

HOW BIG IS *BIG*? ON ASIAN, AFRICAN AND WOOLLY BIG TUSKERS

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African elephants are bigger in body size than woolly elephants and both species are normally bigger than Asian elephants. However, Asians from the Himalayan foothills can reach body sizes comparable to East African elephants and European woollies. For each additional 20 cm in the shoulder height of a mature bull elephant one may roughly add 1 ton. Asian elephants may have enormously domed heads, on a diagonal line half their shoulder height. The head of a 3.4 m tall bull Asian elephant would be as high as that of a 4 m tall African bull. African elephants have usually the heaviest tusks, while the woollies have normally the longest, perhaps also because of the different shape leading to less wear towards the tips. Yet, Asian elephants can also sport 3 m long, 73 kg each tusks. The longest recorded African tusk was 3.5 m and the heaviest confirmed 107 kg. The longest woolly elephant tusks seem to have exceeded 4 m and the heaviest may match the Africans. Because the African and Asian big tuskers have been exterminated by trophy hunting, poaching and captivity, the elephant populations surviving today give the wrong impression that woolly elephants were more endowed. Big tusk and body size are part of the original glorious design of all the three mentioned trunk-bearing pachyderms.

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INTRODUCTION

Have you ever seen an elephant with tusks so long they kissed the ground?

“Seriously? It looks photoshopped!”, “This can’t be true!”, “The biggest I have ever seen!”, “Prehistoric!” – these are some of the most usual reactions I get from people looking for the very first time at pictures of today’s animals from the book I am about to finalize.

Like Thomas Jefferson needed a big moose to rebut Buffon’s claims that American fauna was degenerate in comparison to the Old World’s fauna, my work stands as proof that today’s megafauna is no less impressive than most of the Ice Age giants imprinted in our collective memory, or most of the other megafauna driven to extinction by early humans and climate change. It is only because of certain human errors, exacerbated in the last 100-150 years, that today’s megafauna has largely lost its glamour. I do not see palaeontology only as an enchanted portal to a bygone era, but also as a lens through which to truly appreciate the magnificence of the last giants of today.

Yesterday’s giants live in the last icons of today. Only cave paintings, bones and sometimes frozen tissues remain to testify of the prehistoric legends. Now, their cousins of today face imminent disappearance – of certain species there are only a handful, perhaps 10-30 iconic individuals left. We should not let the truly magnificent giants die once again. This time there will be nothing else left.

As the ice sheet receded and advanced, woolly mammoths and straight-tusked elephants, woolly rhinos and forest rhinos moved north and south in a balanced ecological dance, for hundreds of thousands of years.

Figure 1. If there is any ‘walk of fame’ in the elephants’ world, then this must be the one. The bull in the background is Big Tembo. The two iconic bulls very possibly have the same father. At the very least, they are ‘brothers in tusks’. I am not aware of a more arresting image with both of them together.

Along the way, the warmer climate megafauna got somehow under our radar. If I go out in the street now and I ask random people about straight-tusked elephants, probably none will have the slightest clue. If I ask the same person about woolly mammoths, I suspect quite the opposite - pretty much everybody will have heard of them. So I decided to focus my research on the Ice Age giants, as our cultural reference point.

PLOUGH-THE-EARTH TUSKERS

This is a ploughing elephant! (my mother)

„There is one among them of which the Lord Fini knows for he has asked of him many times. This one is a bull among great bulls. One who moves in such majesty that men have named him Plough the Earth (...) On each side of the spoor a double line scuffed through dead leaves and grass and soft earth where the tips of the tusks touched, and (he) learned why the old bull was called Plough the Earth,” (Smith, 1968, pp. 169 and 171).

I first started working on my book with the then living great tuskers. In the process, I showed my parents pictures of Babu and Bogeshwar, two iconic elephants from Ngorongoro (Tanzania) and Kabini (India). In contrast to my father, who is quite conversant with wildlife matters, my mother has a rather fresh eye. She has a wonderful talent for re-discovering America. A keen sense of observation, ready for apposite comparisons, without knowing that somebody else may have thought along the same lines before. In fact, my mother has never read any of Wilbur Smith’s novels.

A big (or great) tusker may be defined according to either tusks weight or their length. For the purposes of my writings, a big tusker is an elephant with tusks reaching all the way down to the ground, a ‘ploughing tusker’. I call a particular sub-category of big tuskers “supertuskers”, in those exceptional cases when the tusk length is at least equal to the shoulder height of the elephant. Such tusks are curved inwards and forward and in most cases cross each other.

Trophy hunters classify elephant tusks by weight rather than by length. For them, a big tusker is a so-called ‘hundred pounder’, an elephant whose tusks weigh at least 100 pounds (45 kg) per side. The most appreciated amongst hundred pounders are those with tusks over 130 pounds (60 kg) each. Professional trophy hunter Tony Sanchez-Arino counted at least 150 such African elephants in the last 100 years or so (Sanchez-Arino, 2015).

WHY BIG TUSKS?

The main purpose of big tusks is to impress the elephant ladies and to deter potential competitors. They serve a display role. In the case of males, they are proof of a healthy, long-lived animal with superior genetics, features sought after by females. Big tusks are an excellent health certificate. Tusk size is associated with a stronger individual in all respects, which is more resistant to diseases and environmental stress:

“Traits used in sexual signalling and contests between males, including those which are often specifically targeted by humans such as the horns and antlers of bovids and cervids, are known often to show ‘condition dependence’, whereby the degree of expression of the trait is strongly affected by the overall health and well-being (the ‘condition’) of the bearer.

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He is a megafauna expert, a dedicated conservationist and an award-winning fine art wildlife photographer. His photos and texts have been published by National Geographic, BBC Earth, GEO, Wild Planet, Asian Geographic, Africa Geographic, Pachyderm and the European Commission, among others. This article is largely an excerpt from his forthcoming book *The World As It Once Was*.

This condition dependence means that trait expression and therefore mating success is associated with the genetic quality of the male in question...

This benefit from sexual selection is consistently found in laboratory experiments which have shown that strong sexual selection leads to faster adaptation to novel foods and to pesticides, to a reduced extinction risk from thermal stress and to a reduction in inbreeding depression leading to improved persistence of small populations.” (Knell & Martinez-Ruiz, p. 2, 2017)

Bull elephants are sexually mature around the age of 12. They usually leave their families when 14. But virtually all of them remain virgins till the age of 30. Only when 35-40 years old do they reach their prime. Then they have 10 years to enjoy glory. But after 50 they are still reproductively active. Coincidentally, tusks develop exponentially after the bull turns 40. And it is precisely then when trophy hunters kill them.

In the case of females, it is believed that long tusks play a social status role, as usually the biggest tusked female in an elephant family is the matriarch herself. Well-documented examples of such matriarchs with very long tusks are Athena, the main character of *The elephant queen*, Mudanda and Dida, all from Tsavo, as well as Theresia and Theodora, from Amboseli.

Big tusks are also a deterrent, intimidating possible rivals and making certain fights avoidable. They help win fights without physical contact. In the elephants' world, they are weapons of mutually assured destruction. Believe it or not, the iconic individuals with the biggest weapons are amongst the most peaceful in the animal kingdom. It is like having a nuclear briefcase and its codes within reach at all times: who would mess with you?

In fact, a great tusker like Big Tembo (Tim; Fig. 1) from Amboseli achieved dominance without fighting as a mature bull. When in musth, his sheer body size and tusk size were sufficiently good arguments for any other bull to give way. When not in musth, he was intelligent enough to even run away

from belligerent bulls. He was probably the most prolific elephant father ever documented.

I leave you with this immersive account about him by a wildlife photographer who spent twenty years closely documenting Kenyan wildlife:

“Mid-afternoon the elephants start to come out of the swamp. They pause to graze on the long fresh grass at its margins. Suddenly the elephants raise their heads and trunks and look alertly towards the east. I look, too, and see a majestic bull with enormous tusks walking intently towards the herd. His name is Tim. All the elephants begin to trumpet and run excitedly in circles. I have never seen anything like this – the noise is deafening, the other elephants' trunks raised towards him. Tim walks on (...) He immediately addresses his attention to the cow in heat, who walks towards him with no trace of the ambiguous attitude she had with the other males. The bulls that have been with her the whole day submissively give way to Tim.” (Veronesi, 2015, p. 209).

Sometimes, however, fights are unavoidable. Cases when big tuskers have to fight are extremely rare. In such fights, big tusks may be a blessing or a curse, depending on their shape. Big straight tusks are formidable weapons and may quickly decide the winner against a bull with smaller tusks. To the opposite, elephants with heavily curved/crossed big tusks have a disadvantage in such fights, losing sometimes to their opponents. (These are personal observations, based on footage and accounts concerning forest elephants in Dzanga Shanga, Central African Republic, and savannah elephants in Amboseli, Kenya, and Tembe, South Africa.)

Big tusks also come in handy as tools, used by elephants in combination with the trunk for digging for roots, water and minerals, debarking trees and breaking branches, or lifting and pulling vegetation like vines.

In woolly mammoths some may think that big tusks were used to plough snow. I agree with Dick Mol that such a hypothesis is implausible. The mammoth steppe was dry and cold, with very little snow:

“The rounded tusks with a relatively small diameter, on average some 15 cm, and with the dramatic curvature, would have been highly ineffective for displacing snow. Natural selection and evolution would probably have given another shape to the tusk if it needed to be a snow shovel. Another problem would have been for the juveniles and the females, whose tusks are definitely too short even to reach the ground, let alone to manipulate the snow (...) The high crowns of the molars and their complex structure reveals that the animal was a grazer, not a browser, suggesting that the animal lived on a steppe. Furthermore, extensive research of multiple geological, paleontological and palynological evidence has revealed that the biotope of the woolly mammoth was indeed a grassy steppe with little snowfall in winter time leaving the fodder available,” (Mol, 2008, p. 108).

HOW TALL AND HOW HEAVY?

When it comes to the largest land animals, one invariably arrives at the same questions: How big is Big? How do you weigh a wild elephant bull? Pulling him by the tusks on a scale does not seem the happiest option.

After careful studies and observations, I have independently come up with a shoulder height to body mass magic formula. It is very simple and it works especially well for adult bulls. For Asians, we start with 3 tons at 2.6 m and we add 1 ton for every additional 20 cm. That gives a 3m tall, 5-ton elephant and a 3.4 m tall, 7-ton elephant. For African forest elephants we apply a similar formula, by analogy. For African savanna elephants, we start with 5 tons at 3 m and end up with 10 tons at 4 m. Of course, this a rule of thumb estimate. Some elephants are more robustly built, others are leaner. Just like people, wild male elephants have different body shapes: some taller and slenderer; some shorter and stockier; and some both tall and well built (personal observations and discussion with Joyce Poole). Desert elephants have longer legs (Lee & Moss, 1995). Big bulls are in peak condition before musth, usually during the food-rich emerald season, and visibly lose weight after an intense 3-



Figure 2. Jum Pui was the most handsome Asian great tusker in recent years. Born in the wild in 1967, he sadly passed away in June 2016, towards the end of his prime, because of digestive system infections. Those fabulous tusks certainly left a great impression on elephant ladies. In fact, locals told me that they noticed an increase of activity in female elephants each time this handsome bull passed by. It is quite remarkable that this rather small bull had such well-developed domes. Big domes are particularly appreciated in Thailand and regarded as a characteristic of bull elephant handsomeness.

month mating marathon. (Joyce Poole used midriff to back height ratio from pictures as an estimate of body condition; Poole, 1982, p. 93-96. Note that in deer species stags may lose up to 20% of their body weight during the rut. There is no concrete data on the exact percentage in wild Asian or African elephants, but based on field observations it is reasonable to assume an important variation.)

This formula is confirmed by the best shoulder height to body weight study in African and Asian elephants to date, which also takes into account allometry and the very tall individuals: *“The best weight-height relationship was shown by the Mkomasi elephants sample (...). Thus, the body mass of an average-sized African male bush elephant at 320 cm in good condition is expected to be around 6000 kg, a weight already observed in different elephant populations with the same shoulder height (...) (...) An average-sized male E. maximus (275 cm), in optimal conditions, is about 4000 kg (...) Therefore, the tallest Loxodonta africana on record (396 cm) is predicted to have weighed 10.4 tonnes, 1.9 tonnes less than previous estimates (...). Meanwhile the tallest E. maximus (343 cm) is estimated to have had around 7 tonnes of body mass,”* (Larramendi, 2016, pp. 551-553).

To add to the existing examples in that paper, in African elephants, Ahmed of Marsabit was 3 m tall for 5 tons (Shoshani et al., 1987). His height was measured on the skeleton, to which 10 cm was added for soft tissues. His total weight was based on the 16% formula from Shoshani, derived from a female Asian elephant, applied to his 800 kg skeletal weight (Shoshani, 1982). Other papers discuss at large body size (and age) in different populations of African savannah elephants (Lee & Moss, 1995) and in African forest elephants (Turkalo, 2013; I have deepened my understanding of the article by discussing these matters with the author over email). However, these publications say nothing about the correlation shoulder height - body weight. Another category of papers helps estimate Asian and/or African elephants' shoulder height according to the front-back diameter or circumference of the front or back legs (e.g.

Sukumar et al., 1988). Yet, taken alone they are not very helpful when it comes to body mass. Finally, authors sought to find the correlation between chest width measured right behind the front legs, shoulder height and body weight (Chapman et al., 2016).

In Asian elephants, it is well known that most of the elephants captive in Western zoos are overweight (Kurt & Kumarasinghe, 1998), so I did not rely on such data (e.g. Thisiam has a 3.19 m shoulder height for 6.8 tons). Those held captive in Asia are quite the opposite, underweight, as their owners and mahouts want to keep them in shorter musth periods. A bull in his prime, 40 year old, in excellent health condition should be around 3 months (or even more) per year in musth, based on observations on wild African elephants in Amboseli. However, the captive Asians in Thailand of similar age are only 1-2 months per year into musth, because they do not have a good enough condition. So for several Asian big tuskers captive in Thailand weight has generally to be slightly adjusted upwards. I obtained their approximate shoulder heights and their body mass directly from the owners when I went to photograph them: Kum Pang (2.5 m for 2.8 tons), Jum Pui (2.6 m for 3.1 tons; Fig. 2), Japhatee (2.65 m for 3.3 tons; Fig. 3) and Thong Bai (2.9 m for 4.5 tons). Other captive Asians' reliable weights include measurements for Radza from Riga Zoo, at the time he was sent to Emmen (3.15 m at the top of the back for 5.5 tons; Fig. 4), and Thechikkottukavu Ramachandran (3.17 m for 6 tons).

Finally, attempts have been made at the reconstruction of the body mass of extinct proboscideans (Larramendi, 2016).

THE HIGH DOMES OF ASIA

Who hasn't been fascinated by Rudyard Kipling's *The Jungle Book* and hasn't dreamed of following in his adventurous footsteps and journeying to the jade wilds of Asia??

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.

As a combined result of systematically catching bulls from the wild and isolating them in captivity, trophy hunting, and heavy poaching for ivory, the vast majority of bulls in most of Asian elephant populations are now tuskless (called maknas) or have very small tusks. Human-made reverse selection exterminated great tuskers throughout Asia.

The fact that only bull Asian elephants carry ivory has led over time to a severe alteration by humans of the male-female sex ratio. Sadly, there are now very few males left and what is even worse is that the natural proportion of maknas to tuskers has been reversed. Historically, maknas did not exceed 5% of the total number of male elephants in a population. Today, in Sri Lanka alone 93% of the wild elephant bulls are in fact maknas... (Kurt et al., 1995). A study of elephant bulls in Kaziranga National Park (India) showed that at equal body size and musth state, the tusker would normally prevail over the makna in case of conflict in 78.6% of cases (Chelliah & Sukumar, 2013, p. 1210: *“The role of tusk status in dominance is best determined from contests in which two males are comparable in body size and musth status but not in tusk status. Of the 116 contests, 39 involved a pair of males with the same musth status. If we define a pair of males as being comparable in body size when the size difference is 10 cm, only 24 contests with males of comparable size and musth status were observed. Of these contests only 14 were asymmetrical with respect to tusk status, and in 11 of these 14 contests the elephant with a tusk advantage won.”*).

Long tusks were common in the past and big tuskers occurred throughout most of the Asian elephant's range, from India and Sri Lanka to Indochina. Today (as per my own observations and counting, the most complete exercise of this kind so far), there are less than 15 Asian elephants left with tusks reaching all the way down to the ground, of which only one still joins



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Figure 3. Captive Asian elephant Japhatee, the youngest Asian great tusker alive, only 23 years old when this picture was taken. His tusks, still thin, are unusually long for his age.

the ranks of Colonel Hathi's jungle patrols. All the others are captive. Most of these iconic bulls were born in the wild, but then taken away from their mums and chained. As a result, they do not have proper reproductive opportunities.

Tusks may rarely exceed 35 kg in weight and 2m in length each in the remaining Asian big tuskers. King Tusk from Ringling Bros. Circus was said to have 45 kg tusks, while Radza (Riga and Emmen Zoos) and Siam (Paris Zoo) had perhaps 40 kg tusks, measuring around 2.6 m each. Similarly, Bon (Japan), Mettā and Thong Bai (Thailand) still carry long ivory, around 2.5 m (though the Thai bulls have meanwhile been trimmed).

Some of the Asian great tuskers of the past were considerably bigger than those still alive today not only in tusk size (length and weight), but apparently also in body size. The Rowland Ward World Record Asian elephant trophy (by weight) belongs to King George VI and was presented to him in 1911 by the Prime Minister of Nepal. The

elephant was hunted north of Kheri District, Naya Mulk, near Rajghat Terai Jungle, Bheri, Mid Western Nepal, a place well known for its large bodied elephants. Those tusks measure around 2.6 m, weigh a massive 73 kg each and are hosted by the London Natural History Museum.

In fact, the biggest Asian elephants in body size recently recorded came from the same area. John Blashford-Snell and Adrian Lister followed Raja Gaj (King Elephant) in Bardiya National Park, which he called home until his disappearance around 2007 (Lister & Blashford-Snell, 2000). Raja Gaj's thick tusks, almost 1.8 m long each, were one third hidden inside his enormous head. Peter Byrne made famous Tula Hatti (Great Elephant) from Sukila Phanta Reserve (White Grass Plains Reserve), where the bull found his end in 1995, stepping on a wild boar-intended mine (Lister & Blashford-Snell, 2000, p. 35). Both giants were around 3.4 m tall for an estimated weight of over 7 tons, which is twice the size of small to average adult bull Asian elephants and probably

bigger than any elephant in East Africa today.

Muscular bodies, thick necks and enormous domes: Raja Gaj and Tula Hatti were not the only characters populating the Terai jungles to fit the description. Standing over 3-3.2 m and tipping the scales at 5-6 tons, other bulls (like Kansha, Raja Gaj's companion) confirmed that the big size genetics are still a defining feature of that population. In the past, the famous Nepalese war elephants originated from the same area, as well as the biggest captive elephant in London (Jung Pershad). Amongst Asian elephants only the Syrian elephants could reach similar body sizes.

Bardiya's elephants are famous for their exceptional, robust size, and for their monster (double) domed heads. The more they raise their heads, the more those domes look like the Himalayas, pushed up by the Indian sub-continent pressuring the Asian plate. A pair of huge skull muscles over the splenius, called splenius superficialis, absent in African elephants,



Figure 4. Born in 1967 in the wilds of India, Radza spent most of his life in zoos. An Asian of East African size, he was massively built, with high domes and big tusks. He sadly left us in October 2013, but his legacy lives in his more than 10 babies still alive.

flex like the biceps of a bodybuilder. They are a throwback to the old *Elephas* lineage. Viewed from the side they look like mammoths. While the biggest bulls in other Asian elephant populations, exceeding 3 m in height, may also have very big domes (Radza, Siam, Nadungamuwa Raja, Gajaba), in Nepal's Terai jungles this is the rule. Such high heads may measure as much as 1.7 m on a diagonal from the top of the domes to the tusk at the lip – approximately half of the elephant's shoulder height. (Again, an easy to remember formula: the truly big-headed Asian bulls have a diagonal height of their heads roughly half their shoulder height. Indeed, such elephants have some of the highest heads in relative terms of any elephant to have ever walked the earth, representing about half of their shoulder height, that is over 1.7 m in bulls like Raja Gaj (based on measurements by Adrian Lister on Raja Gaj and electronic measurements by myself on Raja Gaj and another bull from the same area, very likely the son of Raja Gaj). The height of their enormous foreheads alone (eyes to the top of the domes) is

some 31% of the shoulder height, and may slightly exceed 1 m (Lister & Blashford-Snell, 2000). These Asian giants are the only elephants to match in relative terms the high-domed foreheads of the larger straight-tusked elephants. While people looking at them in side view tend to compare them with mammoths, in fact it should be the other way around, as the Asian double-domed foreheads seem to be higher than the woolly mammoth's single-domed foreheads.)

Adrian Lister and John Blashford-Snell (2000, p. 36) explain that “*the function of the high cranial domes of the Asian elephant is likely to be, at least in part, intimidatory. In the threat posture or when preparing to charge, the ears are moved laterally, maximizing facial area from the front. In the African elephant (...), the very large ears create a huge area. In (the Asian elephant), the smaller ears are compensated for by the much higher cranial domes than in (the African elephants). It is also possible that the cranial domes form part of the animals' sexual display, consistent with the*

finding that their average size seems to increase at around 30 years of age, approximately the age after which successful bulls are most sexually active.”

In the past, reports of such big sized elephants all came from the Himalayan foothills, from the White Grass Reserve in the west to the Garo Hills of Assam in the east. Based on their front foot circumference, several bulls in the range of 3.2-3.5 m tall at the shoulders were recorded (Wood, 1983). Today (as per my own research), only a handful of such bulls survive in Bardiya and a few smaller, but proportionally equally massively built, in the Dooars forest of the Gorumara National Park.

Similarly to African elephants, the reduced body size and tusk size in Asian elephants today are the unfortunate consequence of human (reverse) selection against big tusked elephants. It is incorrect to say that elephants have 'adapted' so that now they have much smaller tusks or are tuskless. No, that cannot be called 'adaptation'. All that happened is that

the elephants with the best genetics were systematically eliminated till almost none was left. While trophy hunting targeted Asian big tuskers in the past in places such as India and Myanmar, captivity affected biodiversity in Asian elephants to an even greater extent than trophy hunting and poaching, across the whole of their range.

Isolation, exhaustion, being underweight or overweight are the main causes of the disappearance of the big tusk genes in Asian elephants. For centuries, temples and local rulers selectively took males from the wild, due to their more imposing stance. However, those males lived isolated lives and had virtually no opportunity to interact with females and reproduce. Bulls used in wars and present-day ceremonies still recall that. Equally, forest exploitations preferred elephant bulls, which were worked to exhaustion and did not have many opportunities to pass on their genes (Kurt et al., 1995). More recently, the few big tuskers left in tourist camps are kept on low-calorie diets, in 'rationalised' quantities, as camp owners and keepers do not want bulls to be too strong and spend too much time in musth.

Historical pictures with Asian big tuskers show almost exclusively captive animals, as big tuskers in the wild were poorly documented ('captive' is correct, not 'domesticated'). The longest tusk of an Asian elephant on record belonged to the white elephant Chao Phraya Prapubkarn of King Rama IV (Mongkut): it reached around 3 m for 45 cm girth at the lip and it is now on display in the Royal Elephant National Museum in Bangkok. The same size was reached by the Jarkov woolly mammoth. The Jarkov tusks are of a decent size even for the woolly mammoth standards: the right tusk is 2.94 m on the outer curve and has a maximum circumference of 45.5 cm, weighing 45 kg; the left tusk is 2.98 m, has a maximum circumference of 45.8 cm and weighs 47 kg (Mol et al., 2001). The other tusk of the same elephant got broken at the tip and measures around 2.5 m. The most handsome Asian great tusk ever photographed was a favourite of the king of Cambodia at the beginning of the 20th century, where he participated

alongside some other 60 tuskers in elephant beauty contests.

Other rulers in the region used to have similarly big-tusked elephants at their courts. For instance, such elephants with tusks-to-the-ground appear in the old pictures taken at the Ho Quyen arena in Hue (Vietnam), where they were used in Colosseum-style combats against de-fanged and de-clawed tigers. Even today, some of the very last big-tusked elephants are still used in religious processions, such as the Kandy Esala Perahera (Sri Lanka), the Kerala temple festivities (India) and the parades in Banda Aceh (Indonesia), or in different festivals and tourist shows (Thailand). They became the best-known elephants in their countries (Millangoda Raja in Sri Lanka, Plai Thong Bai in Thailand), and one of them even reached Hollywood via one of Harrison Ford's Indiana Jones movies (Heiyantuduwa Raja).

Although the few big tuskers left in Western zoos have more opportunities to mate, they often suffer from obesity due to lack of exercise and/or improper diets. They may weigh 800 kg more than they should. Studies conducted on Asian and African elephants in zoos conclude that, ironically, their life span is on average much lower than in the wild and that their fertility seems to be seriously affected (Clubb & Mason, 2002; Chusyd et al., 2018). Luckily, countries around the world have banned elephants in circuses, as they were another cause of demise of the great tuskers (e.g. the imposing Colonel Joe from the Krone circus was castrated). Unfortunately, to my best knowledge there is no targeted breeding programme focused on big tuskers in any of the zoos or sanctuaries which still host Asian elephants with such genetics.

Finally, the increased human pressure by settlements moving into the last wilderness places is taking a toll on the last big-tusked elephants, too. Human-elephant conflict gives the final blow to the already isolated and fragmented elephant populations. Maybe the most telling example is the death of Parakrama, the most promising emerging big tusk in the wilds of Sri Lanka, during a clumsy

translocation attempt in 2010 (Amaranayake, 2010).

It can be said that there is evidence of around fifty Asian elephants with tusks reaching 2-3 m in length, counting also those trimmed, but very close to that mark. If we factor in that, during the same period, Asian elephant populations have always stood at around one tenth of their African cousins' populations, this would mean that in relative terms Asian elephants may approach Africans in big tusk numbers. In total, I have counted nine bull Asian elephants with at least one tusk in the range of 2.5-3 m in length (out of which four were trophy hunted): Chao Phraya Prapubkarn (Thailand), No1 RW (West Terai Jungles, India/Nepal), No 10 RW (Assam, India), Radza (Riga/Emmen Zoos, born in India), No 12 RW (Burma), Siam (Paris Zoo, born in India), No 5 RW (Coimbatore, India), Bon (Kanazawa Zoo, Japan) and Plai Kao (Phra Savet Adulyadej Phahnon), King Rama IX's first white elephant (Thailand). I am pretty sure that at least four more would have exceeded 2.5m in tusk length if not trimmed: Mettā (Pattaya, Thailand), Thong Bai (Surin, Thailand), King Tusk (Ringling Bros. Circus) and Colonel Joe (Krone Circus). I could identify around twenty bulls with tusks in the range of 2-2.5 m: Ziggy (Brookefield Zoo), Ranchipur (San Diego Zoo), Shenka (Circus Alberti), No 4 RW (Burma), Bogeshwar (Kabini, India), Jum Pui (Lampang, Thailand), No 3 RW (Burma), Millangoda Raja (Sri Lanka), a tusk in Dalian Zoo (China), Nuo Zhe (Nanchang, China), Japhatee (Thailand), Bang (Samui, Thailand), three in Surin, three more in Maesa and Lampang, and one in Khao Yai Zoo (Thailand).

While Asian elephants are the most underestimated of the three big tusk categories, much more data already exists on African elephants and woolly mammoths. That is why in what follows I will discuss those categories less extensively, referring rather to existing literature.

THE BIG EARS OF AFRICA

Today, there are around 400,000 African elephants left. Before poaching became the word of the day, millions of elephants were legally massacred across the entire Dark Continent.

Hannibal ad portas! In 218 BC Hannibal crossed the Alps and almost reached Rome on African war elephants, giving Carthage its most glorious hour two years later at Cannae. At the time, elephants roamed Africa in the millions, from the shores of the Mediterranean to the Cape of Good Hope and from the Atlantic coast to the Indian Ocean. As recently as one hundred years ago, African elephants were still plentiful south of the Sahara.

However, the ivory rush that followed dealt a devastating blow to the species as a whole and to big tuskers in particular, long before the Asian-fuelled poaching would play any major role. Thousands of tons of ivory were sent to countries such as Belgium, France, Germany, the United Kingdom and the United States. From the Belgian Congo alone close to one million kilograms of ivory were sent to Belgium in only four reference years.

Few things on Earth are comparable to the sight of a majestic great tusk in the African bush. Meeting one of these 'Lords of the Wilderness' is like travelling back in time, when the world was a wilder place.

Once a common sight, probably in the thousands, roaming far and wide from Sierra Leone in the west to Somalia in the east and from Sudan in the north to South Africa (e.g. Sanchez-Arino, 2015; Marais & Hadaway, 2006; Marais & Ainslie, 2011), there are now only around thirty elephants with tusks-to-the-ground left to grace the whole of Africa. This number includes a few females and a few forest elephant bulls. A hundred or so presently emerging great tuskers may carry the same superior genetics, but only time will tell. For years, sources on the internet told us that there are about 100 big tuskers left in Africa. It was a discussion between me and a big tusk expert, while preparing my spring 2016 article for *Africa Geo*, that solved the puzzle – there were only around 30 of

them left, out of which some 20 hundred pounders. This number was deleted from the initial draft by *Africa Geo*, but I mentioned it in several public social media posts. Miraculously, the number 30 popped up later in a BBC article, which used as its cover one of the pictures I previously selected for my article. Unfortunately, the BBC never credited me for the counting, but I was happy to see that at least the numbers were finally right.

Big tusks were so common in the past that most of them were never recorded and never kept intact, but instead were cut into smaller pieces and transformed into consumer goods such as billiard balls, combs and piano keys. Historical pictures from ivory markets and warehouses in Zanzibar or London show piles and piles of such big tusks.

According to Rowland Ward's records, the heaviest tusk of an African elephant weighed an astonishing 236 lb (107 kg) shortly after the elephant was killed, while unverified sources quote an even heavier, 258 lb (117 kg tusk) (Wood, 1983). Such tusks are at least as heavy as the heaviest woolly mammoth tusks ever unearthed. Yet, the longest tusks are not always the heaviest, as weight also depends on the circumference. The longest African elephant tusk measured around 3.5 m, and there are some other 14 bulls with at least one 3 m long tusk that I am aware of. (The latest such example: Big Tembo from Amboseli has tusks of 3 m, 73 kg, and 2.8 m, 61 kg, and 50 cm circumference at the lip each.) 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 straighter tusks usually wear out more readily.

African elephants may reach a 1.7 m tusk spread, like the impressive bull called Kenani, the widest big tusk photographed while still alive. Kenani matches the woolly mammoths in absolute spread and even the straight-tusked elephants, relative to his body size. (I have electronically calculated Kenani's tusk spread based on a front view picture by Tsavo Trust. Kenani had the same maximum width of both tusks when in anatomical position in the alveoli as the Yukagir mammoth.

Mol et al., 2006.) Other African big tuskers had tusks spreads over 1.3 m, comparable to the Jarkov mammoth.

Forest elephant tusks are denser, harder and more appreciated than other elephant tusks. In bulls, they can reach mammoth proportions, up to 3 m long and 70 kg per side. (The elephants with that tusk size may be a cross between savanna and forest elephants, although superficially looking like forest elephants. I do not consider savanna and forest elephants as distinct species, but rather as subspecies) Sadly, there are so many of them in trophy hunters' collections, and so few left in the wild. In fact, I would be surprised if any of the tusks of the bulls still alive today exceeds 2 m in length and 35 kg in weight. Pom (Fig. 5) is perhaps the most magnificent forest elephant big tusk alive. Electronically measured to be 2.4 m tall, he is a rare elephant who can simultaneously touch the ground in 9 points.

Forest elephant teens with long ivory fueled the 'pygmy elephants' myth (*L'entretien des éléphants domestiques, Congo belge 1904*). In fact, forest elephant males enjoy precocious tusk development (Andrea Turkalo, personal communication): very long tusks may come at a very young age, at around twenty. But those tusks are thin and will thicken with age.

In females, tusks may exceptionally reach 25 kg per side and over 2 m in length. Recently, Mudanda's tusks measured around 1.8 m in length and weighed 15 kg each (according to measurements by the Tsavo Trust).

After the killing of millions of African elephants through commercial hunting by the Westerners, trophy hunting dealt the surgical precision blow to the elephants with the best genetics (reflected in the biggest tusks and body sizes). Professional hunter Tony Sanchez-Arino alone linked his name to the demise of 1300 big-tusked African elephants, while slaughterhouse baron Marc Péchenart took great pride from killing a dozen hundred pounders in the 1970s (Sanchez-Arino, 2015). The biggest error of judgement of trophy hunters was that they wrongly assumed, or pretended to believe, that these large ivory carriers

were old bulls, beyond reproductive age. A seminal study by Joyce Poole demonstrated that big-tusked, big-bodied bulls are most often breeding bulls in their prime and would normally do most of the mating. Selectively trophy hunting these magnificent bulls allows males with small tusks to breed much more frequently than would be the case under natural conditions, and thus pass their inferior genes to the next generation. Unfortunately, trophy hunting has led to the disappearance of big bodied and big tusked 'Lords of the Wilderness' across Africa, leaving the 'Losers' to do the mating.

The biggest African elephants, from Southern Angola, in the past attained 4 m and over 10 tons, in the same league with Colombian mammoths and European straight-tusked elephants. Today, African elephants reaching 3.8 m

tall and 9 tons may still exist in Luan-gwa, Zambia (Lee & Moss, 1995). In other parts of Africa big bulls may reach 3.5 m and 7.5 tons. Bulls in East Africa are generally smaller, averaging 3.05 m and 5 tons, with the largest recorded (a big tusker called Bad Bull) around 3.6 m and perhaps 8 tons.

Forest elephant bulls may exceed 2.8 m in shoulder height and perhaps over 4 tons, but a 2.3 m tall bull is of a more typical size.

Now, at the crash of the ivory rush 'party', Asian demand in countries such as China, Japan and Vietnam fuels poaching. Increasing human populations leave very little space to wildlife, further fragmenting already endangered habitats and killing those daring crop raiders.

Tuskless elephants were a rarity in Africa in the past, an accident of nature. Today, in a number of populations across Africa, we find most of the elephants either have no tusks or very small tusks, mainly as a result of trophy hunting and relatively recent poaching. In Addo National Park (South Africa) around 98% of female elephants no longer have tusks, where "big game hunters had killed all but eleven elephants by the time the park was created in 1931". In Gorongosa National Park (Mozambique), almost half the females over 35 years old are tuskless, as well as 30% of the younger females, inheriting the bad genes from their mothers (Joyce Poole in England, 2016). The number of tuskless female elephants in Zambia's South Luangwa National Park increased from 10,5% in 1969 to 38,2 % in 1989 (Jachman et al., 1995).



Figure 5. Forest elephant Pom.

In Queen Elizabeth National Park (Uganda) the normal level of tusklessness in an elephant population, somewhere between 3% and 4%, has increased to 9% and even 25% in different areas (LaCapria, 2016). In West Africa, in Zakouma National Park (Chad) most of the elephants have such small tusks they can barely be seen.

THE STEPPE WOOLLIES

Contrary to common belief, woolly mammoths were hardly mammoth size. They were normally the size of an Asian elephant, standing 2.6-3.2 m at the shoulders (Boeskorov et al., 2020; Mol et al., 2001; Mol et al., 2006). It seems that the ones in Western Europe, rising to the size of an elephant in East Africa (3-3.5 m), were bigger than those from Siberia or Alaska. Probably the much bigger Colombian mammoths (up to 4 m tall, the size of the biggest recorded African elephant) were a subspecies of the woolly mammoth, as the two quite frequently cross-bred, producing viable offspring.

“The European form 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. The northern woolly mammoths were about the same height as modern Asian elephants, although proportionally a bit heavier.” (Larramendi, 2016, p. 561).

An analysis of the size of tusks and the heights of the known skeletons of adult and old male woolly mammoths found in the territories of Yakutia and Taimyr concluded that “throughout the period 55,000-11,500 years ago, male mammoths ... (had) tusks reaching a length of 300-350 cm along the outer curvature and weighing up to 75 kg” (Boeskorov et al., 2020, p. 90).

As European woollies were the body size of an African elephant, their tusks seem to have followed the same upward trend. A recent tusk from the North Sea, which I personally measured with Dick Mol, has a record 66cm girth and weighs 86.2 kg. It is presently on display at Historyland in Hellevoetsluis (Fig. 6).

Bigger tusks than that, sometimes exceeding 4 m and/or 100 kg, were found in both Siberia and Alaska, but belonged probably to larger mammoths, steppe mammoths or Colombian mammoths, not to woollies (Boeskorov et al., 2020). The biggest in Rowland Ward, hosted by the American Museum of Natural History, is 201 lbs (92 kg), possibly a Colombian mammoth; the biggest tusk mentioned by Adrian Lister is 84 kg (Lister & Bahn, 2007, p. 110)

Female woollies could have tusks as big as the biggest in female African elephants, up to 2.47 m and 19.7 kg. They were much thinner and usually less curved than bull tusks, and sometimes even straight (Boeskorov et al., 2020).

CONCLUSIONS

1. At least in relative terms, the big-tusked elephants of today are generally as glorious as the most formidable proboscideans of the past.
2. Taking the woolly mammoth as reference, the Asian and African big tuskers are in the same league in absolute terms.
3. While I have nothing against a high quality cloning to bring back the woollies, maybe we should intensify our efforts to save the last Asian and African large ivory carriers, living monuments of natural history.
4. This kind of amazing genes may disappear in the Asian and African elephant species as a whole in the very immediate future. We may have a very last chance to preserve nature's original design of the glorious trunk-bearing pachyderms.
5. That is why several measures are required, especially banning trophy hunting (where it still takes place), armed guard protection 24/7 to the last great tuskers and enhanced security to the whole population they belong to, as well as targeted artificial insemination programmes for those already captive (Asians). At the same time, one should take measures to impede the proliferation of tuskless elephants (including maknas) and facilitate the restoration of natural proportions of tuskers vs tuskless elephants in the affected populations, which may include a gradual selective hunting of tuskless elephants.

Crossed swords or embracing arms? I used to think of crossed tusks like crossed swords. However, the day my old landlady visited me, this perception was changed. She said, looking at the print on my wall: those tusks are like two embracing arms!

In Asian elephants, pictures with the 3m-long tusked Chao Phraya Prapubkarn alive show a crossed tusker. In African elephants, judging from the pictures, the 3.5 m long tusks from the Heads and Horns New York zoological collection were obviously crossed. These tusks came from Abyssinia, were then offered as a gift by Charles T. Barney to the New York Zoological Society. Similarly, the tusks of Shawu (approx. 3.2 m), one of the Magnificent Seven from Kruger, were also crossed. A notable pair of tusks from Alaska which may be the longest and heaviest woolly mammoth tusks ever recorded were also crossed. According to fossil trading company The Curator's Eye, the longest tusk measures 14 feet, 4 inches (4.37 m) and weighs approx. 245 lbs. (111 kg); the two tusks together weigh approx. 465 lbs. (210 kg); however, they may belong to a Colombian mammoth. Thus, the longest tusks in the three mentioned species (Asian, African and woolly) were ALL crossed tusks. So the HUG is the greatest tusker salute! A big hug to all biodiversity-loving and environmentally-friendly readers.

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WIL VAN BALEN

Figure 6. Dick Mol enjoying the proximity of a record-size woolly elephant tusk.

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Samenvatting

Afrikaanse olifanten zijn in omvang groter dan wolharige mammoeten en beide zijn groter dan Aziatische olifanten. Toch kunnen Aziatische olifanten die leven nabij de uitlopers van de Himalaya's een lichaamsgrootte bereiken die vergelijkbaar is aan die van Oost-Afrikaanse olifanten en Europese wolharige mammoeten.

Voor elke extra 20 cm schouderhoogte bij een volwassen stier mag men ruwweg 1 ton bij het lichaamsgewicht optellen. Aziatische olifanten hebben een enorm koepelvormig hoofd, dat diagonaal gemeten overeenkomt met de helft van hun schouderhoogte. Het hoofd van een 3,4 meter grote Aziatische stier zal net zo hoog zijn als dat van een 4 meter grote Afrikaanse stier.

Afrikaanse olifanten hebben doorgaans de zwaarste slagstanden, terwijl de wolharige mammoeten meestal de langste hebben, waarschijnlijk ook vanwege de vorm die leidt tot minder slijtage aan de punten. Maar ook Aziatische olifanten kunnen slagstanden groeien van 3 meter lengte en 73 kg per stuk. Het record voor de langste en zwaarste slagstand ooit gemeten bij een Afrikaanse olifanten staat op 3,5 meter en 107 kg. De langste wolharige mammoetslagstand wordt geschat op meer dan 4 meter, en de zwaarste evenaarde waarschijnlijk die van de Afrikaanse.

Doordat de Afrikaanse en Aziatische 'big tuskers' (olifanten met echt grote slagstanden) zijn uitgeroeid met trofeejacht, stroperij en gevangenschap, geven de nu nog levende olifantenpopulaties een verkeerd beeld, waarbij wolharige mammoeten voorzien zijn van de grootste slagstanden. Maar grote slagstanden en lichaamsomvang zijn onderdeel van het roemrijke ontwerp van alledrie de slurfdragers.