20	9.10	14.60	133.59
Paracolobus? sp. Laetoli	Female	6.00	6.60	9.20	57.96	7.85	8.40	10.65	86.54	8.00	8.20	13.00	105.30
Cercopithecoides williamsi Makapan/ Sterkfontein/Bolt's	Male	6.43	6.68	7.65	50.12	7.55	7.70	8.93	68.12	7.77	8.10	11.65	91.44
Cercopithecoides williamsi Makapan/ Sterkfontein/Bolt's	Female	7.70	7.75	7.67	58.62	8.40	8.50	8.78	76.05	8.65	8.43	11.94	101.94
Cercopithecoides williamsi Leba	Female?	—	—	—	—	7.70	7.90	9.80	76.44	8.20	—	—	—
Cercopithecoides williamsi Kromdraai B	Female	7.90	8.55	10.05	82.65	9.20	9.80	11.20	106.40	9.30	9.50	13.50	126.90
Cercopithecoides? cf. *williamsi* Koobi Fora	Male	6.90	6.90	9.20	63.48	7.70	7.80	9.70	75.18	8.00	8.00	12.40	99.20
Cercopithecoides kimeui Koobi Fora	Male	—	—	—	—	10.70	10.80	13.40	144.05	10.70	10.60	16.90	179.99
Pygathrix (Rhinopithecus) lantianensis	Male	7.30	7.80	7.80	58.89	8.70	9.00	9.50	84.08	9.20	9.10	13.20	120.78
Semnopithecus? sivalensis Siwaliks	Unknown	4.80	5.10	6.20	30.69	5.40	5.50	6.60	35.97	—	5.20	8.20	22.10
Semnopithecus? sp. Yushe	Unknown	—	—	—	—	—	—	—	—	8.60	8.07	12.97	108.10
Mesopithecus pentelicus Pikermi	Female	5.60	5.90	6.50	37.38	6.40	6.60	7.20	46.80	6.30	6.00	8.90	54.74
Mesopithecus pentelicus Pikermi	Male	5.70	6.00	6.90	40.37	6.60	6.90	7.50	50.63	6.60	6.20	9.30	59.52
Mesopithecus pentelicus Macedonia	Female	5.20	5.70	6.70	36.52	6.70	6.70	7.70	51.59	6.80	6.20	9.40	61.10
Mesopithecus pentelicus Macedonia	Male	5.70	5.90	7.20	41.76	6.70	6.90	7.60	51.68	6.60	6.30	9.80	63.21
Mesopithecus monspessulanus Various sites	Female	4.60	4.85	6.10	28.83	5.45	5.55	6.65	36.59	5.55	5.35	9.30	46.90
Mesopithecus monspessulanus Various sites	Male	4.93	5.17	6.67	33.67	5.73	5.93	6.95	40.47	5.90	5.70	8.60	52.78
Dolichopithecus ruscinensis Perpignan	Male	7.10	7.40	9.20	66.70	8.40	8.40	10.70	89.88	8.60	8.20	13.40	112.56
Dolichopithecus ruscinensis Perpignan	Female	6.90	7.10	9.20	64.40	8.00	8.20	10.50	85.05	8.30	7.90	12.50	101.25
Dolichopithecus? eohanuman Shamar	Female	7.45	7.75	9.60	73.01	9.00	9.00	10.60	95.45	9.10	8.80	13.50	120.80
Macaca sylvanus ?pliocena Various sites	Male	6.72	6.75	8.44	51.33	8.13	7.60	10.20	80.32	8.55	7.80	13.50	110.41
Macaca sylvanus ?pliocena Ubeidiya	Female	5.80	5.80	7.70	44.66	6.80	6.30	9.40	61.57	7.10	6.70	12.00	82.80

APPENDIX TABLE 4
Continued

Taxon	Sex	m1AW	m1PW	m1L	m1AR	m2AW	m2PW	m2L	m2AR	m3AW	m3PW	m3L	m3AR
Macaca sylvanus ?florentina Valdarno	Male	6.45	6.27	8.08	51.56	7.82	7.32	9.90	75.10	7.96	7.30	12.80	97.67
Macaca sylvanus ?florentina Valdarno	Female	6.70	6.90	7.90	53.72	8.30	7.50	9.60	75.84	8.40	7.80	13.50	109.35
Macaca sylvanus ?prisca Various sites	Male	6.00	6.30	7.20	44.28	6.80	6.80	8.80	59.84	—	—	—	—
Macaca majori Capo Figari	Male	5.70	5.47	7.32	35.67	6.97	6.77	8.73	59.97	7.05	6.60	10.40	70.62
Macaca majori Capo Figari	Female	5.40	5.30	6.90	36.92	6.40	6.50	7.60	49.02	—	—	—	—
Macaca libyca Wadi Natrun	Female	6.75	7.00	8.00	54.00	8.10	7.80	9.40	74.73	—	—	—	—
Macaca? sp. Menacer	Unknown	—	—	—	—	7.10	6.60	8.50	58.23	7.10	6.00	10.50	68.66
Macaca robusta Zhoukoudian	Female	6.45	6.80	7.85	51.99	8.40	7.80	9.75	79.00	8.70	7.65	12.80	104.21
Macaca palaeindica Siwaliks	Unknown	6.80	7.30	8.30	58.52	8.10	7.90	9.50	76.00	8.35	7.90	13.60	110.46
Paradolichopithecus arvernensis Senèze	Female	8.60	8.50	10.10	86.36	10.50	10.00	12.40	127.10	10.80	10.40	17.80	188.68
Paradolichopithecus arvernensis Graunceanu	Male	8.50	8.60	11.40	97.47	11.00	10.40	14.20	151.94	11.80	11.00	18.80	214.32
Paradolichopithecus arvernensis Graunceanu	Female	8.60	8.70	11.30	97.75	11.00	10.90	13.30	145.64	10.60	10.10	16.50	170.78
Paradolichopithecus sushkini Kuruksay	Male	9.40	9.50	10.30	97.34	12.40	12.10	14.70	180.08	12.10	10.50	18.90	213.57
Paradolichopithecus cf. *arvernensis* Cova Bonica	Male	7.40	7.60	10.50	78.75	9.50	8.70	12.70	115.57	10.00	—	16.20	81.00
Procynocephalus wimani Honan	Female	8.80	9.40	9.70	88.27	11.10	10.00	12.20	128.71	10.80	9.50	16.90	171.54
Procynocephalus subhimalayanus Siwaliks	Female	9.00	9.50	10.10	93.43	11.40	11.50	13.40	153.43	13.00	11.60	17.90	220.17
Procynocephalus subhimalayanus Siwaliks	Male?	—	7.40	8.00	29.60	7.50	7.50	10.80	81.00	10.00	9.70	15.70	154.65
Procynocephalus? sp. Dongcun	Unknown	—	—	—	—	—	—	—	—	12.10	11.60	17.50	207.38
Cercocebus? or *Parapapio jonesi* Makapan	Unknown	7.20	7.40	9.30	67.89	—	—	—	—	—	—	—	—
Cercocebus? or *Parapapio jonesi* Kromdraai A	Unknown	—	—	—	—	9.00	8.70	10.40	92.04	8.90	7.70	12.00	99.60
Parapapio jonesi Sterkfontein	Male	7.43	7.53	9.45	70.67	8.78	8.46	11.04	95.20	8.57	7.63	13.10	106.13
Parapapio jonesi Sterkfontein	Female	7.16	7.12	8.42	61.18	8.50	8.32	10.13	78.81	8.80	8.05	12.90	108.59
Parapapio cf. *jonesi* Makapan	Male	7.17	7.33	8.77	63.54	9.30	9.20	10.50	97.15	9.40	8.10	13.80	120.40
Parapapio cf. *jonesi* Makapan	Female	7.20	7.23	8.94	63.23	9.30	8.63	10.87	80.32	9.40	8.00	13.40	116.58
Parapapio cf. *jonesi* Hadar	Male	—	—	7.60	—	9.20	8.90	10.40	94.12	9.50	8.40	14.10	126.20
Parapapio cf. *jonesi* Hadar	Female	7.60	7.40	7.90	59.25	9.20	9.20	10.00	92.00	9.70	8.40	13.60	123.08
Parapapio broomi Makapan	Male	7.74	7.70	9.17	70.72	9.88	9.66	11.20	100.34	10.22	9.02	13.50	142.74
Parapapio broomi Makapan	Female	8.35	8.19	9.32	76.73	10.06	9.41	10.96	97.31	10.22	8.98	14.50	139.24
Parapapio broomi Sterkfontein	Male	8.20	8.23	9.26	76.02	10.25	10.21	11.05	104.46	10.58	9.36	14.60	129.15
Parapapio broomi Sterkfontein	Female	8.01	8.07	9.20	69.01	9.87	9.39	11.23	96.76	9.81	9.15	14.70	132.63

APPENDIX TABLE 4
Continued

Taxon	Sex	m1AW	m1PW	m1L	m1AR	m2AW	m2PW	m2L	m2AR	m3AW	m3PW	m3L	m3AR
Parapapio whitei Makapan	Male	8.50	7.90	10.23	85.13	10.37	9.80	12.37	124.72	11.05	9.75	14.90	174.76
Parapapio whitei Sterkfontein	Female	8.30	8.70	9.80	83.30	10.70	10.40	13.60	143.48	11.30	10.40	16.50	179.03
Parapapio? ado Laetoli	Male	7.40	7.60	9.50	75.00	9.40	8.60	11.20	100.70	10.80	8.90	15.00	147.75
Parapapio? ado Laetoli	Female	6.87	7.13	8.73	62.91	8.58	8.68	10.67	84.01	8.60	7.97	13.40	111.06
Parapapio sp. Kanapoi	Male	7.10	6.90	7.90	55.30	—	8.40	10.30	43.26	9.60	7.80	12.20	106.14
?*Parapapio* sp. Aramis	Female	—	—	—	—	—	7.10	—	64.50	7.30	6.60	—	74.64
Papio hamadryas robinsoni Sterkfontein	Male	9.10	9.40	9.90	71.10	11.03	10.50	12.93	116.95	12.15	10.25	18.70	209.39
Papio hamadryas robinsoni Sterkfontein	Female	8.70	9.23	9.66	88.23	10.58	10.78	12.12	130.12	10.83	10.23	16.30	169.65
Papio hamadryas robinsoni Swartkrans	Male	—	—	11.21	—	11.21	10.49	14.06	152.58	—	—	—	—
Papio hamadryas robinsoni Swartkrans	Female			9.94	9.69	12.21	119.82	10.30	9.10	16.30	158.11		
Papio angusticeps Kromdraai A	Male	8.80	8.50	9.85	83.13	9.70	9.50	12.20	114.24	10.20	9.17	14.40	139.80
Papio angusticeps Kromdraai A	Female	8.23	7.83	9.20	73.74	11.30	10.30	12.25	99.01	—	—	—	—
Papio izodi Taung	Male	—	—	10.30	—	9.60	—	—	—	—	—	—	—
Papio izodi Taung	Female	—	—	—	—	—	10.20	11.80	60.18	11.80	—	15.50	91.45
Papio (*Dinopithecus*) *ingens* Schurweburg/ Swartkrans	Male	10.00	10.50	12.50	140.43	13.40	12.85	15.53	209.19	13.85	11.35	20.80	261.43
Papio (*Dinopithecus*) *quadratirostris* Omo	Male	10.50	9.60	12.40	94.43	12.35	10.90	14.75	171.47	12.65	9.97	18.30	214.13
Papio (*Dinopithecus*) *quadratirostris* Omo	Female	9.00	9.10	10.80	97.74	11.20	10.80	12.90	141.90	11.60	10.40	16.30	179.30
Papio (*Dinopithecus*) cf. *quadratirostris* Leba	Female?	8.93	8.93	10.97	98.27	11.50	10.30	14.40	156.96	11.65	10.10	18.00	195.18
Gorgopithecus major Kromdraai/Cooper's/ Swartkrans	Male	9.50	9.80	11.80	113.87	11.85	11.30	15.10	174.87	12.75	11.45	19.30	233.08
Theropithecus darti Makapan	Male	9.90	10.25	11.75	119.36	12.10	11.50	15.77	182.31	12.65	11.55	20.40	246.38
Theropithecus darti Makapan	Female	9.20	9.75	11.00	96.68	11.70	11.67	13.45	148.00	12.60	11.37	18.10	216.85
Theropithecus cf. *darti* Hadar	Male	8.53	8.30	10.59	83.62	10.67	9.97	13.29	127.61	12.10	10.58	18.20	206.25
Theropithecus cf. *darti* Hadar	Female	8.03	7.78	9.73	77.71	9.75	9.75	12.19	102.48	10.60	9.70	15.90	149.47
Theropithecus oswaldi oswaldi Kanjera	Female	—	—	—	—	—	11.70	—	169.86	12.10	11.30	—	234.00
Theropithecus oswaldi oswaldi Swartkrans Mbr 1	Male	9.40	9.60	12.90	122.55	12.00	11.50	17.00	199.75	13.70	13.00	23.70	249.96
Theropithecus oswaldi oswaldi Swartkrans Mbr 1	Female	9.70	9.80	11.40	111.15	12.30	11.70	15.00	180.00	13.10	11.80	19.80	246.51
Theropithecus oswaldi leakeyi Koobi Fora	Male	9.20	9.30	11.30	104.5	11.90	11.30	17.20	199.5	13.90	12.60	23.40	310.1

APPENDIX TABLE 4
Continued

Taxon	Sex	m1AW	m1PW	m1L	m1AR	m2AW	m2PW	m2L	m2AR	m3AW	m3PW	m3L	m3AR
Theropithecus oswaldi oswaldi Olduvai DK I	Female	—	—	—	—	—	—	—	—	14.70	12.60	21.90	298.94
Theropithecus oswaldi leakeyi? Olduvai MCK II	Male	—	—	—	—	14.10	14.50	29.50	421.9	16.30	14.20	24.60	375.2
Theropithecus oswaldi leakeyi? Olduvai Average	Male	11.90		14.70	87.47	14.60	13.30	18.30	255.29	16.00	14.00	24.90	373.50
Theropithecus oswaldi leakeyi Tighenif	?Male	11.30	11.00	12.70	141.61	15.00	14.60	17.60	260.48	16.20	14.50	24.30	373.01
Theropithecus oswaldi leakeyi Tighenif	Unknown	—	—	—	—	13.60	12.60	18.50	242.35	15.50	13.00	24.10	343.43
Theropithecus oswaldi leakeyi Thomas Quarry 3?	Male	12.40	11.40	14.10	167.79	12.00	11.60	16.70	197.06	12.70	11.60	21.10	257.63
Theropithecus oswaldi leakeyi Hopefield	Male	11.80	11.60	13.30	155.61	14.00	12.70	18.80	250.98	16.00	14.95	25.60	396.54
Theropithecus oswaldi leakeyi Hopefield	Female	9.70	9.90	13.80	135.24	—	—	17.60	—	—	—	26.40	—
Theropithecus oswaldi leakeyi Olorgesailie Mean	Male	—	—	—	—	16.00	—	22.50	180.00	—	—	—	—
Theropithecus oswaldi leakeyi Olorgesailie Max	Male	13.00	—	17.50	113.75	17.50	—	22.50	196.88	19.00	—	28.40	—
Theropithecus oswaldi leakeyi Olorgesailie Mean	Female	11.50	10.50	14.40	158.40	12.80	13.30	17.80	232.29	15.90	14.50	24.70	375.44
Theropithecus oswaldi delsoni Cueva Victoria	Unknown	—	—	—	—	13.20	12.90	19.60	255.78	—	—	—	—
Theropithecus "atlanticus" Ain Jourdel (m1?)	Unknown	—	—	—	—	9.4	9.3	14.1	131.84	—	—	—	—
Theropithecus "atlanticus" Ahl al Oughlam	Unknown	11.8	—	—	111.50	—	—	—	—	12.1	—	—	—
Theropithecus? baringensis Chemeron	Male	7.90	8.30	10.70	86.67	10.20	9.50	11.80	116.23	10.70	9.20	17.10	174.13
Theropithecus brumpti Omo Shungura	Male	9.40	9.90	12.50	120.63	12.60	12.30	16.20	201.69	13.80	12.80	—	296.59
Theropithecus brumpti Omo Shungura	Female	9.2	9.5	12.2	114.07	11.5	11.1	15.2	171.76	12.4	11.4	19.5	232.05
Theropithecus sp. indet. Lothagam	Unknown	—	—	—	—	11.3	10.6	15.1	165.35	—	—	—	—
Victoriapithecus macinnesi Maboko	Unknown	5.00	5.50	6.00	26.53	6.60	6.37	7.53	49.03	6.20	5.26	8.90	51.51
Prohylobates tandyi Wadi Moghara	Female	5.90	5.50	5.60	31.92	6.20	5.90	5.80	35.09	5.00	—	6.50	—
Prohylobates simonsi Gebel Zelten	Unknown	—	—	—	—	11.00	10.40	10.40	111.28	9.10	8.20	12.90	111.59

Sex determined as indicated in text and appendix table 3, except that (?Male) or (?Female) indicates cases where the largest or smallest teeth of unknown sex were used to estimate mass for that population. Sources of data and variable abbreviations indicated in text and table 2.

APPENDIX TABLE 5

Measurements (in mm) of Upper Tooth Dental Variables Used to Estimate Mass of Fossil Cercopithecids

Taxon	Sex	M1AW	M1PW	M1L	M1AR	M2AW	M2PW	M2L	M2AR
Colobine sp. "A" Leadu/Hadar	Male	7.90	7.40	8.80	67.32	8.60	7.80	8.60	70.52
Colobine cf. sp. "A" Aramis	Male	—	6.85	7.90	—	—	7.25	—	66.40
Colobine cf. sp. "A" Aramis	Female	—	6.78	—	56.50	—	7.54	—	—
Colobus? flandrini Menacer	Unknown	8.90	8.60	8.30	72.63	10.00	9.10	9.30	88.82
Libypithecus markgrafi Wadi Natrun	Male	6.50	6.00	7.20	45.00	7.50	6.30	7.50	51.75
Rhinocolobus turkanaensis Omo/Hadar	Male	8.43	7.85	9.80	67.02	10.00	8.90	10.90	103.07
Rhinocolobus turkanaensis Omo/Hadar	Female	8.60	8.00	10.05	83.83	9.80	8.50	10.65	94.25
Paracolobus chemeroni Chemeron	Male	10.10	9.70	10.90	107.91	11.20	11.00	12.10	134.31
Paracolobus mutiwa Turkana Basin	(?Male)	—	—	—	—	12.10	11.50	13.90	164.02
Paracolobus mutiwa Turkana Basin	Female?	10.50	9.50	10.30	103.00	12.30	10.80	11.80	136.29
Paracolobus? sp. Laetoli	(?Male)	9.05	8.70	9.95	88.31	—	—	—	—
Paracolobus? sp. Laetoli	Female?	8.40	8.10	9.10	56.16	9.80	8.65	9.85	90.95
Cercopithecoides williamsi Makapan/Sterkfontein/Bolt's	Male	8.50	8.10	8.05	66.93	10.20	8.50	9.33	88.65
Cercopithecoides williamsi Makapan/Sterkfontein/Bolt's	Female	8.30	7.60	7.70	61.22	9.60	8.50	9.10	62.72
Cercopithecoides williamsi Swartkrans?	Male	8.20	7.40	8.50	66.30	9.20	8.30	9.40	82.25
Cercopithecoides williamsi Kromdraai B	Female	10.25	9.45	9.80	96.85	11.20	9.90	10.90	115.20
Cercopithecoides? cf. *williamsi* Koobi Fora	Male	8.40	7.70	9.30	74.87	9.30	8.30	10.00	88.00
Cercopithecoides kimeui Koobi Fora	Male	—	—	9.50	—	12.00	11.80	12.00	142.80
Cercopithecoides kimeui Koobi Fora	Female?	9.60	—	9.00	43.20	11.30	11.30	11.60	131.08
Cercopithecoides kimeui Olduvai	Unknown	10.10	9.50	10.90	106.82	11.70	10.80	11.70	131.63
Pygathrix (Rhinopithecus) roxellana? Honan	Female?	8.00	8.10	8.00	64.40	9.30	8.50	9.80	87.22
Pygathrix (Rhinopithecus) lantianensis Gongwangling	Male	8.80	8.70	9.30	81.38	—	—	—	—
Semnopithecus? sivalensis Siwaliks	Unknown	5.95	5.70	6.35	37.00	6.60	6.20	6.50	41.60
Mesopithecus pentelicus Pikermi	Male	6.90	6.70	7.00	47.60	7.70	7.20	7.50	55.88
Mesopithecus pentelicus Pikermi	Female	6.90	6.70	6.80	46.24	7.40	7.00	7.20	51.84
Mesopithecus pentelicus Macedonia	Male	7.00	6.80	6.70	46.23	7.70	7.10	7.40	54.76
Dolichopithecus ruscinensis Perpignan	Female	8.40	8.10	8.90	73.43	9.50	8.40	10.40	93.08
Dolichopithecus? eohanuman Shamar	Female	8.60	9.00	9.60	84.5	10.00	9.70	10.30	101.5
Macaca sylvanus ?prisca Various sites	Male	8.00	7.60	9.00	70.20	10.00	9.10	10.30	98.37
Macaca majori Capo Figari	Male	7.05	6.80	7.40	51.25	8.15	7.70	8.35	66.18
Macaca majori Capo Figari	Female	6.70	6.30	6.80	44.20	7.60	7.20	7.30	54.02
Macaca anderssoni Mien Chih	Male	8.60	7.90	7.70	63.53	10.20	9.60	9.30	92.07
Macaca robusta Zhoukoudian	Male?	9.70	9.50	9.50	91.20	10.80	9.50	10.10	102.52
Macaca robusta Zhoukoudian	Female	8.60	8.10	8.40	70.14	9.70	8.70	10.40	95.68

APPENDIX TABLE 5
Continued

Taxon	Sex	M1AW	M1PW	M1L	M1AR	M2AW	M2PW	M2L	M2AR
Paradolichopithecus arvernensis Senèze	Female	10.20	9.60	10.80	106.92	12.80	11.00	13.30	158.27
Paradolichopithecus arvernensis Graunceanu	Male	10.20	9.60	11.10	109.89	13.20	12.10	13.90	175.84
Paradolichopithecus arvernensis Graunceanu	Female	9.80	9.40	11.20	107.52	12.30	10.80	12.70	146.69
Paradolichopithecus sushkini Kuruksay	Male	11.70	11.80	12.70	149.23	14.70	13.00	14.80	204.98
Paradolichopithecus sushkini Kuruksay	Female	11.70	10.70	13.30	148.96	14.00	12.40	14.70	194.04
Procynocephalus wimani Honan	Female	11.00	10.50	10.50	112.88	12.40	10.60	12.40	142.60
Procynocephalus subhimalayanus Siwaliks	Female	11.00	—	11.20	61.60	13.00	12.40	13.30	168.91
Procynocephalus? sp. Yushe	Unknown	10.45	10.60	10.65	112.60	11.30	11.10	11.10	124.32
Cercocebus? or *Parapapio jonesi* Makapan	Unknown	—	—	—	—	9.70	9.00	9.30	86.96
Cercocebus? or *Parapapio jonesi* Kromdraai A	Unknown	8.00	8.00	8.40	67.20	9.80	8.70	9.30	86.03
Cercocebus? or *Parapapio jonesi* Taung	Unknown	—	6.70	8.00	—	7.90	7.60	10.20	79.05
Parapapio jonesi Sterkfontein	Male	9.00	8.60	8.25	63.36	10.40	9.80	10.00	93.93
Parapapio jonesi Sterkfontein	Female	8.93	8.12	8.90	62.80	10.06	9.22	10.30	92.57
Parapapio cf. *jonesi* Makapan	Male	8.50	7.60	8.60	69.23	11.00	10.13	10.25	106.91
Parapapio cf. *jonesi* Makapan	Female	8.40	8.00	8.50	69.70	10.10	9.20	10.10	97.47
Parapapio cf. *jonesi* Hadar	Male	8.20	8.30	8.00	66.00	—	—	10.60	—
Parapapio cf. *jonesi* Hadar	Female	10.20	9.80	8.20	82.00	11.90	10.50	10.60	118.72
Parapapio broomi Makapan	Male	9.63	8.98	9.50	87.95	11.42	10.53	11.33	109.42
Parapapio broomi Makapan	Female	9.70	9.15	9.58	87.16	11.06	9.81	10.93	106.71
Parapapio broomi Sterkfontein	Male	9.68	9.25	9.80	94.01	12.03	10.92	11.42	117.33
Parapapio broomi Sterkfontein	Female	9.80	8.84	9.30	83.12	11.06	10.31	11.02	108.02
Parapapio broomi or *whitei* Bolt's Farm 23	Male	10.20	—	9.80	49.98	12.00	11.20	11.40	132.24
Parapapio whitei Makapan	Male	10.45	9.60	10.35	103.67	12.66	11.16	12.18	144.96
Parapapio whitei Sterkfontein	Female	10.10	9.80	9.60	95.52	12.50	11.00	11.40	133.95
Parapapio antiquus Taung	Male	8.70	8.40	9.70	82.94	10.30	8.80	11.70	111.74
Parapapio antiquus Taung	Female	8.83	7.93	9.63	80.28	10.33	9.20	11.53	112.68
Parapapio? *ado* Laetoli	Male	—	—	—	—	11.80	10.55	11.85	132.28
?*Parapapio* sp. Aramis	Female	—	—	—	55.20	—	—	—	—
Papio hamadryas robinsoni Sterkfontein	Male	10.90	10.20	11.80	124.49	12.90	11.60	14.10	172.73
Papio hamadryas robinsoni Sterkfontein	Female	10.50	9.80	10.46	106.75	12.03	11.46	12.90	151.69
Papio hamadryas robinsoni Swartkrans	Male	—	—	—	—	12.68	11.54	14.16	171.51
Papio hamadryas robinsoni Swartkrans	Female	9.87	9.08	10.08	95.54	—	—	—	—

APPENDIX TABLE 5
Continued

Taxon	Sex	M1AW	M1PW	M1L	M1AR	M2AW	M2PW	M2L	M2AR
Papio angusticeps Kromdraai A	Male	10.70	9.60	9.60	105.53	11.25	10.08	12.00	127.83
Papio angusticeps Kromdraai A	Female	9.24	8.32	9.92	87.25	10.80	9.90	12.23	126.80
Papio izodi Taung	Female	9.40	9.20	10.03	93.00	10.00	10.40	11.75	78.58
Papio cf. *izodi* Sterkfontein	Female	10.00	9.10	10.60	101.23	11.20	10.20	11.40	121.98
Papio (Dinopithecus) ingens Schurweburg/Swartkrans	Male	13.05	12.50	14.15	180.76	16.20	—	—	—
Papio (Dinopithecus) ingens Schurweburg/Swartkrans	Female	11.62	10.96	12.88	150.48	13.78	12.25	15.02	195.50
Papio (Dinopithecus) quadratirostris Omo	Male	11.10	11.50	12.35	132.21	13.85	13.15	14.70	198.55
Papio (Dinopithecus) quadratirostris Omo	Female	10.65	10.10	11.20	116.19	12.85	11.40	13.75	166.83
Papio (Dinopithecus) cf. *quadratirostris* Leba	Male	—	—	11.90	—	15.20	14.20	15.80	232.26
Papio (Dinopithecus) cf. *quadratirostris* Leba	Female?	11.50	11.00	11.90	133.88	13.80	13.10	15.10	203.10
Gorgopithecus major Kromdraai/Cooper's/Swartkrans	Male	11.80	11.00	12.90	147.06	14.10	13.10	15.50	210.80
Gorgopithecus major Kromdraai/Cooper's/Swartkrans	Female	11.50	10.80	11.80	131.57	14.30	13.30	14.70	202.86
Theropithecus darti Makapan	Male	—	10.70	—	—	14.10	13.80	—	—
Theropithecus darti Makapan	Female	9.95	9.60	12.47	121.77	12.00	11.50	16.45	197.40
Theropithecus cf. *darti* Hadar	Male	9.80	9.90	11.15	83.65	11.70	10.50	12.75	144.30
Theropithecus cf. *darti* Hadar	Female	8.95	8.30	10.75	92.71	11.05	9.95	12.70	133.43
Theropithecus oswaldi oswaldi Kanjera	Male	—	—	—	—	14.50	13.20	17.90	247.92
Theropithecus oswaldi oswaldi Kanjera	Female	—	—	—	110.70	—	—	—	—
Theropithecus oswaldi oswaldi Swartkrans Mbr 1	Male	11.50	12.00	13.00	152.75	13.50	12.00	18.00	229.50
Theropithecus oswaldi oswaldi Swartkrans Mbr 1	Female	11.15	10.25	13.30	142.73	13.85	13.05	17.25	232.44
Theropithecus oswaldi leakeyi Koobi Fora	Male	10.70	10.90	14.30	154.4	11.80	10.80	17.30	195.5
Theropithecus oswaldi leakeyi? Olduvai MCK II	Male	—	—	14.50	—	15.20	13.90	19.00	276.5
Theropithecus oswaldi leakeyi Olorgesailie Mean	Male	15.30	14.70	16.00	240.00	—	—	—	—
Theropithecus oswaldi leakeyi Bodo	Male	—	—	—	—	16.51	14.97	18.55	291.90
Theropithecus oswaldi delsoni Mirzapur	Unknown	14.00	13.30	14.60	199.29	17.30	16.30	20.80	349.44
Theropithecus "atlanticus" Ahl al Oughlam	Unknown	—	10.6	—	11.6	—	—	—	—
Theropithecus? baringensis Chemeron	Male	10.50	9.80	10.50	106.58	12.30	11.60	12.50	149.38
Theropithecus brumpti Omo Shungura	Male	11.40	11.00	13.20	147.84	13.50	12.80	16.60	218.29
Theropithecus brumpti Omo Shungura	Female	11.00	10.10	12.60	132.93	13.50	12.50	16.00	208.00
Victoriapithecus macinnesi Maboko	Unknown	7.10	6.70	6.60	45.54	7.87	7.47	7.57	58.05

Sex determined as indicated in text and appendix table 3, except that (?Male) or (?Female) indicates cases where the largest or smallest teeth of unknown sex were used to estimate mass for the population. Sources of data and variable abbreviations indicated in text and table 2.

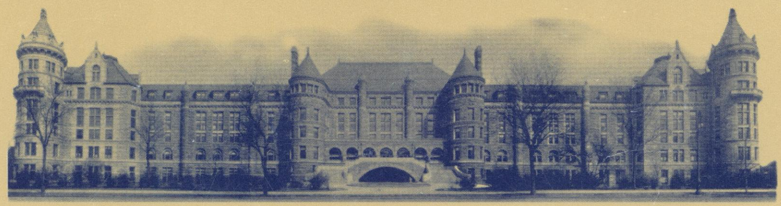
APPENDIX TABLE 6
Measurements (in mm) of Cranial Variables Used to Estimate Mass of Fossil Cercopithecids

Taxon	Sex	NAIN	GLIN	NABA	GLBA	PORB	BIOR	ORBW	ORBH	ORBAR
Libypithecus markgrafi Wadi Natrun	Male	97.5	94.0	65.6	67.5	43.5	71.7	23.6	26.6	627.8
Rhinocolobus turkanaensis Omo/Hadar	Male	101.7	100.3	85.9	86.1	49.0	95.5	29.0	27.5	—
Rhinocolobus turkanaensis Omo/Hadar	Female	106.0	105.5	90.0	90.0	49.0	90.0	26.0	29.0	—
Paracolobus chemeroni Chemeron	Male	—	—	—	—	57.5	104.5	24.8	28.3	701.8
Cercopithecoides williamsi Makapan/Sterkfontein/Bolt's	Male	109.3	107.5	77.7	79.2	54.8	83.0	27.8	23.0	641.0
Cercopithecoides williamsi Makapan/Sterkfontein/Bolt's	Female	—	—	71.8	74.5	49.0	80.0	29.3	22.8	670.3
Cercopithecoides williamsi Kromdraai B	Female	—	—	—	—	50.0	81.0	31.5	30.0	945.0
Cercopithecoides? cf. *williamsi* Koobi Fora	Male	—	—	—	—	—	104.0	25.0	20.0	500.0
Cercopithecoides kimeui Koobi Fora	Female?	113.0	111.5	80.0	83.0	47.0	97.0	34.0	26.0	884.0
Cercopithecoides kimeui Olduvai	Unknown	119.7	118.2	—	—	52.7	—	—	—	—
Pygathrix (*Rhinopithecus*) *roxellana*? Honan	Female?	—	100.0	—	—	48.0	70.0	—	—	—
Mesopithecus pentelicus Pikermi	Male	82.0	80.0	65.0	57.0	48.5	72.3	25.3	23.0	—
Mesopithecus pentelicus Pikermi	Female	76.0	75.5	59.0	60.0	—	62.0	23.0	18.6	—
Dolichopithecus ruscinensis Perpignan	Female	—	—	—	—	48.5	75.0	—	19.5	—
Macaca majori Capo Figari	Male	—	—	—	—	41.0	65.4	19.9	21.2	421.9
Macaca anderssoni Mien Chih	Male	—	—	—	—	46.0	81.8	—	25.3	—
Macaca robusta Zhoukoudian	Male?	95.0	92.5	72.2	74.0	44.0	86.0	28.0	28.0	784.0
Paradolichopithecus arvernensis Senèze	Female	115.0	110.6	78.5	88.0	48.2	101.0	32.5	27.8	—
Paradolichopithecus arvernensis Graunceanu	Male	109.8	109.4	93.0	96.0	—	—	—	—	—
Paradolichopithecus sushkini Kuruksay	Male	—	—	—	—	60.0	80.0	—	—	—
Paradolichopithecus sushkini Kuruksay	Female	107.0	105.0	76.5	78.0	50.0	75.0	26.0	20.5	533.0
Parapapio cf. *jonesi* Makapan	Male	—	—	—	—	53.1	—	27.0	24.2	653.4
Parapapio cf. *jonesi* Makapan	Female	—	—	—	—	53.0	—	26.5	24.0	636.0
Parapapio cf. *jonesi* Hadar	Male	99.0	99.0	69.5	69.5	47.5	85.0	25.0	22.0	550.0
Parapapio broomi Makapan	Male	—	120.5	—	—	54.6	76.3	28.2	23.5	663.8
Parapapio broomi Makapan	Female	—	96.0	—	—	51.0	—	26.5	22.8	604.2
Parapapio broomi or *whitei* Bolt's Farm 23	Male	112.0	110.0	81.0	82.0	54.0	87.0	28.3	26.7	755.6
Parapapio whitei Makapan	Male	121.0	117.5	81.0	84.0	53.0	78.0	28.0	22.5	631.0

APPENDIX TABLE 6
Continued

Taxon	Sex	NAIN	GLIN	NABA	GLBA	PORB	BIOR	ORBW	ORBH	ORBAR
Parapapio antiquus Taung	Male	97.0	95.0	70.0	72.0	43.0	81.0	27.0	24.0	648.0
Parapapio antiquus Taung	Female	91.5	91.0	70.0	75.0	54.5	70.5	25.0	22.0	550.0
Papio hamadryas robinsoni Sterkfontein	Female	—	105.0	73.5	—	—	—	—	—	—
Papio angusticeps Kromdraai A	Male	—	—	78.0	80.0	50.0	82.5	26.0	21.5	559.0
Papio angusticeps Kromdraai A	Female	100.0	100.5	66.0	68.0	47.7	67.7	19.0	18.0	372.0
Papio izodi Taung	Male	—	—	74.0	—	—	—	—	—	—
Papio izodi Taung	Female	91.7	91.7	66.5	69.0	52.0	75.0	26.5	23.0	609.0
Papio (Dinopithecus) quadratirostris Omo	Male	121.0	119.0	—	—	46.0	106.5	29.0	27.0	783.0
Papio (Dinopithecus) quadratirostris Omo	Female	110.0	111.0	—	—	49.5	75.5	27.5	27.0	743.0
Papio (Dinopithecus) cf. *quadratirostris* Leba	Female?	—	—	—	—	41.0	—	—	—	—
Gorgopithecus major Kromdraai/Cooper's/Swartkrans	Male	—	125.0	—	—	—	—	—	—	—
Gorgopithecus major Kromdraai/Cooper's/Swartkrans	Female	—	—	—	—	—	95.0	—	—	—
Theropithecus darti Makapan	Female	108.5	108.0	80.5	81.5	43.5	78.5	27.5	22.5	618.8
Theropithecus cf. *darti* Hadar	Female	100.5	100.3	73.7	75.2	46.0	81.0	26.8	25.7	688.8
Theropithecus oswaldi oswaldi Kanjera	Male	125.5	—	—	—	—	—	—	—	—
Theropithecus oswaldi oswaldi Kanjera	Female	116.0	—	83.5	87.5	49.5	—	—	—	—
Theropithecus oswaldi oswaldi Swartkrans Mbr 1	Female	116.0	116.0	83.5	87.5	45.0	83.0	28.5	25.0	712.5
Theropithecus oswaldi leakeyi Koobi Fora	Male	138.0	—	104.0	107.0	—	—	—	—	—
Theropithecus oswaldi leakeyi Koobi Fora	Female	114.5	114.0	84.0	84.5	60.5	91.5	30.5	28.0	854.0
Theropithecus oswaldi leakeyi Bodo	Male	171.3	—	110.9	112.7	—	—	—	—	—
Theropithecus? baringensis Chemeron	Male	—	—	90.0	—	43.5	91.5	24.0	27.5	660.0
Theropithecus brumpti Omo Shungura	Male	114.5	—	87.0	92.0	—	—	—	—	—
Theropithecus brumpti West Turkana	Male	135.5	—	99.0	102.0	—	—	—	—	—
Victoriapithecus macinnesi Maboko	Male	75.5	—	52.5	52.0	—	—	—	—	—

Sources of data and variable abbreviations indicated in text and table 2.



Extant Cercopithecidae (Old World monkeys) range in mass from about 1 to 50 kg, and extinct species have been suggested to have weighed as much as 100 kg. The development of reliable methods for determining body size in extinct taxa is an important prerequisite to more detailed paleobiological analyses. In this monograph, the authors develop a series of equations to be used in such estimation as well as a protocol for the selection of the "best" equations. Bivariate relationships between each of the variables and mass were determined in a subset of taxa to obtain prediction equations. These equations were then tested on a smaller subset of taxa that had not been included in the previous step, in order to determine prediction accuracy as judged by Mean Prediction Error. A final set of prediction equations was developed for the highest-ranked variables in each of seven taxon-sex subgroups. The scaling of these variables with mass was examined in extant taxa using reduced major axis regression. The prediction equations were applied to over 90 fossil taxa, using postcranial, dental, and cranial specimens from both sexes. The resulting mass estimates were used to examine sexual dimorphism, body size evolution, and energetics in extinct cercopithecids.

Eric Delson is a paleoanthropologist whose research interests range from the origin of the anthropoid primates to the spread of anatomically modern humans, with a focus on fossil Old World monkeys, family Cercopithecidae. Currently he is codirecting both field research at the French Pliocene site of Senèze and laboratory work in three-dimensional geometric morphometric analysis of primate skulls. His major publications include *Evolutionary History of the Primates* (with Frederick S. Szalay), *Ancestors: The Hard Evidence,* and the *Encyclopedia of Human Evolution and Prehistory*, second edition (edited with Ian Tattersall, John A. Van Couvering, and Alison S. Brooks). He is Chairman of the Department of Anthropology at Lehman College of the City University of New York; a member of several graduate faculties at CUNY; and the Director of the New York Consortium in Evolutionary Primatology.

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