

## Supplementary Note 1. Body mass of KNM-NP 59050, KNM-RU 7290 and *Oreopithecus*.

The exact body mass estimates used here are given in grams in Supplementary Table 1.

### KNM-NP 59050

The M<sup>1</sup> crown of KNM-NP 59050 is fully formed and can be used to estimate adult body mass of the specimen. Based on M<sup>1</sup> crown area (mesiodistal length x buccolingual width) and published regression formulae<sup>55,56</sup> body mass estimates were obtained of between 14 and 18 Kg (Table). These values appear large for KNM-NP 59050. It is most similar in cranial dimensions to *Symphalangus syndactylus* infants of the same developmental age (Extended Data Table 1), and this species has an adult body mass of about 11 Kg (ref. 45). As previously reported for proconsulines<sup>57</sup>, *Nyanzapithecus alesi* could thus be megadont, a phenomenon likely related to the prominent cingula enlarging molar crown size. To study the endocranial volume and semicircular canal size of KNM-NP 59050 we therefore consider a range of body masses. Although most similar to *Symphalangus* infants, some cranial dimension of the specimen are intermediate between *Nomascus* and *Symphalangus* infants (Extended Data Table 1b: maximum cranial length and maxillo-alveolar length). As the smallest body mass we therefore use the mean of the latter two species or 9.4 Kg (ref. 45). As the largest value we use 17.9 Kg, based on the M<sup>1</sup> area (Table). As the main body mass estimate we use 11.3 Kg, based on the similarities in cranial dimensions to *Symphalangus* infants.

Body mass (BM) estimates based on M<sup>1</sup> and M<sup>2</sup> crown area, using regressions reported in refs 55 and 56 for samples of extant primates. Estimates with 95% confidence intervals (95% CI) are given in Kg. \*Samples which do not include great apes.

	Source	Extant sample used	KNM-NP 59050		KNM-RU 7290	
			BM	95% CI	BM	95% CI
M <sup>1</sup>	Egi et al <sup>56</sup>	anthropoids*	17.9	16.4-19.3	22.1	20.7-23.6
	Egi et al <sup>56</sup>	primates*	14.5	13.2-15.8	17.9	16.6-19.2
	Gingerich et al <sup>55</sup>	primates	13.9	12.3-15.7	16.9	14.8-19.3
M <sup>2</sup>	Egi et al <sup>56</sup>	anthropoids*	-	-	20.0	18.6-21.4
	Egi et al <sup>56</sup>	primates*	-	-	17.7	16.5-18.9
	Gingerich et al <sup>55</sup>	primates	-	-	17.9	15.6-20.4

### KNM-RU 7290

*Ekembo heseloni* is known to be megadont<sup>57</sup>. Indeed, for KNM-RU 7290 body mass estimates based on M<sup>1</sup> and M<sup>2</sup> area range from 17 to 22 Kg (Table), but orbital height suggest a body mass of about 14 Kg (ref. 58). In the comparisons of endocranial volume and semicircular canal size of this specimen we use the estimate derived from orbital height (Extended Data Fig. 7a,b; SupplementaryTable 1), which appears to be most consistent with the largest values obtained based on postcranial elements of *E. heseloni*<sup>57</sup>. In comparisons of adult specimens we use ratios, scaling cranial dimensions against M<sup>1</sup> crown area (Methods; Extended Data Fig. 4, 5). To explore if the megadontia of *E. heseloni* substantially affects the ratio values of KNM-RU 7290 an alternative, reduced M<sup>1</sup> area of 58.5 mm<sup>2</sup> was used, in addition to the measured area of 76.0 mm<sup>2</sup>. This reduced M<sup>1</sup> area was calculated to match the 14 Kg suggested by orbital height of KNM-RU 7290.

### *Oreopithecus bambolii*

The body mass of male *Oreopithecus* has been estimated to be 32 Kg, based on postcranial elements<sup>59</sup>. Males are estimated to be about 40% larger than females (T. Harrison, pers. comm), suggesting a body mass estimate for females of 23 Kg. The endocranial volume used here<sup>60</sup> was estimated from the foramen magnum area of a smaller individual, and the female body mass value was used in Extended Data Fig. 7a. The BA208 specimen whose semicircular canal size was analysed is of unknown sex<sup>61</sup>, thus the male-female body mass range is shown in Extended Data Fig. 7b.

**Supplementary Table 1 | Comparative semicircular canal measurements.** Given are the sample size (n), height/width proportions of the anterior (ASCh/w) and lateral (LSCh/w) canal arcs, relative arc size of the lateral canal (LSC-R%), and where used in Extended Data Figure 7, the body mass<sup>26,44,45</sup> (BM in g) and mean radius of curvature (SC-R in mm). See Methods for more details.

Taxon	Source	n	ASCh/w	LSCh/w	LSC-R%	BM	SC-R
<i>Aotus trivirgatus</i>	Ref. 42	2	92	79	30	-	-
<i>Cebus apella</i>	Ref. 42	4	93	77	29	-	-
<i>Saimiri sciureus</i>	Ref. 42	3	96	76	31	-	-
<i>Cercopithecus cephus</i>	Ref. 42	1	81	102	33	4290	2.2
<i>Cercopithecus diana</i>	Ref. 42	1	86	88	34	5200	2.4
<i>Cercopithecus mitis</i>	Ref. 42	1	81	86	33	7930	2.5
<i>Cercopithecus nictitans</i>	Ref. 42	2	81	97	34	5100	2.3
<i>Macaca fascicularis</i>	Ref. 42	3	87	91	32	5465	2.4
<i>Macaca mulatta</i>	Ref. 42	1	81	96	33	4475	2.3
<i>Macaca nigra</i>	Ref. 42	2	91	97	32	9286	2.6
<i>Macaca sylvanus</i>	Ref. 42	1	94	83	31	7680	2.5
<i>Semnopithecus entellus</i>	Ref. 42	2	93	92	32	13550	2.6
<i>Trachypithecus obscurus</i>	Ref. 42	1	84	97	30	31600	2.8
<i>Trachypithecus vetellus</i>	Ref. 42	2	91	96	32	14533	2.5
<i>Nomascus</i> sp	This study	3	76	94	30	7535	2.6
<i>Hoolock hoolock</i>	This study	1	80	98	31	6875	2.6
<i>Hylobates agilis</i>	This study	4	75	91	32	5850	2.4
<i>Hylobates muelleri</i>	This study	10	76	91	33	5530	2.5
<i>Hylobates lar</i>	This study	2	85	100	30	5620	2.7
<i>Symphalangus syndactylus</i>	This study	6	77	94	32	11300	2.5
<i>Pan troglodytes</i>	This study	30	67	93	31	44967	2.5
<i>Pan paniscus</i>	This study	6	73	82	31	39100	2.6
<i>Gorilla beringei</i>	This study	7	67	96	34	120950	2.8
<i>Gorilla gorilla</i>	This study	39	64	96	34	126550	2.9
<i>Pongo abelli</i>	This study	8	66	86	30	56750	2.7
<i>Pongo pygmaeus</i>	This study	16	62	82	30	57150	2.6
<i>Aegyptopithecus zeuxis</i> CGM85785; DPC5401, 6642	Ref. 43	3	91	79	29	4649	1.9
<i>Victoriapithecus macinnesi</i> KNM-MB 29100	Ref. 43	1	93	92	31	6000	2.2
<i>Saadanius hijazensis</i> SGS-UM 2009-002	Ref. 43	1	100	91	29	20000	2.3
<i>Ekembo heseloni</i> KNM-RU 2046a1	Ref. 43	1	85	93	32	13933	2.4
<i>Hispanopithecus laietanus</i> CLI 17000	Ref. 43	1	74	91	29	34000	2.3
<i>Rudapithecus brancoi</i> RUD 77, 200	Ref. 43	2	73	98	29	26850	2.3
<i>Oreopithecus bambolii</i> BA208	Ref. 43	1	73	82	28	27429 (22857- 32000)	2.6
<i>Nyanzapithecus alesii</i> KNM-NP 59050	This study	1	66	81	28	11300 (9418- 17900)	2.1

**Supplementary Table 2 | GPS Coordinates of stratigraphic sections and localities shown in Extended Data Fig. 2a.** All GPS coordinates based on the WGS84 datum.

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CSF 2015-1	Base section	2° 58.151'N	35° 52.052'E
	Top section	2° 57.995'N	35° 51.861'E
CSF 2015-2	Base section	2° 57.546'N	35° 52.270'E
	Top section	2° 57.995'N	35° 51.861'E
CSF 2015-3	Base section	2° 58.192'N	35° 52.070'E
	Top section	2° 58.531'N	35° 51.859'E
KNM-NP 59050	cranium	2° 58.129'N	35° 52.046'E
Dating sample	15-NPD-03	2° 57.584'N	35° 52.337'E

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**Supplementary Table 3 | Scanning parameters used for KNM-NP 59050.** The fossil was scanned on beamline ID 19 of the European Synchrotron Radiation Facility (ESRF) in Grenoble, France. Four different voxel sizes were used, and the associated scanning parameters are given here.

	<b>complete cranium</b>	<b>teeth, ear region</b>	<b>Long period lines in teeth</b>	<b>enamel microstructure</b>
<b>Voxel size</b>	28.06 $\mu\text{m}$	12.86 $\mu\text{m}$	3.44 $\mu\text{m}$	0.72 $\mu\text{m}$
<b>Average energy</b>	126.2 keV	140.8 keV	100.8 keV	60.2 keV
<b>Filters</b>	Al 5.6 mm Cu 6 mm	Al 5.6 mm Cu 12 mm	Al 5.6 mm Cu 2.8 mm	Al 2.8 mm Cu 0.35 mm Au 0.14 mm
<b>Propagation distance</b>	13000 mm	13000 mm	3000 mm	300 mm
<b>Sensor</b>	FReLoN 2K CCD	sCMOS PCO edge 5.5	FReLoN 2K CCD	sCMOS PCO edge 5.5
<b>Scintillator</b>	LuAG:Ce 750 $\mu\text{m}$	LuAG:Ce 500 $\mu\text{m}$	GdG:Eu 100 $\mu\text{m}$	GdG:Eu 50 $\mu\text{m}$
<b>Insertion device</b>	W150	W150	W150	U32 / U32
<b>ID Gap</b>	40 mm	42 mm	40 mm	14.3 / 14.3 mm
<b>Projection number</b>	4998	9974	6000	8000
<b>Scan geometry</b>	360°, half-acquisition, double scan	360°, half-acquisition, double scan	360°, half-acquisition, double scan	360°, half- acquisition
<b>Exposure time</b>	0.3 s	0.05 s	0.25 s	0.1 s
<b>Time per scan</b>	26.5 min	10.3 min	26.6 min	15.1 min
<b>Number of scans</b>	24	15	51	36
<b>Total time</b>	10.6 h	2.6 h	22.6 h	9.1h
<b>Reconstruction</b>	phase retrieval	phase retrieval	edge detection	edge detection

## References

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