

The World Records in Asian Elephants

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Summary

I have the biggest database in the world regarding big tusked Asian and African elephants and I discovered the new world record Asian elephant tusks by length and by girth and confirmed the biggest specimens in body and head size.

Asian elephants sport tusks up to 3.3m long, 58cm thick at lip and 75kg in weight, which are of similar length to those of African elephants, but usually slimmer and lighter than those of both African elephants and woolly mammoths. Because Asian elephants are usually smaller than African elephants, their tusks are proportionally longer, and it is much more often that Asian elephants have tusks which exceed or match in length their shoulder height!

Bull Asian elephants from the high-domed, big tusked, robustly built genetic line may reach up to 3.35m at the shoulders and weigh 7.2 tons, being close to the height and mass of the biggest confirmed woolly mammoths. Two of their key features are very high scapulae, up to 100cm, and wide pelvic girdles, up to 142cm.

The biggest Asian elephants have in absolute and relative terms bigger heads and skulls in almost every respect when compared with woolly mammoths and with African elephants. Such monster heads may be on a diagonal from the top of the domes to the tusk at lip almost half of the shoulder height of the elephant (out of which some 135cm the skull alone), wider than those of woolly mammoths and matching the widest heads of African elephants (about 95cm)! Monster skulls present a frontal ridge in the domes area, for the insertion of the massive splenius superficialis muscles, absent in African elephants.

By comparatively studying skulls and tusks of Asian, African and woolly elephants I came up with a formula which says that the maximum tusk length of big tuskers in the three species is about five times the maximum alveoli depth.

Finally, to acknowledge large intra-specific variations, designating an elephant as a “big tusked” should take into account tusk weight and length calibrated to the body size of the elephant. The most impressive big tuskers are the “super tuskers” and those “Plough-the-Earth”.

1. Introduction

Over the years I have accumulated a wealth of knowledge and field experience in iconic megafauna. In fact, I managed to build the biggest databases in the world regarding giants that have captured our imagination, such as big tusked Asian (*Elephas maximus*) and African (*Loxodonta africana*) elephants, big horned black (*Diceros bicornis*) and white (*Ceratotherium simum*) rhinos and big antlered giant moose (*Alces alces gigas*).

To do justice to their commanding presence, in 2020 I published the book *The World As It Once Was*, which is only the tip of the iceberg, a summary of what I wanted to share with

¹ Book author, researcher, inspirational speaker, conservationist, award-winning fine art wildlife photographer. Correspondence should be addressed to dian.balan@gmail.com. I have opted at this stage for the classic footnotes and can adapt references to specific journal requirements.

the world, keeping in mind that I addressed not only specialists, but also a wider audience. This award-winning book enjoyed a warm welcome from the general public, as well as from the scientific and artistic communities.²

The book *The World As It Once Was* brings a significant contribution to comparatively understanding the giants of yesterday and those of today, busting myths and misconceptions. It elucidates, for instance, the fact that while the giant Ice Age deer (*Megaloceros giganteus*) had the antlers with the biggest span, those were not the biggest of any deer by mass, as the giant moose of today matches and even slightly better the Ice Age icon in both body and antlers mass.

The book also presents, for the very first time, the correct comparison between ivory size and certain body proportions of Asian, African and woolly elephants. Because there were still naysayers, I felt compelled to share more and to deepen even further my research, coming up with additional evidence of how glorious the giants of today still are. As a result of this thorough enterprise, I discovered new world records, which is quite surprising and refreshing, as Asian elephants are amongst the most studied animals in this day and time.

My research has important implications for conservation, finding the last iconic individuals left and showing their biodiversity value, while putting that in the historical perspective of the much more common occurrence of such specimens in the past.

Revered as the elephant god, used in labour-intensive forest exploitations and tourist entertainment sites, or still roaming free in isolated pockets of wilderness, Asian elephants are an essential part of South Asia's cultures. Only bull Asian elephants may grow huge tusks, while cows have small incisor teeth called tushes.

Because of the shifting baseline syndrome, we tend to think that Asian elephants have much smaller ivory than they were originally designed by Mother Nature. This is not correct. This is the result of 3500 years of human-made reverse selection, the opposite of natural selection, by selectively catching tuskers from the wild and not providing them with opportunities to perpetuate the species in captivity, by unsustainable hunting, poaching and habitat encroachment.³

In addition, the bad habit of trimming the tusks of captive elephants throughout their natural range countries means that possibly hundreds of big tuskers have passed unnoticed.⁴

² The book can be ordered also on Amazon and profits are donated to save iconic megafauna (<https://www.amazon.co.uk/World-As-Once-Was-Gloriously/dp/2805205901>).

³ George Dian Balan, *The World As It Once Was: The Shifting Baseline In Iconic Megafauna*, Ancient Origins, November 2021, <https://members.ancient-origins.net/articles/megafauna>; Raman Sukumar, *Elephants, Empire and Ecology in Ancient India: Capture of Elephants* (min 35:49 - 38:53), Adventures in Archaeology, June 2020, https://www.youtube.com/watch?v=k_BTecAE2EQ.

⁴ For instance, if one would look today at Indian big tuskers Santosh (Mudumalai camp) and Suraj (Wildlife SOS camp) one could not tell that before their tusks were unfortunately sewed they literally touched the ground! Conversely, Thai big tusker Kham Mueang, the bearer of the most handsome tusks of all elephants alive on Earth at the time of writing this article, would not have looked that impressive if his tusks were trimmed by his current owner (his tusks were kept very short while working in forest exploitations in Northern Thailand).

Indeed, long tusks in Asian elephants are, and especially *were*, not as rare as one may think. I have so far counted some 35 elephants with at least one tusk over 2.5m long out of about 140 elephants with at least one tusk over 2m long! For comparison, the Rowland Ward records of Big Game mention only about 20 specimens of Asian elephants with ivory over 2m long.⁵

This study confirms that bull Asian elephants sport ivory of almost the same length as their African counterparts. Furthermore, the giant Asian elephants from the robustly built body type have bigger heads in almost every respect, in both absolute and relative terms, than big African and woolly elephants of the same shoulder height.

The methodology used to collect and analyse data is explained in each section. In addition, there is a separate section at the end dedicated to certain methodological considerations.

2. The longest tusks

2.1. The New World Record

I discovered the longest recorded Asian elephant tusk, which belongs to Raja the Great, an Indian elephant originating from Karnataka (Mysore area).



Jean Kern

I first wrote to the Riga Zoo in 2018 and asked about Raja's tusks and body measurements, as well as for access to personally measure his preserved skull and tusks. While I received partial measurements, I was not granted the permission to personally examine the specimen.

After a change in the management of the Riga Zoo, I re-submitted my request in 2022. I received a favourable answer, so I travelled and took comprehensive in situ measurements of the skull and the tusks. On that occasion, I could note that the tusk measurements received in 2018 were erroneous, as they only concerned the part of the tusks outside of the huge skull (2.61m and 1.49m respectively). By examining cracks in the alveoli, I noticed that the tusks are in their anatomical position, and not only slightly inserted in the sockets, like in the case of most mammoths displayed in natural history museums.

⁵ Rowland Ward Records of Big Game, 2016, p. 325.



Therefore, I could already note that the left tusk is the new all-time world record by length and I asked for the permission to take the tusk out of the skull and properly measure it. The request was promptly granted and together with the young and dynamic team from the Riga Zoo I celebrated my birthday in 2023 by properly measuring this impressive tusk.

Raja's left tusk is **3.26m** on the outer curvature and has a mass of 48kg dried weight (possibly up to 53kg fresh).⁶ Both tusks are moderately thick (43cm at the lip).⁷

Unfortunately, Raja got injured as result of an accident in 2011, when he was pushed by playing females into the trench surrounding his enclosure at the Emmen zoo, occasion on which he broke over 1m of his right tusk.⁸ The remaining part of the tusk is about 2.14m long, meaning that the total length of the right tusk was similar to that of the left tusk. Raja was euthanized in October 2013.

I am helping create a genetic database with DNA samples from Asian big tuskers, both alive and who already passed away, and Raja the Great is the first that we try to sequence. I am

⁶ To understand the difference between fresh and dried tusk mass, I weighed myself the top biggest tusks in the possession of the Karnataka Forest Department, coming from elephants which passed away at least one year before my visit. On that occasion, I could note a tusk weight loss up to 6.6% from the initial records (in the case of a tusk from a wild elephant which passed away 13 years before). As tusks are made of dentine in proportion of 95% (Baker B, Jacobs R, Mann M, Espinoza E, Grein G., *CITES identification, Guide for Ivory and Ivory substitutes*, editor Allan Crawford, 4th ed., CITES Secretariat and World Wildlife Fund, p.14, 2020), and about 10% of this tissue is water (Driessens FCM, *The mineral in bone, dentin and tooth enamel*, Bulletin des sociétés chimiques belges, 89(8):663–689, 1980, doi: 10.1002/bscb.19800890811), that means that after a longer drying period the mass of a tusk may diminish by up to 10%.

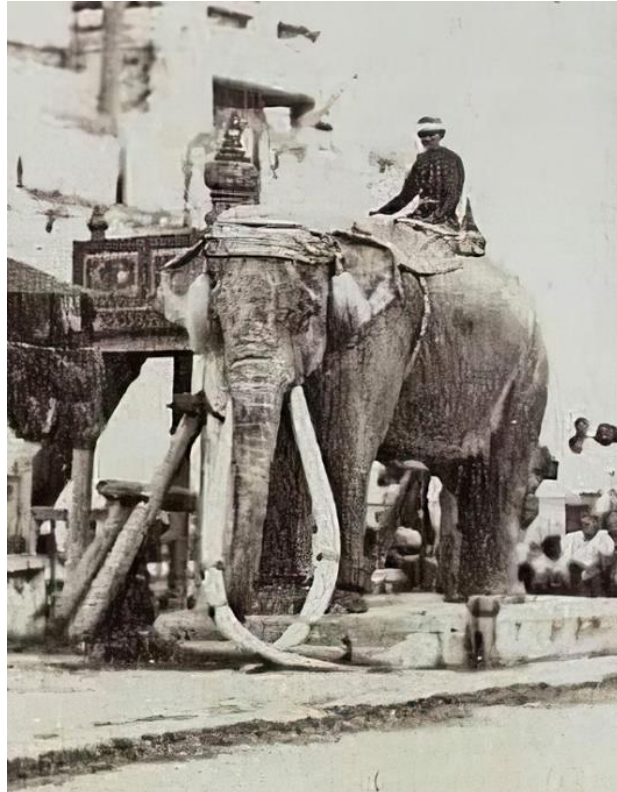
⁷ I presented this discovery on the occasion of the 19th International Elephant Conservation and Research Symposium, 14 November 2023, Chiang Mai, Thailand, in the Elephant Genetics section: *The longer, the healthier: A new world record Asian elephant tusk* (https://elephantconservation.org/wp-content/uploads/2023/11/IEF2023General-Info_7Nov.pdf) and at the conference *Elephants & Tusks: Morphology and Science of Measurements*, delivered on 25 November 2023 for Friends of Elephants (India) (<https://youtu.be/Z9-31NrHtmo?si=y1jESwFiuE6Lt42>).

⁸ The incident was recorded by eye-witnesses and posted as part of multiple videos on the Internet. See e.g. RTV Drenthe, *Dierenpark laat olifant Radza inslapen*, 2 October 2013, <https://www.youtube.com/watch?v=DvaJEhIANLA>.

working on this project with Colossal,⁹ an initiative by George Church from the Harvard genetics lab.¹⁰ By taking DNA samples and breaking the big ivory codes it is hoped to create a genetic reserve for Asian large ivory carriers. This may help also gather the last pieces in the genetic puzzle of a cold-adapted elephant, a hybrid between Asian elephants and woolly mammoths, which could benefit from vast Arctic spaces in sparsely populated areas.

2.2. The former world record

As numerous authors cited a tusk which belonged to the Royal Thai elephant Chao Phraya Prapubkarn (เจ้าพระยาปราบไตรจักร) (circa 1880) as the longest recorded in Asian elephants,¹¹ I wanted to take my own measurements.



Because he was a Royal elephant, the approval procedure was quite elaborated. First, I had to reach to my country's Ambassador to Thailand to support my application with a letter addressed to the Lord Chamberlain of the Thai Court. Then, I had to fill in several documents and submit the whole application to the Thai National Research Council. After several months, the request was approved and the National Museum in Bangkok was instructed to help me with the research.

⁹ <https://colossal.com/>.

¹⁰ <https://wyss.harvard.edu/team/core-faculty/george-church/>.

¹¹ H. M. Smith, *Large tusks in a Siamese elephant*, J. Nat. Hist. Soc. Siam, 8(2):121, 1930.



Chao Phraya Prapubkarn's right tusk is **3.01m** along the outer curvature, 38cm in circumference at lip and presently weighs 45kg (the fresh weight was probably up to around 50kg). The left tusk is 2.70m long, and weighs 44kg for the same girth. Both tusks have short pulp cavities (33.5cm and 27cm respectively), which helps explain the great mass for their circumference.

The pair of tusks of this amazing elephant is presently stored at the National Museum in Bangkok, after the Changton Museum was discontinued.¹²

2.3. Other very long ivory

The Indian tusker Bonbay sports almost 3m long tusks. According to the Kanazawa Zoo officials, his tusks broke / were shortened by 80cm in the past, which means that this average body-sized elephant has already grown over 3.5m of tusks during his lifetime!



¹² The former Changton Museum, presently physically inexistant, can still be visited online at: <http://www.virtualmuseum.finearts.go.th/changton/index.php/en/> (last accessed on 20 March 2024).

As per my own research, I have recorded so far about 35 Asian elephants with at least one tusk in the range of 2.5m – 3.3m. Almost all of them are crossed tuskers and most of them are super tuskers by length, meaning that their tusks length matches or exceeds their shoulder height. It is well known that curved tusks grow longer than straight tusks, even more so if the curved tusks do not grow down (Plough-the-Earth) but only forward and therefore suffer from less wear.¹³

In addition, I have on my list about 100 elephants sporting ivory in the range of 2m-2.5m. The shape of these tusks varies from dead straight (e.g. Millangoda Raja) to slightly curved or very curved, and from pointing downward to frontward and upward. I intend to publish another study where I will describe in much more detail the longest, thickest and heaviest ivory in Asian elephants.

3. The thickest and heaviest tusks

3.1. The New World Record

The new World Record I discovered is the left tusk of an elephant called Manissery Rajendran which has a staggering circumference of **58cm** at the lip. Manissery Rajendran is a 51-year-old elephant, alive, born in the wilds of the Indian state of Karnataka and presently owned by a private person in the Indian state of Kerala.

The constructed weight of this left tusk, based on a normal length of about 2.5m¹⁴ and on known weights of other big Asian elephant tusks, should slightly surpass the weight of the 56cm thick tusks from Nepal (see below) and could reach as much as 75kg.

The right tusk measures only slightly less (57,5cm) and would normally also reach a record weight for the species, given that close to the trimmed tip the tusk is still 50cm in girth.



¹³ See also *Report from Dr Johan Marais on Duke's tusk record consideration*, October 2011, Kruger National Park, <https://www.sanparks.org/wp-content/uploads/2021/03/duke-tusk-record.pdf>.

¹⁴ I constructed the normal length of Manissery Rajendran's tusks by adding the approximate part in his rather large head (about 70cm), the tusk from lip to tip (about 1.20m) and the distance from behind the tip to the ground, following the tusk line when the elephant keeps his head in resting position (about 60cm).

This super tusker participates in numerous weddings, temple and village festivities.¹⁵ During all these events elephants are required to lift their heads and there is a wrong belief that tusks have to be periodically trimmed so that they do not become too heavy for the elephant to perform the movement. This is scientifically wrong, because Asian elephants are designed with an additional pair of skull & neck muscles, called splenius superficialis, which help raise their enormous heads.

However, this misconception persists and the only way to see these world record size tusks in all their glory would be to allow them to reach full size and to stop trimming them. This would mean finding an alternative financing ensuring revenues of 110,000 euro per year to the owner, which may be possible via a well-orchestrated crowdfunding, coupled with tourist visit fees.

3.2. The former world record(s)

For more than 100 years, the greatest recorded circumference was the Rowland Ward World Record Asian elephant tusk (by weight), which belonged to King George VI and was presented to him in 1911 by the Prime Minister of Nepal. After I did investigations and found out that the tusks were not recorded in the Royal Archives, I discovered that the pair is presently hosted by the London Natural History Museum. The elephant was hunted north of Kheri District, Naya Mulk, near Rajghat Terai Jungle, Bheri, Mid-Western Nepal. The biggest of those tusks is the left tusk, which measured 56cm maximum girth, 2.67m in length, and used to weigh a massive 73kg.



The original tusks of the world record Bilkandi elephant were not kept with the skeleton, as they might had been sent elsewhere after the elephant was hunted. So their whereabouts are not known. By measuring the replicas inserted in the skull and the alveoli, it looks like

¹⁵ Locals familiar with the tusker entertainment industry explained to me that Manissery Rajendran's fees are about 3,300 euro/ pooram (festival) participation for a total of 50-60 rentals per season/ year, translating into a net profit for the owner in the range of 110,000 euro per year, after deducting some 60,000 euro costs.

the maximum girth of those tusks was in the range of 56cm (54,5cm at the lip)¹⁶ and they were about 2.7m long. Coincidentally, the girth and length of the replicas coincide with the 1911 Nepalese tusks presently stored in the London Museum of Natural History.

In addition, I was told by an old biologist that the Corbett National Park Museum used to display a pair of very thick tusks, one shorter (broken) and the other one quite long, weighing 72kg. I could not further verify this information and would be grateful for more details, including images and the exact length and circumference of those mighty tusks.

3.3. Other thick and heavy ivory

While Asian elephants consistently produced very long tusks throughout their entire historical range, it seems that thick and heavy ivory originated mostly from India and Burma. This conclusion is based on my personal measurements and observations, on historical databases like the Rowland Ward Records of Big Game and on the most comprehensive research on captive Indian elephants' ivory size to date.¹⁷

Small-bodied elephants from Thailand, India and Sri Lanka usually sport ivory not exceeding 35cm - 39cm girth at lip, which looks quite impressive relative to their size and makes people think that those tusks are actually thicker, especially in the case of mature and older bulls, when the ivory is of quite constant circumference along most of their length.

However, in absolute terms thicker tusks for the species can be considered those about 45cm in circumference or more, which would be comparable to the lower-end girth for African and woolly elephant big tuskers.

In India, such tusks adorned elephants from the Terai in the North to the warmer jungles of the present-day Karnataka. Astoundingly, such sizeable tusks occurred in elephants of average to world record body size. I have identified so far about 50 Indian bulls with a tusk circumference of 45cm - 53cm, of which several are still alive.

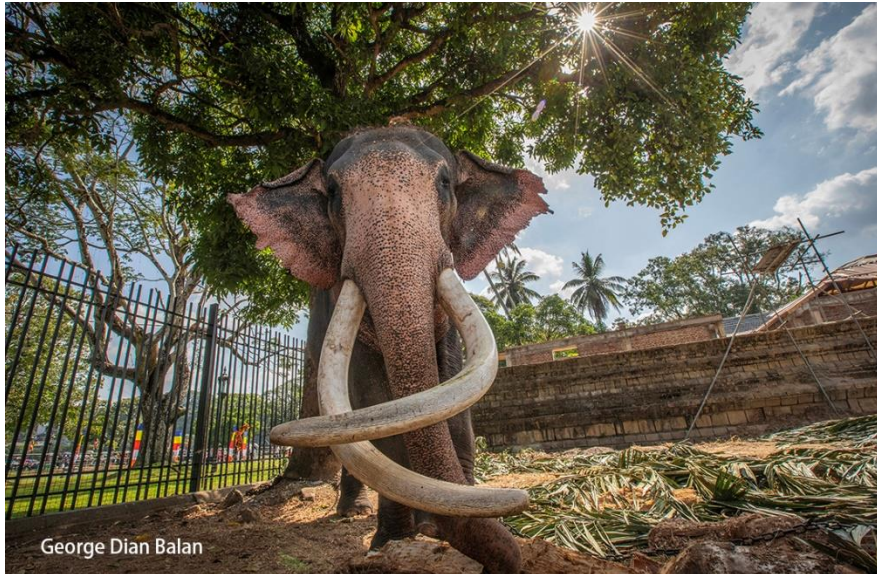
I find it interesting that small to average sized Burmese elephants have consistently produced thick ivory, from the time of the white elephants and of Elephant Bill to the present day, when the last Myanmar big tuskers are captive in two locations in Sri Lanka.

Perhaps the most famous Burmese bull from the past is a white elephant known as Nivana Pitsaya Naga Raja from 1857, who appears in numerous drawings and paintings, and whose 44.5cm thick tusks are on display in the Yangon Elephant Museum, after being repatriated from the UK.¹⁸

¹⁶ T. Benthams, *Mammals - Measurements of the skeletons of two large Indian elephants in the collection of the Indian Museum*, Records of the Zoological Survey of India, 2(3), 303-303, 1908, <https://doi.org/10.26515/rzsi/v2/i3/1908/163339>.

¹⁷ See Varma, S., Eswaran, E.K., and Sujata, S.R., *Selection of specific age and sex of Asian elephants in captivity as cultural and economic identity; Investigations into status, population demography, decline and the future of captive elephants in Kerala*, CUPA/ANCF- Occasional Report 13, Compassion Unlimited Plus Action (CUPA) and Asian Nature Conservation Foundation (ANCF), Bangalore, India, 2010. More details were obtained through correspondence with the authors.

¹⁸ They are also recorded in Rowland Ward at position no. 4, with weights of 46,3kg and 44,3kg and lengths of 2.22m and 2.21m.



Kotte Raja, an elephant of small to average body size, is one of the most impressive living Myanmar big tuskers, sporting 2.30m long tusks with a girth at lip of 48cm and an estimated weight of close to 50kg per side.

4. Tusk size comparison with woolly and African elephants

4.1. Comparison with woolly mammoths

I have taken the woolly mammoths as a point of comparison because (i) they were contemporary with modern humans, disappearing only about 4000 years ago, (ii) their fossil record is the richest of any extinct proboscidean, (iii) their tusks were the biggest of any elephant, at least relative to their body size and (iv) they are close relatives of the Asian elephants.

Unfortunately, when it comes to several morphological aspects, including ivory size and shape, Asian and African elephants are usually downplayed, while mammoths are always augmented. That is not scientifically correct.¹⁹ For example, only older female mammoths, possibly matriarchs, sported long (up to 2.4m), but thin ivory, in a similar way that certain African elephant females do. However, in almost every painting or museum exhibit female mammoths are depicted with not only long, but also thick ivory, a characteristic found only in certain males. What is more astonishing is that even three-year-old mammoth calves are sometimes represented with sizeable ivory, which was not the case at that very young age. Finally, getting to the bull mammoths, only big tuskers in their prime sported the characteristic, so well-known big ivory.²⁰

¹⁹ See George Dian Balan, 2021.

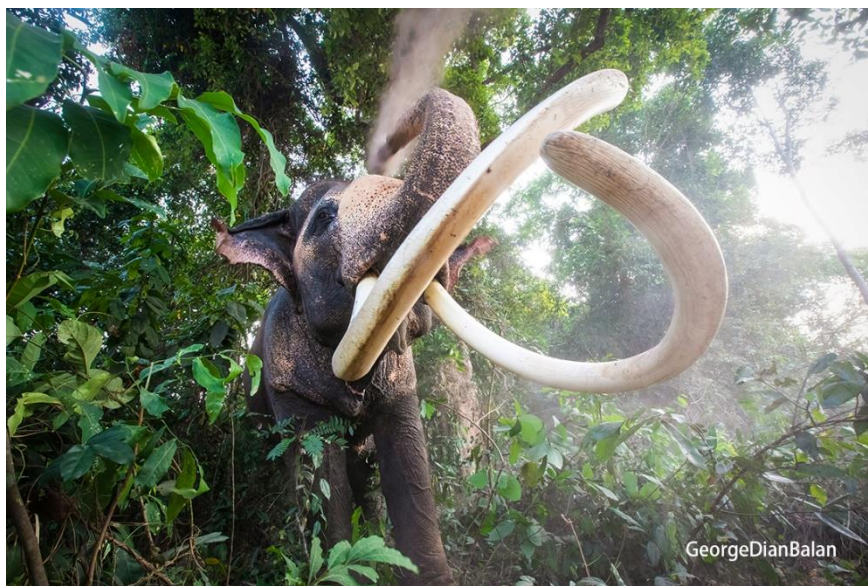
²⁰ For instance, *Science* (Volume 373, Issue 6556, 13 August 2021: <https://www.science.org/toc/science/373/6556>) published a study on a 30-year-old male's movements, on the basis of a 1.70-meter-long tusk. However, the cover of the journal is illustrated with a bull 20 years older, with tusks two times longer and several times heavier. Probably this is what the public expects from a bull woolly mammoth after all. To match that, it would mean that each time there is news about no matter which Asian or African elephant, we should see just images of 2.5m-3m long tusked bulls. That is not the case. There is a huge asymmetry in representation.

As a result of the propagation of such exaggerations, there is a widespread misconception that Asian and African elephants have much smaller ivory than the woolly mammoths. True, woolly mammoths had the biggest tusks relative to their body size, and even in absolute terms some of the biggest amongst all known proboscideans. But Asian and African elephants also sport some of the biggest ivory in elephant evolution relative to their body sizes!

The mentioned misconception is due to the human-made reverse selection, the opposite of natural selection, which gradually eliminated the big tusk genes during the last 3500 years, coupled with the bad habit of trimming the tusks of captive Asian elephants.

Asian elephants with very long ivory are in almost all cases crossed tuskers, sporting strongly curved ivory, similar to a good extent to that of the woolly mammoths. However, mainly due to a different preferred environment (jungles vs the open mammoth steppe), the maximum spread in Asian elephants rarely exceeds 80cm,²¹ exceptionally reaching 110cm or more, while in woolly mammoths the maximum spread usually ranged between 130cm (Jarkov, Haltern²²) and 170cm (Yukagir).²³

Also similarly to woolly mammoths, Asian elephants are much more often than African elephants super tuskers by length, defined as elephants sporting ivory matching or exceeding in length the shoulder height of the elephant.



Robustly built Cit is adorned with 2.5m long mammoth-shaped tusks for a shoulder height of only about 2.5m.

Woolly mammoth big tuskers sported very long ivory. A comprehensive analysis of the size of the biggest tusks found in the territory of Yakutia and Taimyr (Siberia) concluded that

²¹ This average maximum tusk spread coincides with the average maximum head width of these bulls, which facilitates advancement in the jungle.

²² Arno Heinrich, *Ein Mammutschädel von Haltern/Westfalen*, 1978, p. 40.

²³ Dick Mol et al., *The Yukagir Mammoth*, Scientific Annals, School of Geology, Aristotle University of Thessaloniki (AUTH), Special volume 98: 299-314, 2006.

“throughout the period 55,000–11,500 years ago, male mammoths ...[had] tusks reaching a length of 300–350cm along the outer curvature and weighing up to 75kg”.²⁴

The longest tusk of a Siberian woolly mammoth was allegedly found along the Kolyma River and measured 4.20m in length and weighed 84kg.²⁵ According to the fossil trading company The Curator's Eye, the longest Alaskan woolly mammoth tusk they handled measures 4.37m and weighs approx. 111kg. Together with its pair, the two tusks weigh approximately 210kg (465lbs.),²⁶ matching the heaviest preserved pair in African elephants.²⁷

But a more frequent tusk length ranged between 2m - 3m. One well studied example is the Jarkov mammoth. His right tusk is 2.94m on the outer curve and has a maximum circumference of 45.5cm, weighing 45kg, while the left tusk is 2.98m, has a maximum girth of 45.8cm and weighs 47kg.²⁸

As we will see below, European woolly mammoths were bigger in body and head size than their Siberian and Alaskan counterparts. However, it seems that their tusks were shorter (but not slender) than those of the Siberian and Alaskan mammoths.

Indeed, the longest woolly mammoth tusks pair ever found in Europe seem to have reached 3.50m in length and 47cm in girth, coming from the North Sea.²⁹ Other long, beautifully curved tusks were found at the exceptionally rich site Ripiceni-Izvor in Romania, such as a

²⁴ Gennady Boeskorov et al., *Big tuskers: Maximum sizes of tusks in woolly mammoths – Mammuthus primigenius (Blumenbach) - from East Siberia*, Quaternary International 537: 88 - 96, 2020. However, the weight of some of the tusks analysed in the study is not reliable, as they are *much* heavier than any other elephant tusk of that length and girth. For instance, the Yukagir mammoth tusk could not weigh 75kg at 45cm in girth and 3.16m in length, even if having a small pulp cavity(?), but rather some 15-20kg less if we consider (i) the left tusk identical in length and girth of Shawu, one of the Magnificent Seven (3.17m, 45cm girth for 52.7kg: <https://www.sanparks.org/conservation/parks/kruger/letaba-elephant-hall/big-tuskers/the-magnificent-seven>) and (ii) the observations below on excess water in tusks found in the permafrost.

By way of example, a mammoth tusk initially weighing 52kg and presenting very large cracks shrank by 11,7kg once reverting to the normal shape (as confirmed by the size of the cracks). Similar weight loss was noted on other occasions (personal communication with Dick Mol). This means that fresh mammoth tusks taken from the permafrost lose about 22.5% of their mass to dry, which is not natural. Indeed, I have already explained that a fresh Asian elephant tusk may theoretically lose much less, up to 10% when drying up. Therefore, when the weight is taken immediately after the mammoth tusk is discovered in Siberia or Alaska, it is not reliable and has to be adjusted downwards. See Blacktail Studio, *Mammoth Tusk Restoration*, 6 July 2023, at mins 1:21, 8:10 and 8:15 (<https://www.youtube.com/watch?v=bhj33-ZhTFA>).

²⁵ Adrian Lister, Paul Bahn, *Mammoths: Giants of the Ice Age*, University of California Press, 2007, p.81. I could not find any picture of that tusk, and it seems that it is not preserved and cannot be verified. See also Gennady Boeskorov et al., 2020, p. 90.

²⁶ Pictures and measurements of those tusks are no longer available on the Internet, but I saved that information and keep it in my database.

²⁷ Independent examination of these tusks was not possible.

²⁸ Dick Mol et al., *The Jarkov Mammoth: 20,000-Year-Old carcass of a Siberian woolly mammoth Mammuthus primigenius (Blumenbach, 1799)*: 305-309, 2001.

²⁹ <https://timevaultgallery.com/mtx001-investment-largest-11-5-foot-tusk-pair-fossil-woolly-mammoth-tusks/>.

pair of tusks both around 3m and another tusk measuring 3.10m.³⁰ The Haltern mammoth, described below, sported tusks 3.10m and 2.97m long, 54cm and 55cm in circumference.³¹

The thickest tusk belonging to a European woolly mammoth comes from the North Sea and was measured by Dick Mol and myself, having a maximum circumference of 66cm, presently on display at the Historyland Museum.³²

Therefore, woolly elephants sported tusks up to 4.4m long, 66cm in girth and over 110kg, while Asian elephants grow tusks up to 3.3m long, 58cm in girth and 75kg.

4.2. Comparison with African elephants

In both Asian and African elephants the longest tusks are not always the heaviest, as weight depends a lot on the circumference. The longest African elephant tusk measured 3.49m and weighted around 66kg, and there are some other 14 bulls with at least one 3m long tusk that I am aware of.³³ The longest tusks are normally curved inwards and the tips overlap/cross each other, similarly to the longest tusks ever recorded in Asian elephants and woolly mammoths, as straight tusks growing downward wear out more readily.³⁴

According to Rowland Ward's records, the heaviest tusk of an African elephant weighed an astonishing 236lb (107kg), while unverified sources quote an even heavier, 258lb (117kg) tusk. Such tusks are about as heavy as the heaviest woolly mammoth tusks ever unearthed and about 50% heavier than the heaviest Asian elephant tusks found. Tony Sanchez-Ariño counted 150 African elephants with at least one tusk weighing 60kg³⁵ and I am aware of about 10 more African bulls "130 pounders" not mentioned in that study.

To recall, Asian big tusked bulls were selectively taken out from the wild and isolated in captivity, without any passing on of their genes, for the last 3500 years, and only during the last 150 years or so affected by hunting, while African elephants in general were affected by the ivory trade since antiquity, but more seriously since the 1400s, with hunting targeting the big tuskers in the last 150 years. As a consequence, before poaching and human-wildlife conflict kicking-in, the African elephant population dropped by the millions. African elephant ivory was commonly used for sculptures or consumer goods such as combs, piano keys and billiard balls and a lot of big tusks ended up cut into smaller pieces.

³⁰ Alexandru Păunescu, *Ripiceni-Izvor paleolitic si mezolitic. Studiu monographic*, Romanian Academy, 1993, pp. 55-57 and 71.

³¹ Measurements provided by Asier Larramendi.

³² <https://historyland.nl/>. See George Dian Balan, *How Big is Big? On Asian, African and Woolly Big Tuskers*, Cranium, 2020, p. 113.

³³ Most of these bulls are also mentioned by Tony Sanchez-Ariño, *Africa's Greatest Tuskers*, Volume 84, Safari Press Classics, 2015.

³⁴ George Dian Balan, *The World As It Once Was*, Graphius, 2020, p. 143.

³⁵ Tony Sanchez-Ariño, 2015.



Millions of kilograms of ivory were sent from Africa to Europe and America at the beginning of the last century, the London Ivory House becoming a symbol of the ivory trade.

Asian elephants have been around one tenth to one twentieth of the population of African elephants for the last 100 - 150 years, period for which tusk size data could be collected. So, to have a proper comparison, the about 140 Asian long tusked elephants I have identified so far should be compared with 1400 - 2800 African elephants. In both cases, the number of long tusked elephants must have been much higher than the ones we keep a trace of, but most of the big tuskers were probably never recorded.

Asian elephants sport ivory of pretty much the same length (up to 3.3m) as African elephants (up to 3.5m), but usually lighter. The great length of the Asian tusks, which more often than in the case of African elephants exceeds the shoulder height of their bearers is mainly explained by the more pronounced curvatures of the Asian tusks, which grow to overlap themselves much more often than in their African counterparts. As already mentioned, almost all of the 35 Asian elephants with tusks in the range of 2.5-3.3m long are crossed tuskers.

5. The tallest and heaviest

Today, the biggest Asian elephants generally come from the Himalayan foothills and adjacent areas to the South. However, it needs to be recalled that tropical regions are not like the Arctic freezer, where one can take out from time-to-time entire woolly mammoths and study them. The preservation of skeletons, including of skulls and tusks, is much more difficult and very rare.

There are various mentions of the so-called Syrian elephants, allegedly the biggest subspecies of Asian elephants, extinct during antiquity. Those claims are controversial and could not be verified for now.

5.1. Ex-aequo world records (3.35m)

5.1.1. The Bilkandi tusker

In May 1870 W. M. Smith shot a huge tusker in every respect (body, head and tusks) in an area called Bilkandi, Nia Dumka, Santal Parganas and his skeleton was presented to the

Indian Museum, where it continues to impress visitors with its stature.³⁶ As mentioned above, the fate of the original tusks is not known, and my measurements are based on the existing replicas.

I measured the shoulder height of the Bilkandi skeleton in anatomical position and it was 3.18m for the left front leg. As the manus is incomplete, we measured the manus height to the ulna, which is 45cm, normal for an elephant of that size. This means that the animal alive was about 5.5% higher,³⁷ giving a total shoulder height in flesh of around 3.35m.



While the humerus (104cm) and femur (123cm) are only slightly bigger than those of elephants having a shoulder height of almost 3.2m (like Siam, see below), the **scapula** is enormous even in comparison to that of Siam (90,3cm), measuring 100cm! This may be key to the understanding of the tallest robustly built Asian elephants, as they get proportionally higher in this particular anatomical segment.

Coupled with the fact that the maximum horizontal width of the **pelvic girdle** is a good 142cm, on a par with the very big European woolly mammoths of a similar height,³⁸ this suggests a great body volume and mass, which for an individual of this shoulder height would be over 7.2 tons at the maximum body condition, when the bull bulks up before entering musth!

Therefore, contrary to what has been previously believed, woolly mammoths did not have proportionally wider bodies than Asian elephants when we consider for comparison the

³⁶ T. Bentham, 1908, *idem*.

³⁷ Asier Larramendi, *Shoulder height, body mass, and shape of proboscideans*, *Acta Palaeontologica Polonica* 61 (3): 537–574, 2016, p. 540.

³⁸ The maximum horizontal width of the pelvic girdle of a composite skeleton exhibited at Historyland is 141cm (personal communication with Dick Mol). The biggest of the Condoover woolly elephants (G.10744 þ G.10743) measured 143cm in the same anatomical segment (Adrian Lister, *Late-glacial mammoth skeletons (Mammuthus primigenius) from Condoover (Shropshire, UK): anatomy, pathology, taphonomy and chronological significance*, *Geol. J.* 44: 447–479, 2009, p. 455).

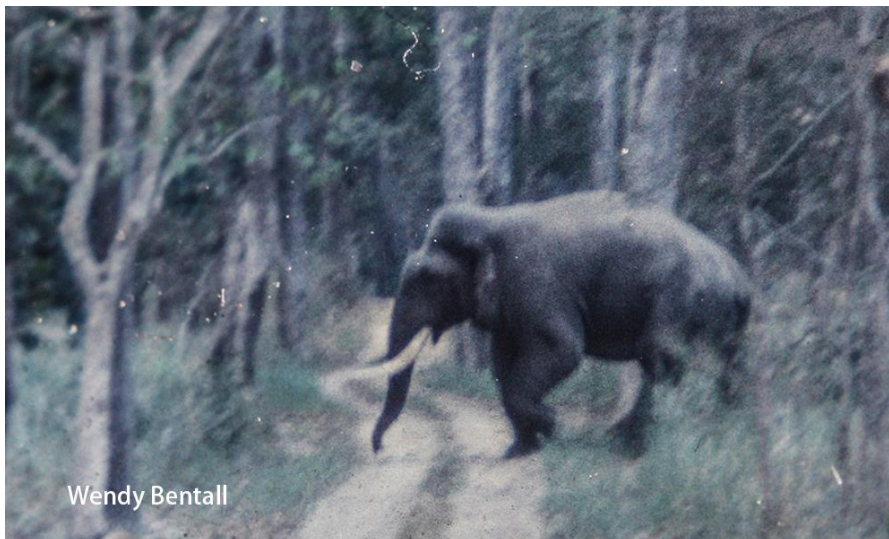
very big Asian elephants from the robustly built line versus the very big European woolly mammoths.³⁹

As we will see in the next section, the Bilkandi specimen has also the biggest head in both absolute and relative terms in comparison to even taller African elephants and to the similarly-sized very big European woolly mammoths!

5.1.2. Raja Gaj

Thirty years ago, reports of jungle mammoths emerging from the mists of time captured everybody's imagination. Adventurers, scientists, journalists, all went in search of the beasts with sloped backs and high domed heads. John Blashford-Snell and Adrian Lister followed Raja Gaj (King Elephant) in Bardiya National Park, Nepal, which the bull called home until his disappearance around 2007.⁴⁰

Adrian Lister measured the diameter of Raja Gaj's front footprint to be 57cm.⁴¹ By applying the usual front foot to shoulder height formula (multiplication by 6 times) this gives a shoulder height of 3.42m. I attempted to double check that against the only side view picture of the elephant I could find showing the entire body, including the feet, but the low resolution made any definitive conclusion not possible.



So, I looked for any circumstantial evidence to help me solve Raja Gaj's true height puzzle.

First, I noted that Raja Gaj was frequently seen in the company of another high domed, robustly built bull called Kancha, who was probably 10 years younger. Based on the measurements of Kancha's humerus (99cm) and scapula (86cm), it resulted a shoulder height of around 10 feet in flesh (3.05m),⁴² which is less than the shoulder height derived

³⁹ The maximum horizontal width of the pelvic girdle of other very big Asians is also within the same range. For instance, in the case of Chengalloor Ranganathan it is 140cm.

⁴⁰ George Dian Balan, *The World As It Once Was*, p. 130.

⁴¹ See Adrian Lister, John Blashford-Snell, *Exceptional size and form of Asian elephants in western Nepal*, *Elephant*, 2(4): 33-36, 2000, p. 35.

⁴² Postcranial measurements provided by Adrian Lister and confirmation of reconstruction by Asier Larramendi.

from his front footprint size (3.18m based on an antero-posterior forefoot diameter of 53cm).⁴³

Then, I compared pictures where Raja Gaj and Kancha were close to each other:⁴⁴ it resulted a shoulder height of about 3.35m for Raja Gaj, similarly to the Bilkandi tusker.

As one can notice by corroborating the Bilkandi tusker skeletal measurements and the pictures of the robustly built Raja Gaj, the tallest individuals in Asian elephants are also amongst the most robustly built. It is worth also recalling that both individuals were wild and both sported record size or big ivory: the Bilkandi tusker bore tusks about 2.7m long (as per the replicas) and some of the thickest of the species, at about 54.5cm-56cm in girth, while Raja Gaj's tusks were about 2m in length (out of which 1.3m from the lip to the tip, and almost 80cm inside the head).

5.2. Unconfirmed giants

In the past, reports of such big sized elephants came from a stretch of 2000 km in the Himalayan foothills, from Jim Corbett and Shuklaphanta (White Grass) National Parks in the west, through Sonpur to the Garo Hills of Assam in the east. Based on their front foot circumference, several bulls in the range of 3.3-3.4m tall at the shoulders were described.

Peter Byrne made famous Tula Hatti (Great Elephant) from the Shuklaphanta National Park (White Grass Plains, Nepal), where the bull found his end in 1995, stepping on a landmine intended for wild boar. He was estimated to be close to 3.4m tall.⁴⁵

The following huge specimens are mentioned in the 1983 *Guinness Book of Animal Facts and Feats*:

- a single-tusked bull shot by the Maharajah of Susang in the Garo Hills, Assam, India in 1924 which, on the evidence of its forefoot circumference, measured an estimated 11ft 3in 3.43m at the shoulder. This fabulous animal had been lured into a stockade, and was killed as it attempted to break out;
- a bull shot by Lalji Kumar of Gouripur in the same area in 1945 measured 11ft 3.4m (circumference of forefoot 5ft 6in 1.68m);
- on 21 May 1965 Duncan Hay shot a very large tusker near the Reserve Forest, Lakhimpur, Assam which stood 10ft 11in 3.33m (circumference of forefoot 5ft 5in 1.66m);

⁴³ If Raja Gaj and Kancha have a similar foot size to shoulder height ratio, then it means that Raja Gaj's shoulder height was 3.28m. But it is well known that there are individual variations within a given population.

⁴⁴ I used for comparison two pictures taken by Jack Picone during his several-week Bardiya expedition. In the first image ([in-search-of-raja-gaj-raja-gaj-and-kancha-stand-out-as-different-because-A2WM28.jpg \(1300x949\) \(alamy.com\)](https://www.alamy.com/in-search-of-raja-gaj-raja-gaj-and-kancha-stand-out-as-different-because-A2WM28.jpg)), Raja Gaj and Kancha are both in the tall elephant grass: while one cannot see their feet and it may be that the ground was not perfectly even, Raja Gaj is the taller bull by about 30cm. The second picture is taken when the two bulls (in the company of two other younger and smaller bulls) get out of a river after crossing it: while the two mature bulls seem to not have crossed in Indian file, but close to each other, one can note on their bodies the water level: Raja Gaj is about 30cm more drier than Kancha, while the two smaller bulls are completely wet, sign that the water was over 2.5m deep ([in-search-of-raja-gaj-raja-gaj-is-spotted-in-distance-with-male-colleague-A2WM20.jpg \(1300x949\) \(alamy.com\)](https://www.alamy.com/in-search-of-raja-gaj-raja-gaj-is-spotted-in-distance-with-male-colleague-A2WM20.jpg)).

⁴⁵ Adrian Lister, John Blashford-Snell, 2000, p. 35.

- in June 1950 H Mant shot an elephant in a Sri Lanka swamp, which had a forefoot circumference of 6ft 1½in 1.87m; normally this would be equal to a shoulder height of 12ft 3in 3.73m, but [...] swamp-dwelling elephants often have disproportionately large feet because of the nature of their habitat.⁴⁶

While these elephants were undoubtedly of very big size, relying just on forefoot circumference is questionable, as there is a wide degree of intra-specific variation, the ratio ranging from 1.74 to 2.18, some bulls having proportionally smaller or wider feet than the average ratio of 2.⁴⁷ That is why it is always better to rely on additional evidence, such as side view pictures taken at mid-height⁴⁸ and/or complete skeletons.⁴⁹

Today, only a handful of such massively built bulls survive in areas such as Bardiya/Dudhwa at the Indo-Nepalese border and the Dooars forest (Gorumara National Park), at the Indo-Bhutanese border. While they usually reach just a little bit above 3m at the shoulders, the biggest bulls may still be close to the maximum recorded size, like a bull recently photographed in the mentioned region of northern West Bengal.

5.3. Very big individuals (3.15m - 3.30m)

5.3.1. Chengalloor Ranganathan

Chengalloor Ranganathan was a legendary tusker who carried the main idol from 1906 to 1914 during the Thrissur Pooram,⁵⁰ one of the most exotic festivals in the world. He passed away in 1917 and luckily his skeleton was entirely preserved. He was definitely the tallest elephant in the area during his time, as can be noted from historical images. Claimed to be the tallest Asian elephant that ever lived (at 3.45m), this allegation deserved to be investigated.

I got the permission to measure his skeleton on display at the Thrissur Zoo Museum and he is 3.03m at the top of the right scapula. However, his manus is only about 35cm high (while for an elephant of his size it may be over 40cm), which suggests that in correct anatomical position the whole skeleton would be a few centimetres taller. By corroborating this with a

⁴⁶ Gerald L. Wood, *The Guinness Book of Animal Facts and Feats*, Sterling Publishing, 1983, pp. 17 – 18.

⁴⁷ Raman Sukumar, N.V. Joshi, V. Krishnamurthy, *Growth in the Asian elephant*, Proceedings of the Indian Academy of Sciences (Animal Sciences) 97, 561-571, 1988.

⁴⁸ As already explained, side-view pictures taken at mid-height can be very useful tools if the antero-posterior forefoot diameter is known and if the foot can be clearly seen in the picture. Using the ruler tool in Adobe Photoshop one can then get quite accurate results.

⁴⁹ As described in this study, a formula based only on humerus or femur size is also not accurate for the very tall, robustly built Asian elephants: I have discovered that such bulls have very big scapulae, resulting in a higher shoulder height than one obtained solely by using humerus or femur size as references. Therefore, it is preferable to have all or most of the bones of the forefeet preserved in order to calculate the shoulder height in flesh.

⁵⁰The Hindu, *New Malayalam documentary on 'the tallest elephant to have lived in Asia'*, 19 August 2022 <https://web.archive.org/web/20220825121119/https://www.thehindu.com/entertainment/movies/new-malayalam-documentary-on-thrissur-chengalloor-ranganathan-the-tallest-elephant-in-asia/article65774692.ece>.

99cm tall scapula and adding the 5.5% for the in-flesh size, the total shoulder height must have been slightly over 3.25m.

After the Bilkandi tusker, this is the second tallest (almost)⁵¹ complete skeleton of an Asian elephant preserved. The pelvic width, the scapula and skull sizes are also second only to the Bilkandi tusker.



As one can note in this picture, the skeleton is not correctly mounted: the spinous processes should be at the same level with the top of the shoulder blades and not higher. This explains the 3.45m tall wrong allegation. This is a common mistake in most museums of the world, from the University of Nebraska to the Grigore Antipa Natural History Museum, usually done in the case of mammoths, which are displayed to look bigger.

5.3.2. Siam

Siam was bought as a baby in Sonpur, which is right in the middle of the 2000km of Himalayan foothills traditionally home to the tall, high-domed, robustly-built, big-tusked Asian elephants. He passed away aged about 52, in September 1997, euthanized because of the captivity-induced feet and obesity problems.⁵²

I studied his bones in the basement storage area of the Paris Natural History Museum, together with Asier Larramendi. By placing the front feet bones in anatomical position, it resulted a skeleton shoulder height just above 3m, which confirms that in real life the elephant was close to 3.2m tall. Siam's skeleton is the third tallest complete skeleton of an Asian elephant preserved.

Thisiam is the son of Siam, born in May 1998. At this young age he is already of the same shoulder height (3.19m) and body weight (6.5 tons) as his illustrious father.⁵³ However, as it can be seen in the collage below, his tusks and head domes are smaller and will perhaps develop later.

⁵¹ One of the original tusks is missing and was replaced with another tusk of similar size.

⁵² *Special Siam*, La lettre de la SECAS, no 12, December 1997.

⁵³ Personal communication with Knie's Kinderzoo. By looking at various images and reading different accounts it results that at some point the elephants got overweight and approached 7 tons.



5.3.3. Other notable giants

Several other big size specimens are mentioned in the literature:

- in 1882 another large bull was shot by W H Varian at Chalampia Madua in the North Coast Province of Sri Lanka. The following measurements were taken immediately after death: height at shoulder 11ft 1in 3.38m (standing height c 10ft 7in 3.23m); at arch of back 11ft 9in 3.58m; overall length 26ft 7.92m; girth of body at thickest part 22ft 4in 6.81m; estimated weight about 8 tonnes;
- in November 1967 a massively-built tusker measuring 10ft 6in 3.2m at the shoulder (circumference of forefoot 5ft 3in 1.6m) was shot by D K Lahiri Choudhury near Filbari in the Garo Hills after it had (allegedly) killed a number of people;
- one of the largest wild elephants surviving in India (in 1983) was a single-tusked bull living in the Morghat Reserve Forest, North Bengal which, on the basis of a forefoot impression, measures about 10ft 10in 3.3m at the shoulder;
- a makna called Bholanath owned by Kumar Jitendra Choudhury of Bengal measured 10ft 11in 3.33m at the shoulder in 1905;
- The Maharajah of Nepal's famous tusker 'Hari Prasad' stood 10ft 9in 3.28m in 1957;
- another huge tusker belonging to the Rajah of Nahan-Sirmount in the Punjab; he was 10ft 72in 3.24m in 1870;
- the Rajah of Gouripur's great tusker 'Jung Bahudar' stood 10ft 5in 3.19m a few months before his death in 1964;
- during the Second World War another big tusker in the Maharajah of Gwalier's stable was measured by Stracey at 10ft 5in 3.18m;

- in 1932 a shoulder height of 10ft 4in 3.15m was reported for a huge tusker named 'Harry' (b 1880) at West Berlin Zoo, Germany, but this measurement cannot be confirmed because the zoo records were destroyed by Allied bombing during the Second World War.⁵⁴

I have reservations about how at least some of these individuals were measured. From my experience in India, I could note that dead elephants were measured as lying on the side and along the curvature of their forelegs, which led to an error of approximately +30cm.⁵⁵

Another notable captive elephant is Keshavan, said to had been 3.28m tall, who served the Guruvayur temple in Thrissur for 50 years. Because of his gargantuan size he was named Gajarajan (King Elephant). Famous for his stature and high head domes, he passed away in 1976 and was then subject of a documentary.

At 3.16m shoulder height, the 60-year-old Thechikottukavu Ramachandran is presently the tallest elephant held captive in the southern Indian state of Kerala.

Chirakkal Kalidasan (featured in a famous Indian movie called *Baahubali*) is the second tallest captive elephant in Kerala, with a shoulder height of over 3.14m at the age of 43. His tusks are 49cm thick and he is a big tusker, but one may easily think otherwise, as his tusks are regularly sewed for his participation in various festivities.



To give the scale, I am 1.92m tall and Chirakkal Kalidasan towers well over me.

5.4. The biggest Asian elephants are not predominantly maknas

In light of the above, an important observation is that the biggest (tallest and robust) recorded specimens in Asian elephants, both in the wild (Bilkandi, Raja Gaj, Tulla Hathi) and in captivity (Ranganathan, Siam), were almost all tuskers and a good part of them *big* tuskers.⁵⁶

⁵⁴ Gerald L. Wood, *idem*.

⁵⁵ The correct way to measure a captive elephant alive is shown in this video featuring Pampadi Rajan: <https://www.youtube.com/watch?v=UAFJOy8LNhg>.

⁵⁶ To recall, Raja Gaj's tusks were over 2m in length and the Bilkandi tusker sported tusks about 2.7m long and 55cm thick based on the replicas!

This partially contradicts previous research, which seemed to suggest that very tall and very robust individuals invested much less in ivory size because bull Asian elephants followed *alternative strategies*: (i) some smaller and slender bulls developed huge ivory, while (ii) the more robust ones invested in body and head size and much less in ivory.

The source of the previous beliefs could be a biased dataset at which one was looking, by considering elephant populations where tuskers and maknas occurred in similar proportions.⁵⁷ But those elephant populations are not healthy and not representative of a normal Asian elephant population, of the world as it once was,⁵⁸ where maknas were exceptional and represented less than 5% of the total number of bulls.⁵⁹

While it may be true that relatively to their body size smaller bulls carry slightly bigger ivory, long and/or heavy ivory also occurs in the biggest individuals.

5.5. Comparison with woolly mammoths

Woolly mammoths from the Siberian and Alaskan populations⁶⁰ and Asian elephants from Indochina and Southern India are generally smaller and less robustly built.⁶¹

A comprehensive study on the size of proboscideans largely confirms my personal observations, noting that “the European form [of woolly mammoths] was considerably larger than North Siberian specimens, surpassing 6 tonnes in body mass and 315 cm at the shoulders on average, with particularly big specimens exceeding 8 tonnes in mass.”⁶²

Therefore, the maximum shoulder height is pretty much the same in Asian elephants and woolly mammoths, with the possibility that certain exceptional European woolly mammoths were slightly bigger.⁶³ The big European woollies were also of a similar body mass with the biggest Asians, as the Asians from the robust line have the same maximum horizontal width of the pelvic girdle with confirmed woolly mammoths of a similar height.

⁵⁷ Raman Sukumar, 2003, pp. 123- 124.

⁵⁸ To recall, the biggest bodied and tusked bulls were selectively captured by locals and targeted by hunters, and their amazing genes were unfortunately not perpetuated, leading in long term to an unnatural change in the structure of the bull elephant populations.

⁵⁹ Fred Kurt, Marion Garai, *The Sri Lankan Elephant in Captivity*, Cambridge University Press, 2007, p. 9.

⁶⁰ See e.g. Dick Mol et al., 2006.

⁶¹ Big tuskers from both the slender and robust morphological types occur in Karnataka (India), where the tallest bulls from the robust line may exceed 3m in shoulder height.

⁶² Asier Larramendi, 2016, p. 561.

⁶³ The Siegsdorf mammoth may be the biggest woolly mammoth recorded, with a shoulder height in life of 3.5m and a maximum pelvic width of a staggering 160cm. However, in a personal exchange with Adrian Lister he insightfully noted that “I have for a long time wondered if the Siegsdorf mammoth, with its huge size, might be an *M. trogontherii* like that of Steinheim. The molars certainly do not exclude that, but being worn and n=1 do not really separate *trogontherii* from *primigenius*. If it is the former, then the radiocarbon date (ca. 40 ka) is likely erroneous but this is very common with dates in that range close to the limit of the method; then are often in fact ‘infinite’ but with a trace of contamination. At present we have no way of determining that unless further samples can be obtained for dating methods not available at the time (radiocarbon dating on hydroxyproline or amino-acid dating on enamel)”. See also Adrian Lister, *Mammoth evolution in the late Middle Pleistocene: The Mammuthus trogontherii-primigenius transition in Europe*, Quaternary Science Reviews, Volume 294, 2022, 107693, ISSN 0277-3791, <https://doi.org/10.1016/j.quascirev.2022.107693>.

Finally, females of Asian elephants and woolly elephants are generally of the same size, with individual populations variations like in the case of males.

5.6. Comparison with African elephants

When Europeans first compared Asian and African elephants, the Asians were of a bigger size. Indeed, the Battle of Raphia in 217BC was the only battle where African and Asian elephants fought against each other. The Asian elephants of the Seleucids were bigger than the African elephants that the Ptolemies sourced from Northern Africa, shifting the balance.⁶⁴ In addition, according to Cato, Hannibal's most impressive war elephant was Surus, an Asian elephant bigger than the African elephants in his army.⁶⁵ For such reasons the species was called *maximus*.

But the deeper Europeans got into Africa, the more African elephants they encountered, and most of them of bigger sizes than those from Northern Africa. At the same time, the significant drop in the Asian elephant populations, especially of those producing bigger individuals, meant that a different conclusion is presently warranted.

Indeed, bull African elephants are taller and heavier than bull Asian elephants both on average and when we compare the maximum recorded sizes of the two species. While bull Asian elephants are on average 2.75m tall and 4 tons,⁶⁶ African elephant bulls average 3.2m tall and 6 tons.⁶⁷

As shown in this study, the maximum confirmed height in Asian elephants is about 3.35m for a weight of 7.2 tons. African elephants can reach 3.8m in shoulder height (and 9 tons),⁶⁸ possibly even about 4m and 10 tons,⁶⁹ but individuals around 3.6m tall weighing 8 tons are already very big.⁷⁰

Finally, females of Asian elephants and African elephants are generally of the same size, with individual populations variations like in the case of males.

This means that the size difference between the two species concerns mostly males and results from the fact that bull African elephants usually grow twice the size of females, while bull Asian elephants are usually one third to half bigger, and only exceptionally twice the female size.⁷¹

⁶⁴ M. B. Charles, *Elephant Size in Antiquity: DNA Evidence and the Battle of Raphia*, *Historia: Zeitschrift Für Alte Geschichte*, 65(1), 53–65, 2016, <http://www.jstor.org/stable/45019217>.

⁶⁵ H. H. Scullard, *Ennius, Cato, and Surus*, *The Classical Review*, 3 (3/4): 140–142, 1953, doi:10.1017/S0009840X00995805, JSTOR 703426. S2CID 162984205.

⁶⁶ Raman Sukumar et al., 1988.

⁶⁷ Raman Sukumar, *The Living Elephants: Evolutionary Ecology, Behavior, and Conservation*, OUP, 2003.

⁶⁸ Phyllis Lee, Cynthia Moss, *Statual growth in known-age African elephants (Loxodonta africana)*, *Journal of Zoology*, Volume 236, Issue 1, 1995.

⁶⁹ Asier Larramendi, 2016, p. 552.

⁷⁰ Such examples may be Bad Bull, the biggest recorded (big tusked) elephant in East Africa (Amboseli Trust for Elephants, *Please Helps Us Save Bad Bull*, 2003) and the Fenykovi specimen (Asier Larramendi, 2016, p. 552).

⁷¹ George Dian Balan, *The World As It Once Was*, p. 129.

6. Monster heads

6.1. Ex-aequo world records

6.1.1. The Bilkandi tusker

The Bilkandi elephant has it all: impressive height, formidable mass, huge head and (apparently) some of the biggest tusks recorded in the species. It definitely contradicts those erroneously thinking that maknas grow bigger than tuskers, or those thinking that captive Asian elephants grow bigger than those in the wild.

The skull is about 1.35m tall on a line from the top of the domes to the tip of the alveoli and has a maximum width of about 93cm! Furthermore, it is higher than that of any woolly mammoth I am aware of, as measured from the tip of the eye to the top of the domes. The alveoli are also the biggest I measured in an Asian elephant, at 67cm.

The bony ridges in front of the domes serving for tendon and muscle attachment suggest big splenius superficialis muscles, similar to those of Siam and Raja Gaj. Such ridges, very pronounced in several big skulls I examined, do not exist in woolly mammoths or in African elephants, where the scars for muscle attachment are less pronounced.

Indeed, the total height of the head of the animal alive, after adding about 15cm of muscles and skin over the domes and over 10cm of skin to the lip line, was about 1.65m!



This kind of robustly built, high domed Asian elephants are a throwback to the old Asian elephant lineage, as it can be seen by comparing the huge Bilkandi tusker skull⁷² with a quite well-preserved skull of *Elephas hysudricus* of a similar size.⁷³

6.1.2. Raja Gaj

As already seen above, Raja Gaj is one of the tallest Asian elephants for which the Leviathan size could be verified. He was robustly built and his head was almost half the shoulder

⁷² A 3D rendition of the Bilkandi tusker skull is about to be produced.

⁷³ Proby Cautley, Hugh Falconer, *Fauna Antiqua Sivalensis, Being the Fossil Zoology of the Sewalik Hills, in the North of India*, London, 1846, Plate 4.

height,⁷⁴ as it can be also seen in the image above. In the Nepalese Terai such robust bulls are called *kumaria band*.⁷⁵

A particular feature of these giants are the very high head domes, which are partly due to the conformation of the skull and partly to the huge splenius superficialis muscles, absent in African elephants. These twin head domes are a feature of bull elephant handsomeness in several Asian cultures, being appreciated in Thailand or in the Southern Indian state of Kerala, in the latter place being called *thalakkuni*.

The more these bulls raise their heads, the more those domes look like the Himalayas, pushed up by the Indian sub-continent pressuring the Eurasian Plate. The pair of huge skull muscles flex like the biceps of a bodybuilder.⁷⁶



While the biggest bulls in other Asian elephant populations, exceeding 3m in height, may also have very high domes (Raja the Great, Nadungamuwa Raja), in the Terai jungles this is the rule.

6.2. Other very big skulls/heads

Chengalloor Ranganathan has the second biggest preserved skull, almost matching in size the skull of the Bilkandi tusker.

Among the top 10 biggest skulls preserved in Asian elephants are also those of Raja the Great and Siam, individuals already mentioned in this article for their huge ivory and big body size. Other very big skulls already measured belong to tuskers which were in the range of roughly 2.90m – 3.05m tall at the shoulders, such as Ziggy and Kancha.

A more detailed article providing comprehensive measurements and a comparative analysis of the biggest skulls in Asian, African and woolly elephants is in preparation with a distinguished international team of experts.

⁷⁴ George Dian Balan, *The World As It Once Was*, p. 130.

⁷⁵ Correspondence with Adrian Lister.

⁷⁶ George Dian Balan, *The World As It Once Was*, p. 130.

6.3. Comparison with woolly mammoths

The biggest preserved skull of a woolly mammoth seems to be Haltern, which has a maximum length of 142cm, a maximum breadth of 86cm and a premaxillary length of 80cm.⁷⁷ Other very big woolly mammoth skulls approach these measurements. While still rich in comparison with other proboscideans, the skull fossil record for woolly mammoths is not as extensive as the number of preserved tusks.

World record Asian elephants have bigger skulls in almost every respect than similarly record-sized woolly mammoths: they are wider at least frontally and even higher in the eye to the top of the head part! The only segment where woolly mammoth skulls get bigger is the tusks sockets. The longest alveoli in woolly elephants may exceed 80cm, while the longest recorded alveoli in Asian elephants are close to 70cm.

6.4. Comparison with African elephants

The biggest preserved skull of an African elephant seems to be that of the Fenykovi specimen, which has a maximum length of 127cm, a maximum breadth of 92,6cm and a premaxillary length of 67cm.⁷⁸

This means that Asian individuals like the Bilkandi tusker had bigger skulls (and heads) in almost every respect when compared to even taller and slightly heavier African elephants.

This kind of comparison holds true also if we compare the skulls of fully grown bull Asian and African elephants of shoulder heights in the range of 3m: the Asian elephant has a bigger head (higher and frontally wider) than his African counterpart.

6.5. Alveoli to tusk length formula

Most of the literature, elephant experts and Big Brother Google mention that about one third of the tusk length of an elephant is hidden in the skull. That may hold true for certain individuals, but does not apply to the big tuskers.

By comparatively studying tusks and skulls of Asian, African and woolly elephants, I noted that there is a clear correlation between the maximum tusk length and the alveoli depth. Indeed, the formula to understand *how long tusks* a certain big tusker can biologically grow (natural wear also factored in) is that about **one fifth** of the tusk is embedded in the skull.

The table below offers some notable examples to illustrate this formula:⁷⁹

Species	Specimen(s)	Alveoli size (cm)	Tusk length (m)	Notes
Asian	Bilkandi tusker	67	2.70	world record skull; based on the replica

⁷⁷ Measurements taken together with Asier Larramendi at the Quadrat Museum, Bottrop. Complete measurements of this world record skull will be provided in a subsequent collective article.

⁷⁸ Measurements provided by Andrew Shek, who personally examined and 3D scanned the specimen at the mammalogy department of the Smithsonian Museum Support Center. Complete measurements of this world record skull will be provided in a subsequent collective article.

⁷⁹ For African savanna elephants and woolly mammoths the skulls bearing the longest recorded tusks were not preserved. Therefore, I used as proxy the alveoli size of the biggest skulls I have in my database (Fenykovi and Haltern), as alveoli size varies very little between *world record* skulls and *big* skulls of big tuskers within the same elephant species, while the gap in other skull dimensions (e.g. maximum width and length) is bigger.

				tusks
Asian	Raja the Great	65	3.26	big size skull; world record tusk by length
Asian	Naturalis tusker	38	2.14	small sized individual
African	composite	67	3.49	world record skull; world record tusk by length
		Fenykovi	Ethiopia tusk	
African	Duke	63 ⁸⁰	3.20	average size individual; broken tusk added length
African	Ahmed of Marsabit ⁸¹	59	2.95	small sized individual
Woolly	composite	80	4.37	world record skull; world record tusk by length
		Haltern	Alaska	
Woolly	Yukagir ⁸²	45	3.16	small sized individual

7. Some methodological remarks

There are plentiful methodological explanations throughout this study. However, I thought appropriate to group together some considerations in a separate section, as they reflect common questions that I face during presentations or when simply talking to people.

7.1. Reliability of tusk data collected from captive specimens

Is it true that, as a rule, captive Asian elephants grow bigger tusks than those in the wild?

No, I do *not* think that *as a rule* captive Asian big tuskers develop longer and/or heavier tusks because of captivity. It should be rather a case-by-case assessment.

Contrary to what some believe, the natural wear and tear of tusks in the wild, sometimes leading to occasional breakage, is not always impacting more on tusk size (and in particular on length) than captivity.

Indeed, while in captivity certain elephants may be shielded from elements of the environment that contribute to regular tusk wear and tear, they may be exposed to other elements, unnatural (such as concrete and steel enclosures), which may lead to more tusk wear and tear, possibly followed by breakage.

In captivity tusks wear out unnaturally on the outer edges and tend to break along those thinned areas. The result is that such tusks end up being shorter, thinner and lighter than

⁸⁰ Measurement provided by Dawie Fourie, who personally examined Duke's skull at Crocodile Bridge, Kruger National Park. This corresponds to measurements I took on other African elephant skulls of a similar size.

⁸¹ Shoshani, J., J.C. Hillman, J.M. Walcek, "Ahmed", *The logo of the Elephant Interest Group: Encounters in Marsabit and notes on his model and skeleton*, Elephant 2-3, 7-32, 1987.

⁸² Dick Mol et al., 2006.

under natural wear and tear. Such examples are the tusks of the big bull Siam from the Vincennes zoo (Paris) or those of Khu from Maesa Elephant Camp.⁸³

To justify trimming the tusks, elephant camps and zoos claim that huge ivory is a hindrance to elephant movement or feeding. While huge ivory is a cost for a bull elephant in terms of energy, these males are well adapted to that, including by having powerful neck and head muscles, and do not need human intervention. Big ivory has an important role in elephant reproduction, which was noted by reference to female elephant reactions to big ivory carriers even in captive conditions.⁸⁴ In addition, big tusks protect the trunk from possible injuries.

Finally, most of the Asian elephants captive in zoos die prematurely, which also affects their tusk size, as ivory grows exponentially when elephants are older.⁸⁵ For instance, the new World Record by tusk length was euthanized when only 46 years old because of the captivity-induced health issues. In normal conditions, such a bull would have lived around 10 years more in the wild, very likely growing even longer and heavier ivory. This is totally plausible, because of his tusks shape: they did not grow down, but rather forward, upward and inward, crossing each other.

7.2. Reliability of body size data collected from captive individuals

Is it true that because of plentiful food captive Asian elephants get bigger in body size than those in the wild?

To start with, the biggest recorded specimens (the Bilkandi tusker and Raja Gaj, as well as several other bulls with unconfirmed measurements) were all entirely wild animals.

What happens in captivity is that the elephants may grow and reach their (almost) maximum shoulder height and sexual maturity faster. However, there are genetic limitations to their growth and an elephant resulting from short parents will not become a very tall individual just because food is bountiful in captivity.

What may happen in such situations is that because of lack of exercise (small enclosures) and plentiful food the elephants get overweight, which is affecting their health.

However, the fact that big captive Asian elephants in zoos are heavier than adult African elephants of a similar shoulder height should not be entirely attributed to obesity. One should also factor in the circumstance that some of these elephants are naturally robustly built, as also confirmed by the maximum width of their pelvic girdle.

⁸³ Such a negative impact of concrete enclosures on captive specimens was observed also on other species, like rhinos, which do not manage to grow horns equally long as in the wild. A well-known example is of an Eastern black rhino bull called Kata Kata, who had only a stub of a front horn while kept s at Chester Zoo. Once that rhino was moved to Bioparc, a zoo offering much closer to natural conditions, his front horn grew exponentially, fructifying its genetic potential.

⁸⁴ For instance, I was told that female elephant communication increased when a spectacular big tusker called Jum Pui passed by at the Thai Elephant Conservation Center in Lampang.

⁸⁵ Tusks develop more after the bull elephant has almost completed his body growth. This means that in the wild big ivory is already well defined around the age of 35 and gains even more length and especially more weight when the elephant is aged 40 to 50, and older.

7.3. Definition of a “big tusker”

How should one define an Asian “big tusker”?

It is difficult to find a single absolute objective criterion because of large intra-specific variations in body size and tusk shape. A possible approach can take into account tusk size relative to body size. In any event, for me the most impressive big-tusked elephants are those that I call “Plough-the-Earth” and “super tuskers”.

In Africa, hunters particularly prize the so-called “hundred pounders”, elephants sporting at least one tusk weighing 100lb (45kg) or more. Unfortunately, a “hundred pounder” has become an *absolute* synonym for most of the people with “big tusker”, “great tusker” or “super tusker”, irrespective of the actual body size of the elephant and tusk size relative to body size. I disagree with making these notions perfectly interchangeable, as I think that “big tusker” and “great tusker” should be broader terms, not limited to “hundred pounders”.⁸⁶

As to the term “super tusker”, I think that should be reserved only to the most spectacular cases, when the tusk length matches or exceeds the shoulder height of the elephant (super tusker by length) or when the tusk mass of one single tusk represents at least 1% of the total body mass of the elephant (super tusker by weight). This way, an average bull African savannah elephant (3.2m tall for 6 tons) would need to bear either at least one tusk 3.2m long or one tusk weighing 60kg to qualify as a super tusker. Therefore, most of the African “hundred pounders” will not qualify as “super tuskers”.

Indeed, a better approach than the one-size-fits-all “hundred pounder” is one which establishes minimum thresholds by taking into account tusk size in relation to the smallest shoulder height and body weight of a big tusked bull within a given species.

With regard to tusk mass, if we start our calculations from a “hundred pounder” and an average body sized African elephant (of 3.2m shoulder height and weighing 6 tons), then a 45kg tusk represents 0.75% of the overall body mass of the elephant.

If we accept that African and Asian elephants invest in tusks mass on average a similar percentage of their total body mass, then for an average bull Asian elephant (of 2.75m shoulder height and weighing 4 tons) 0.75% means 30kg. Should we then draw the line at 30kg in case of an Asian elephant to be considered a “big tusker”?⁸⁷

⁸⁶ Also in Africa elephants bearing very big ivory relative to their body size, but not qualifying as “hundred pounders”, have to be acknowledged. Bull forest elephants, for instance, may sport very impressive ivory for their size, but that would rarely exceed 30kg, although the maximum recorded weight is about 70kg. An even bigger dilemma is on how we call the female savannah elephants carrying big ivory, as those tusks can reach 1.8-2.4m in length, but only 15-25 kg in weight, as they are very slim. While for such females one may use “iconic cow tuskers”, for the forest elephant bulls or smaller savannah bulls I think “big tusker” should be used, even if those smaller individuals are not “hundred pounders”. See also George Dian Balan, *The World As It Once Was*, pp. 148, 159.

⁸⁷ According to a study, bull Asian elephants sported probably in the past tusks typically around 2m and 30kg (Asier Larramendi, *Estimating tusk masses in proboscideans: a comprehensive analysis and predictive model*, *Historical Biology*, 1–14. <https://doi.org/10.1080/08912963.2023.2286272>, 2003). I largely agree with those estimates, but given the almost five times larger dataset that I have analysed (about 140 big tuskers vs 30), I would think that an average Asian tusker should be considered at around 2.2m tusk length.

I would have hesitations about that. While in absolute terms it may make sense, in relative terms one cannot usually expect from a small 3.2-ton bull Asian elephant to sport ivory as heavy as an average Asian elephant, which is 800kg heavier, or a 5-ton African savannah elephant to sport ivory as an average African elephant one ton heavier (albeit that can happen).

So, what about taking the smallest bodied Asian (3.2 tons) and African (5 tons) big tuskers as reference, and applying the 0.75% to their body masses? In that case an Asian big tusk would be expected to sport at least one tusk weighing 24kg and an African big tusk at least one tusk of 37.5kg.

Can one perhaps alternate or combine the weight criterion with a minimum tusk length?

With regard to tusk length, I think that it is visually (and scientifically)⁸⁸ relevant: even if ivory is not very thick (and therefore quite light), how can one tell about an elephant with tusks so long that they reach all way down to the ground that it is not big-tusked? In the case of a small bull Asian elephant measuring only 2.5m at the shoulders, straight tusks reaching to the ground would be around 2m long, out of which about 1.50m visible, outside of the head. Then, if we accept a certain length relevant for a certain ivory shape (e.g. straight tusks growing down), perhaps tusks having a different shape (e.g. curved tusks growing onward/upward) of equal lengths should be accorded equal consideration.

In particular, younger bulls have usually thinner and much lighter ivory than older bulls. But some of them grow very long tusks at a relatively young age, those tusks becoming thicker and heavier only later in life. If one would consider only tusk weight, such bull are not big tuskers. But by length they can definitely be very impressive.



29-year-old Pong has long tusks measuring about 2m per side outside of the head (total tusk length: over 2.5m each). But his tusks are only 31cm in girth at the lip and thin throughout all their length, resulting in a weight of around 20kg each.

⁸⁸ Did you know that studies in Southern India have shown that the longer the tusks, the healthier the elephant? Indeed, there is a direct correlation between tusk length and the absence of parasites in the elephant dung (Raman Sukumar, *The Living Elephants: Evolutionary Ecology, Behavior and Conservation*, OUP, 2003).

In light of such reflexions, maybe it is reasonable to take 24kg or 1.5m outside of the head as thresholds for Asian elephant big tuskers, in order to give a fair chance to small bulls with big ivory relative to their body size, as well as to (young) bulls holding long, but thin and light ivory, to be properly acknowledged.

But how relevant would be such minimum thresholds for much bigger bodied elephants?

With regard to length, if we take as reference the kiss-the-ground status for straight tusks growing down, then a 3.35m tall bull would need to sport around 2.7m long tusks to meet the test, out of which about 2m would be visible outside of the head.

Indeed, a 1.50m visible part of a tusk (outside of the head) looks impressive on a small bull Asian elephant (2.5m tall), as it represents 60% of the shoulder height of the elephant. However, in the case of a 3.35m tall bull, if we see outside 1.50m of tusk, this represents only 45% of the shoulder height of the elephant.

With regard to weight, 24kg may be a good threshold for a small bull, but for a bull twice that size a threshold twice that mark may be more sensible.

In light of all the above, it may make sense to have ***different tusk weight and/or length classes***, calibrated to the body size of the elephant.

In any event, irrespective of absolute tusk weight, to me the most impressive big-tusked elephants are those that possess at least one of the qualities below:

- sport tusks whose length matches or exceeds the shoulder height of the bearer: I call them ***super tuskers by length***; or
- have at least one tusk weighing 1% or more of the total body mass of the elephant: I call them ***super tuskers by weight***; or
- sport tusks so long that they kiss the ground: I call them ***Plough-the-Earth***.⁸⁹



Of course, some Asian elephants can be Plough-the-Earth and super tuskers by length and by weight at the same time, and fewer of them can even be “hundred pounders”. Or some

⁸⁹ Inspired also by a novel by Wilbur Smith, who used “Plough-the-Earth” in *Shout at the Devil* (1968).

may simply grow their tusks forward instead of down, and still be super tuskers by length and “hundred pounders”.

8. Conclusions

The incorrect perceptions with regard to tusk and body size in Asian elephants are due to the shifting baseline syndrome and 3500 years of human-made reverse election, the opposite of natural selection, to the deceiving practice of trimming the tusks of captive Asian elephants and to the lack of a previous thorough comparative research.⁹⁰ If you are surprised by the results of my research and the conclusions below, you are not alone.

In light of all the evidence analysed in this study, *contrary to* what has been previously believed:

(i) ***Big ivory was originally not exceptional in bull Asian elephants.*** In fact, it was and still is an important sexual secondary trait, associated with a stronger immune system (resistance to parasites) and therefore important for mate choice by females.

Given the historical context and population size, it is a miracle that Asian big tuskers have made it to our days and that I could identify so far about 140 elephants with at least one tusk over 2m long.

The fact that even if female Asian elephants lost their tusks at some evolutionary point in time (probably under certain environmental stress factors like lack of resources, coupled with the need to prioritize gestation and lactation), while bulls still kept huge ivory irrespective of their body size, shows the importance placed by evolution on this physical characteristic in males.

(ii) ***Male Asian elephants did not invest either in body size or in ivory size as alternative strategies:*** the smaller (and slender) bulls are not the only ones to bear big ivory relative to their body size, as big tusks can be found in Asian elephants irrespective of their body size and morphology.

Indeed, world record specimens with regard to body and head size also sport some of the biggest ivory recorded in the species, such as the Bilkandi tusker and possibly the bearer of the Nepalese tusks of 1911. Other big (Raja the Great) and very big (Siam) size individuals who are robustly built and high-domed also sport record-size ivory. The high-domed, big-tusked, robustly built morphologic type is the most precious and most ancient-looking type of Asian elephants, a throwback to the ancient *Elephas hysudricus*.

(iii) ***The tallest Asian elephants do not get proportionally lighter,*** as they belong to the robustly built genetic type. To the contrary, they must be slightly heavier than the results obtained by applying the shoulder height to body weight average formula I developed.⁹¹

(iv) ***Male woolly mammoths were up to 15% bigger in body size than bull Asian elephants:*** while the smaller to average Siberian and Alaskan woolly mammoths were

⁹⁰ As already explained, while Asian and African ivory size is very often presented as much smaller than in reality, woolly mammoth tusks size is usually exaggerated, resulting in a much larger size difference among these species than in reality.

⁹¹ George Dian Balan, *The World As It Once Was*, 2020, p. 125.

the size of a small to average Asian elephant, the very big European woollies slightly exceeded the size of the very big Asian elephants from the Himalayan foothills.

(v) ***The biggest tusks of woolly elephants are one third longer and over 50% heavier than the biggest tusks of Asian elephants*** and about 25% longer and only slightly heavier than the biggest tusks of African elephants.

Indeed, while the woollies had the biggest ivory in elephant evolution in relative terms (up to 4.4m long, 66cm thick and over 110kg per side), Asian and African elephants are also amongst the biggest tusked proboscideans relative to their body size (up to 3.3m long, 58cm thick and 75kg per side and up to 3.5m long, 65cm thick and 117kg per side respectively).

(vi) ***Woolly mammoths did not have proportionally bigger heads than the Asian elephants*** from the robustly built morphologic type: in fact, the only part of the mammoth head which was longer were the tusk sockets.

All the other relevant dimensions are bigger in Asian elephants, including the distance from the eye to the top of the head and the maximum front view width. Of all these measurements it is important to underline the fact that Asian elephants from the high domed line have higher domes than woolly mammoths, due to higher skulls and bigger muscles!

African elephants also have relatively (or in case of woolly mammoths absolutely) wider heads than the mammoths, both frontal view and side view, and it would be interesting in a future study to calculate the volume and mass of those heads and see whether the woolly elephants bettered the African elephants when we draw the line.

(vii) ***Woolly elephants did not have proportionally wider bodies than Asian elephants*** when we compare the very big Asian elephants from the robustly built line with similarly sized, very big European woolly mammoths.

Indeed, the maximum horizontal width of the pelvic girdle in both elephant species is in the range of 140-145cm for the 3.25-3.35m tall individuals.

(viii) ***Like the longest tusked woolly mammoths, Asian elephants sporting the longest ivory are also normally crossed tuskers***, with strongly curved ivory. In fact, almost all of the top 35 (2.5 - 3.3m long tusk) Asian big tuskers I have identified so far are crossed tuskers.

The main difference from mammoths is the maximum spread of the tusks, which is greater in mammoths probably because they lived in an open environment, the mammoth steppe.

(ix) ***Asian elephants can bear tusks representing together up to 3.5% of their body weight***, which is very impressive for any proboscidean.

It is known from studying elephants or different deer species, that a certain type of animal has a maximum genetic potential to develop sexual secondary traits such as big

antlers, horns or tusks which can be expressed as a percentage of the body mass of the animal.⁹²

Indeed, the discovery of the new world record Asian elephant tusks by girth (58cm) and possibly by weight (normally constructed at up to 75kg per side) on a living elephant which is just above the Asian elephant average size (he is 2.8m tall and weighs over 4 tons) has important implications for understanding the maximum possible ivory size in prehistoric elephants, at least when it comes to just above the average sized individuals.

(x) A *“hundred pounder”* should not be used an absolute synonym to *“big tusker”*, *“great tusker”* or *“super tusker”*.

Rather, *“big tusker”* and *“great tusker”* should be used as broader concepts, referring to elephants which carry impressive ivory relative to their body size.

Amongst the Asian big tuskers, the most impressive to me are the super tuskers by length or/and by weight, and those that bear tusks so long that they kiss the ground, *“Plough-the-Earth”*.

Books have to be re-written and drawings adjusted. The partial misconceptions about the surviving elephants are unfortunately shared by the large public and scientists as well, as confirmed by a 1st of April (2019) post by the American Museum of Natural History reproduced below,⁹³ to which I added a picture of the impressive Thai elephant Sura for comparison.⁹⁴



⁹² That is why, for instance, it should not come as a surprise that giant moose sports antlers on a par or even heavier than the Ice Age giant deer, as giant moose bulls are usually taller and heavier than the Ice Age giant deer. See George Dian Balan, *The World As It Once Was*, pp. 32, 65 and 67.

⁹³ <https://www.facebook.com/naturalhistory/photos/a.61738066990/10155731546941991/?type=3>. While it is not impossible that a Columbian mammoth with tusks like in that illustration existed, that drawing is not based on the fossil record, but rather on an artistic rendition of a reconstructed imaginary individual on display at La Brea Tar Pits.

⁹⁴ Sura sadly passed away of old age in 2020.

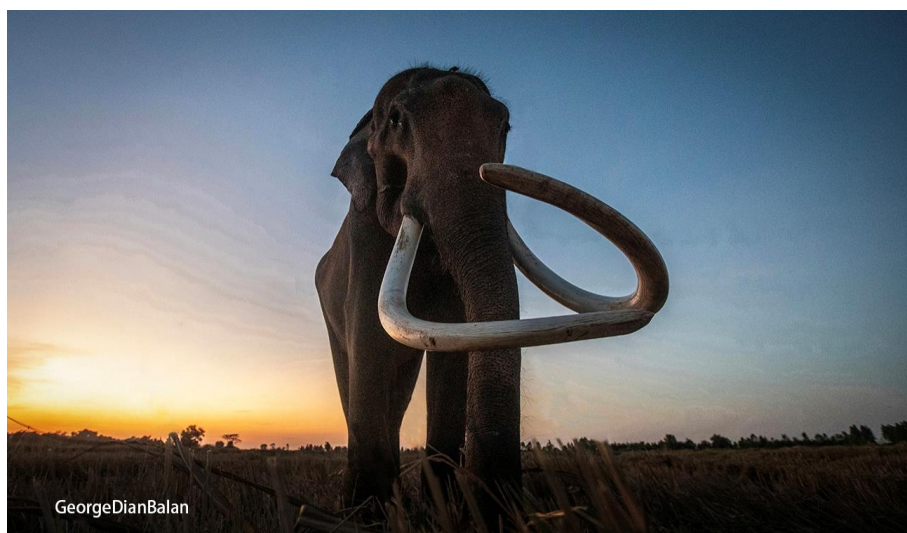
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I have been enriched by the intensive exchanges with Asier Larramendi, Adrian Lister, Dick Mol and Andrew Shek, with whom we are preparing a detailed comparative article on elephant skulls and head morphology.

Finally, if our knowledge about Asian elephants is so advanced in general, we owe a lot to the inspiring work by researchers such as Jeheskel Shoshani, Fred Kurt and Raman Sukumar.



To me, crossed tusks used to look like crossed swords. However, one day my old landlady said, looking at a print on my wall: "those tusks are like two embracing arms!" So, after that day, upon reflection, I call this "the **Great Tusker Salute**", a **Hug**.