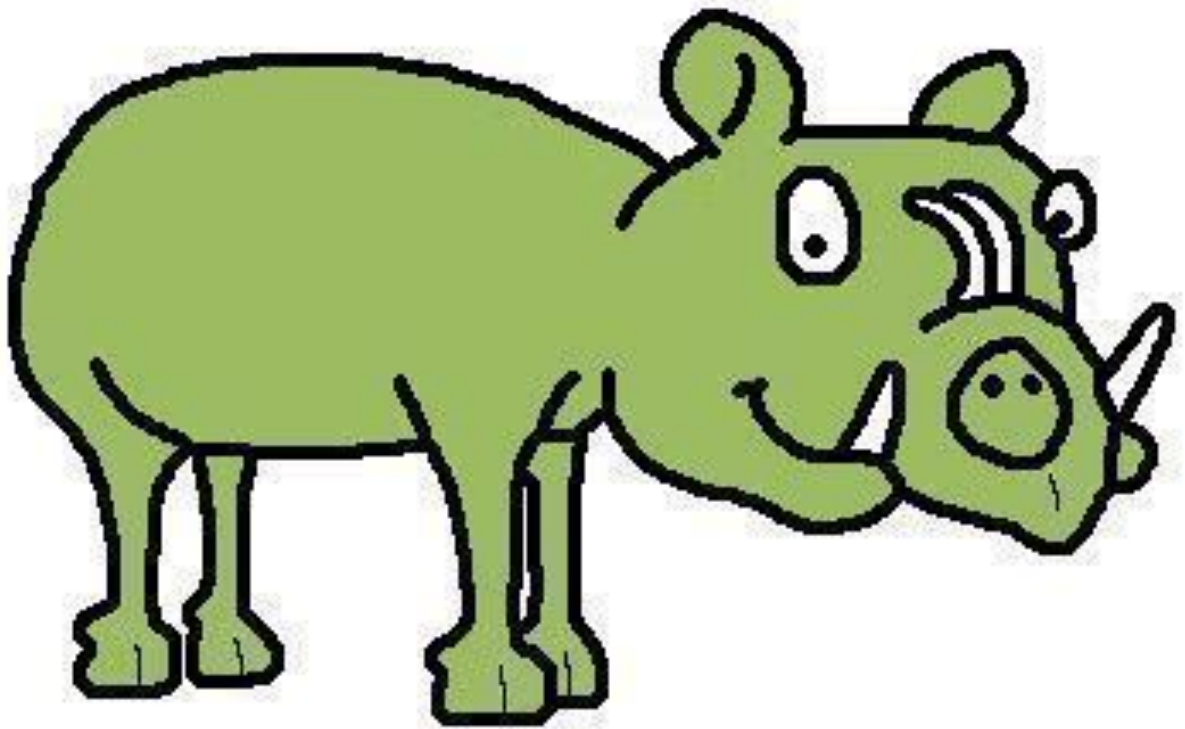


The Babirusa Project

Version 2



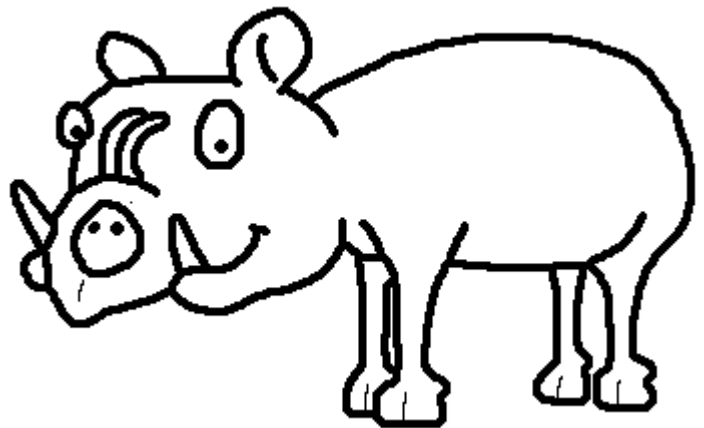
David Twamley

The babirusas (or 'pig-deer') are a genus of three (possibly four) species of bizarre-looking pigs from a few islands in Indonesia. All species are listed as threatened by the IUCN Red List.

This document was first written in February 2018, and amended April-May 2024.

Contents

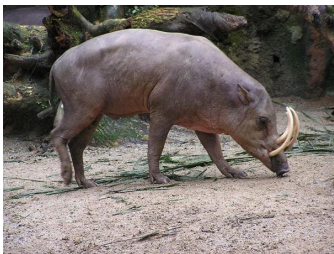


1. Taxonomy
2. Physical Appearance
3. Distribution and Habitat
4. Feeding and Social Life
5. Reproduction and Life Cycle
6. Threats and Conservation
7. Fun Facts
8. Genera of Suidae
9. Wildlife of Sulawesi
10. My Love for Babirusas
11. References



Taxonomy

Babirusas are members of the pig family Suidae within the order Artiodactyla (which also includes camels, deer, antelope, cattle, hippos and even whales (Geisler and Uhen, 2003; Boisserie *et al.*, 2005)). There are three currently accepted species, forming the genus *Babyrusa*. Until 2002, these were all considered subspecies of a single species, *Babyrusa babyrusa*. They have since been reclassified as distinct species based on various morphological differences as detailed in the table below (Meijaard and Groves, 2002).

Table 1: Babirusa species and their distinguishing features

Picture	Species	Distinguishing features (Meijaard and Groves, 2002)
 <p>© Masteraah</p>	Sulawesi babirusa <i>(Babyrusa celebensis)</i>	Found on the northern arm of Sulawesi; sparse or no hair; sparse tail tuft; upper canines long and thick, converging slightly before arching back towards the forehead.
 <p>© Indonesian Ministry of Environment and Forestry/Maluku Natural Resource Conservation Agency.</p>	Buru babirusa <i>(Babyrusa babyrusa)</i>	Smallest species, from Buru and the Sula islands; long, thick hair over body (alternative names are hairy or golden babirusa); well-developed tail tuft; upper canines short, slender, slightly convergent and grow back towards the forehead.
 <p>© IUCN Wild Pig Specialist Group</p>	Togian babirusa <i>(Babyrusa togeanensis)</i>	Largest species, from the Togian islands off the coast of Sulawesi; sparse covering of short hair; well-developed tail tuft; upper canines short, convergent and rotated forwards.

In addition to the species described above, a fourth species has been proposed, *Babyrusa bolabatuensis*, from southern Sulawesi. However, this species is known only from subfossil remains, and its status as a valid species remains unclear (Meijaard and Groves, 2002).

Babirusas have traditionally been treated as a tribe (Babyrosini) within the Suinae subfamily as accepted by Meijaard *et al.* (2011), but one study by Gongora *et al.* (2011) suggests they constitute their own subfamily, Babyrosinae.

Physical Appearance

All species of babirusa are relatively small by pig standards, sharing a barrel-shaped body, arched back, slender legs, and a pointed snout. Unlike other pigs, they lack the rostral bone in the snout that allows them to root (Meijaard *et al.*, 2011).

Their trademark feature is a pair of strange, curling tusks that pierce through the pig's snout and (except in the Togian species) curl towards the forehead, giving the babirusa a prehistoric appearance. The tusks have been known to eventually pierce the skull (Naish, 2010b), so in captivity, the tusks may be partially removed, as shown in BBC's *Ingenious Animals* (2016). These tusks are only present in the male, who also has large tusks in his lower jaw, just like other pig species. Females have either smaller tusks or no tusks at all. The tusks are also what give the animals their name; "babirusa" is Indonesian for "pig-deer", because it reminds some people of the antlers of a deer (Macdonald, 1993).



Figure 1: Skull of a Buru babirusa. © Klaus Rassinger and Gerhard Cammerer

While the Sulawesi babirusa is virtually hairless, the other two valid species are hairier by comparison. The Buru species has a coat that varies in colour from white to gold (hence its other name "golden babirusa"), with a black rump. The Togian babirusa has shorter hair, with darker upperparts that also vary in colour (Meijaard and Groves, 2002). Like other even-toed ungulates, babirusas have four toes on each foot, but walk on the enlarged middle two, with the first and fourth digits never touching the ground.

Distribution and Habitat

Babirusas are endemic to Indonesia, specifically Wallacea, which includes the island of Sulawesi (formerly known as Celebes), the Lesser Sunda Islands, the Maluku islands and Timor. Named after the explorer Alfred Russel Wallace (1823-1913), the region is home to distinctive animals of both Asian and Australasian origin; whereas the islands of Sundaland in the west are home to animals that can be found on mainland east Asia, such as elephants and tigers, the fauna of the islands of Lombok and eastwards are characterised by marsupials and birds similar to those found in Australia. Sulawesi is home to a mixture of both (Wallace, 1869). As already discussed, babirusas are native to Sulawesi, Buru, and the Togian and Sula islands (Figure 2).

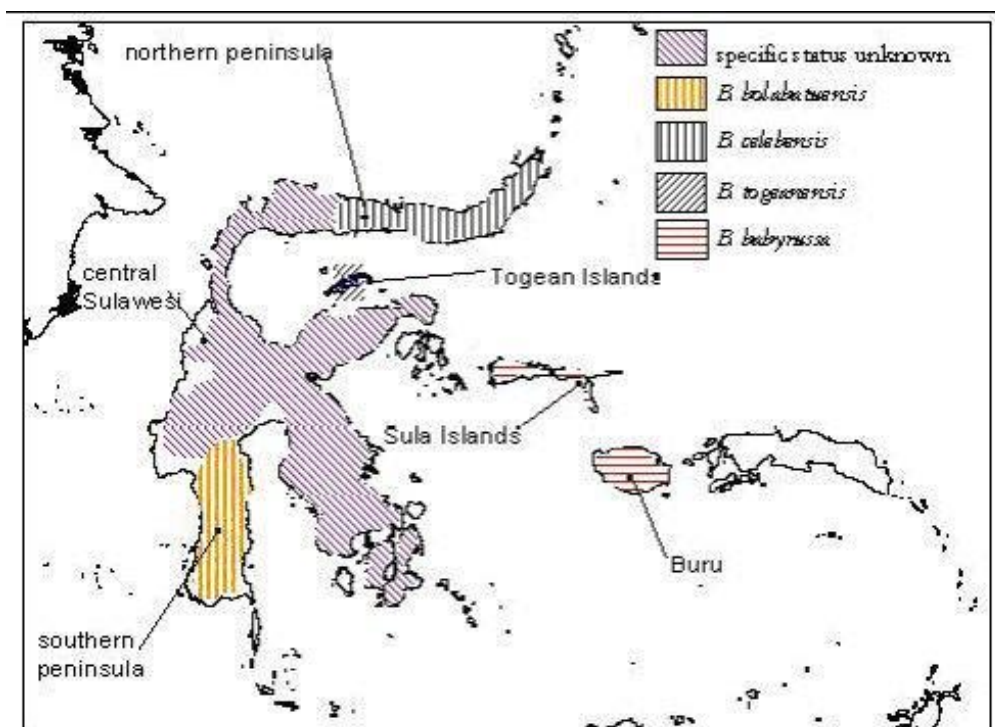


Figure 2: Where in Indonesia babirusas can be found, taken from <http://scienceblogs.com/tetrapodzoology/2010/02/23/many-babirusa-species/>. Originally from Meijaard and Groves (2002).

Babirusas prefer lowland tropical rainforests along riverbanks (Riley, 2002), although local people have reported sightings of the Buru babirusa in hilly/mountainous areas (Rowlands *et al.*, 2018). The Togian babirusa has also been observed in “mixed gardens” and “village edges”, in addition to more natural environments (Akbar *et al.*, 2007).

Groves (2001) suggested that the babirusas from Sula and Buru (constituting the species *Babyrousa babyrussa*) may have been introduced to the islands by humans as royal gifts. However, since these animals are known to be excellent swimmers (Melisch, 1994), it is possible that they made it to the islands themselves.

Feeding and Social Life

Like other pigs, babirusas are omnivores, with fruit and seeds forming the main portions of their diet in the wild, along with leaves, grass, soil and rock fragments, and small animals if they can catch them (Meijaard *et al.*, 2011; Clayton, 1996). Disturbingly, adults have also been known to cannibalize piglets of their species as well (Leus *et al.*, 1992). Their digestive tract is similar to that of domestic pigs (*Sus scrofa domesticus*), but the diverticulum of the stomach is enlarged, which may point to the babirusa being a ruminant, though this is not supported by evidence (Macdonald, 1993). They have powerful jaws and teeth which reportedly allow them to crack nuts and seeds with ease (Meijaard *et al.*, 2011). Due to the lack of a rostral bone, the babirusa cannot use its nose to root into hard substrate (Leus *et al.*, 1992; Macdonald, 1993).

Babirusas are known to socialise at volcanic salt licks, where they have been observed licking the rocks, ingesting soil, and drinking high quantities of salt water. The mineral composition of some studied salt licks indicates that these areas contain sufficient quantities of minerals such as calcium, magnesium, potassium and sodium, which are lacking in fruits eaten by the pigs (Patry *et al.*, 1995; Clayton, 1996).

The boars are solitary animals, rarely travelling in pairs or trios, whereas sows and their piglets form herds of as many as 84 (Patry *et al.*, 1995). Active during the day (Leus *et al.*, 1992), the babirusa has been reported to construct nests from branches in which to sleep, by breaking off branches with its jaws, though it is also said to sleep in depressions made in the ground. They have also been reported to bite off leaf branches to use as a sort of “umbrella” against the rain (Macdonald, 1993).

During fights, a male babirusa doesn't use his upper canines as weapons, as they are considered brittle (Macdonald and Leus, 1995; Meijaard *et al.*, 2011). Instead, they are used for defence, with the lower tusks as offensive weapons. When fighting, the males jump up on their hind legs and hit out at their opponent with the forelegs in a form of “boxing” (Macdonald *et al.*, 1993).



Figures 3 & 4: A tusked male (3) and a tuskless female (4), taken from <http://www.arkive.org/sulawesi-babirusa/babyrousa-celebensis/>

Reproduction and Life Cycle

Babirusas do not seem to have a set mating season as births can occur year-round. Females are in oestrus for 2-3 days. Before giving birth, the female constructs a nest from branches that she breaks off of bushes and trees, which may be 25 cm deep and 3 metres long (Macdonald, 1993). After a gestation that typically lasts between 155-158 days (a gestation of 171 days has been reported), typically one or two piglets are born (Macdonald, 1993), although triplets are occasionally produced (Chester Zoo, 2018). While unusual compared to other pig species, which often produce large litters, this small litter size is the result of the female having only one pair of teats.

Captive babirusas have been known to become sexually mature at 5-10 months of age (Meijaard *et al.*, 2011), though in the wild they may not reach maturity until they are over a year old due to nutritional constraints (Macdonald, 1993). They have been known to live up to 24 years in captivity, but in the wild they may live just 7-12 years (Meijaard *et al.*, 2011).

Babirusas have been known to interbreed with domestic pigs. In 2006, a male Sulawesi babirusa at Copenhagen Zoo, Denmark, was accidentally allowed to mate with a female domestic pig, as the two species were thought to be too evolutionarily distinct to breed with one another. This resulted in a litter of 5 hybrid piglets; two of the piglets died from “maternally induced trauma”, while the surviving 3 were found to be infertile at the age of 27 months (Allen *et al.*, 2018; Thomsen *et al.*, 2010).

Adults have little to fear from predators, as large carnivores are absent from the islands, but the young may be preyed upon by pythons (*Python* sp.) and the Sulawesi palm civet (*Macrogalidia musschenbroekii*). The animals’ slow rate of reproduction and small litter size suggests that they are not adapted to experiencing high levels of predation (Whitten *et al.*, 1987; Macdonald, 1993). But whatever few predators they might have, babirusas have something much more serious to worry about...



Figures 5 & 6: Female and male Sulawesi babirusas (5); Female babirusa and piglet (6), taken from ARKive

Threats and Conservation

According to the International Union for the Conservation of Nature (IUCN), the Buru and Sulawesi species of babirusa are both Vulnerable to extinction (Macdonald *et al.*, 2008; Leus *et al.*, 2016), while the Togian babirusa is classified as Endangered (Macdonald *et al.*, 2016). All three species are threatened by hunting and habitat destruction. Whitten *et al.* (1987) noted that babirusas are among the first animals to disappear when their forest home is destroyed, suggesting that this may be due to piglets becoming easy prey for domestic dogs. There may be fewer than 10,000 Sulawesi babirusas left in the wild (Leus *et al.*, 2016), while the Togian babirusa may number no more than 1,000 individuals (Macdonald *et al.*, 2016).

All three species are protected in Indonesia, (Macdonald *et al.*, 2008; 2016), and are present in many protected areas, but these measures may not be sufficient to prevent the extinction of these remarkable mammals. The Sulawesi babirusa can be found in many zoos around the world, although this population has historically been highly inbred (Macdonald, 1993), which may explain why the population in Europe has seen a decrease up until the late 2010s, after which the number of European zoos with the species has been steadily increasing again.

There is an international studbook in place for the world's captive population (Rowlands *et al.*, 2018), with the European Endangered species Programme (EEP) for the babirusa in Europe currently being held at Tiergarten Nürnberg in Germany (Tiergarten Nürnberg, 202?). In addition, babirusas are one of three ungulates - together with the banteng (*Bos javanicus*) and anoas (*Bubalus depressicornis* and *B. quarlesi*) - to be covered by the Action Indonesia Global Species Management Plans (GSMPs). Founded in 2015 and approved in 2016 by the World Association of Zoos and Aquariums (WAZA) and the Ministry of Environment and Forestry, the goals of the GSMPs include reaching a genetically and demographically sustainable ex situ population of these species, raising awareness among zoo visitors, and supporting in situ projects (WAZA, 201?).



Figure 7: Bukaan, born in 2016, with mother Kendari, at Chester Zoo. © Chester Zoo

Fun Facts

- As determined by Gongora *et al.* (2011), babirusas are the most basal members of the suidae family, diverging from other pigs between 13.25-22.4 million years ago during the Miocene epoch.
- The babirusa has been observed reaching high for leaves on its hind legs (Macdonald and Leus, 1995), in a similar manner to the gerenuk (*Litocranius walleri*) of Africa.
- The Sulawesi babirusa is not only the most common babirusa species, it remains the only species for which there are widely available photographs, and the only one kept in zoos, although some have claimed that the Buru babirusa also occurs in captivity, and that no captive Sulawesi babirusas exist outside North America (Naish, 2010a).
- Unusually for pigs, babirusas have been observed ploughing into soft sand, forming a deep furrow by kneeling down and pushing their head forward until the sand was level with their eyes. Before ploughing, the hogs produce strange, foamy saliva in the corners of their mouths that disappears after the ploughing has ended. Only males are known to perform this behaviour, and will plough for the longest time if they are kept with another male. This behaviour is believed to be used for scent-marking and chemical communication, partly based on the presence of steroids in the saliva (Leus *et al.*, 1996).
- It seems that humans have known the babirusa since prehistoric times. Cave paintings found in Sulawesi have been dated to around 35,000 years old (making them one of the oldest known pieces of art), and include hand stencils and figures of wild animals, including a babirusa (Cyranski, 2014).
- It has been claimed on the website of Brevard Zoo, Florida, as well as the Animal Diversity Web, that babirusas may be more closely related to hippos than to other pigs, but most scientists now agree, based on fossil, genetic and molecular evidence, that hippos are more closely related to whales than to pigs as previously thought (Geisler and Uhen, 2003; Boissarie *et al.*, 2005), so the babirusas remain in the suidae family. The claim is equivalent to saying that humans are more closely related to lemurs than to other great apes.



Figure 8: Male Sulawesi babirusas in 'bipedal boxing', taken from ARKive

Genera of Suidae

The following images feature representatives of the 6 extant genera of the Suidae family, which includes *Babyrousa*.



Clockwise from top left: *Sus* (wild boar, warty pigs and bearded pigs), *Porcula* (pygmy hog, formerly included in *Sus*), *Potamochoerus* (red river hog and bush pig), *Babyrousa* (babirusas), *Phacochoerus* (warthogs) and *Hylochoerus* (giant forest hog). All photos taken from ARKive.

Within Artiodactyla, the closest living relatives of the suidae are the tayassuidae, which consists of three species of peccaries from North and South America. Pigs and peccaries both form the suborder Suina.

Wildlife of Sulawesi

Babyrousa celebensis may be one of the most iconic endemic species of Sulawesi, which is one of the four Greater Sunda Islands in Indonesia and the 11th largest island on Earth. However, there are many other fascinating species that can only be found on this island. Here are just a few of those species:



Clockwise from top to bottom: Lowland anoa (*Bubalus depressicornis*), the smallest of the world's wild cattle but the largest of Sulawesi's land animals, one of two species of anoa, both native to Sulawesi; Crested black macaque (*Macaca nigra*), the most endangered of seven species of macaque in Sulawesi; Sulawesi bear cuscus (*Ailurops ursinus*), one of two species of cuscus found on the island, and one of the few marsupial species native to Asia; Sulawesi knobbed hornbill (*Rhyticeros cassidix*), the larger of two species of hornbill native to Sulawesi; Spectral tarsier (*Tarsius tarsier*), one of several species of tarsier found in Sulawesi; Maleo (*Macrocephalon maleo*), a large megapode gamebird that buries its eggs in volcanic sands, perhaps the best known of Sulawesi's endemic bird species. All of these species are threatened with extinction. All photos were taken from ARKive.

62% of the land mammals found in Sulawesi are endemic, while the number of endemic birds is only half that percentage (31%). Some species of freshwater fish are also endemic to Sulawesi.

My Love for Babirusas

The first time I heard of babirusas was from a Dorling Kindersley handbook about mammals (Clutton-Brock, 2002, p.327) that I got around 2007. At the time, I liked the sound of the name 'babirusa', though I wasn't too big into them back then. In 2012, I got a book on the history of Dublin Zoo, with one page showing a plan for the zoo in the future that mentioned 'babirusa' in the Asian rainforest section (de Courcy, 2009, p.311). On one visit to the zoo, a keeper told me that the zoo may be getting babirusas sometime in the future, and years later, I wrote a letter to the zoo's then director, Leo Oosterweghal, to discuss babirusas and make suggestions as to what their enclosure should be like. By then, I had already figured out why the zoo might have liked to get these pigs: the crested black macaques. Both the babirusa and macaques are native to Sulawesi, and Dublin Zoo actively supports the Selamatkan Yaki project for the macaque. The intended enclosure is now home to a pack of Dholes, but babirusas might still appear in Dublin sometime in the distant future.

Probably the first time I ever saw a babirusa was at Chester Zoo in August 2014, but we didn't take the best of photographs. The only two photos we have of the babirusa show it from a distance, its face obscured. Two years later, my family and I watched the BBC documentary *Ingenious Animals* (mentioned in the Physical Appearance section). The second episode of this series featured 'Albus', a male babirusa at Louisville Zoo, Kentucky, whose reproductive success was limited due to limping, until he received an acupuncture. The programme was what really got me into babirusas. Not long after, I saw babirusas featured in episode 6 of David Attenborough's series *The Life of Mammals* (2003). However, it wouldn't be until April 2024 - 6 years after I initially wrote this essay - when I eventually saw babirusas again at London Zoo, allowing me to fully appreciate these unique and underappreciated pigs and get much better photos than those we took at Chester a decade before. Babirusas are unquestionably my favourite members of the pig family!



Figure 9: Male Sulawesi babirusa at London Zoo, April 2024. Photo taken by me

References

- Akbar, S., Indrawan, M., Yasin, M.P., Burton, J. and Ivan, J., 2007. Status and conservation of *Babyrousa babyrussa* in the Togeian Islands, based on direct observations and questionnaire surveys (intermittently, 1990-2001). In: *Suiform Soundings*, 7(1). pp.19. Available at: https://www.iucn-wpsg.org/_files/ugd/119740_f415b3b0d2774997b690a5d9ec66ce9b.pdf#page=17
- Allen, R., Ryan, H., Davis, B.W., King, C., Frantz, L., Barnett, R., Linderholm, A., Loog, L., Haile, J., Lebrasseur, O., White, M., Kitchener, A.C., Murphy, W.J. and Larson, G., 2018. Predicting the viability of archaic human hybrids using a mitochondrial proxy. *bioRxiv*, [e-journal] p.7. doi:10.1101/289892.
- Boisserie, J.R., Lihoreau, F. and Brunet, M., 2005. The position of Hippopotamidae within Cetartiodactyla. *Proceedings of the National Academy of Sciences*, [e-journal] 102(5). pp.1537–1541. doi:10.1073/pnas.0409518102.
- Chester Zoo, 2018. *Three adorable babirusa piglets have been born at Chester Zoo*. [online] Available at: <https://www.chesterzoo.org/news/three-adorable-babirusa-piglets-have-been-born-at-chester-zoo/> [Accessed 22 May 2024].
- Clayton, L.M., 1996. *Conservation biology of the babirusa, Babyrousa babyrussa in Sulawesi, Indonesia*. Thesis (Ph.D.), University of Oxford.
- Clutton-Brock, J., 2002. *Mammals*. London: Dorling Kindersley. p.327.
- Cyranoski, D., 2014. World's oldest art found in Indonesian cave, *Nature* [preprint]. doi:10.1038/nature.2014.16100.
- de Courcy, C., 2009. *Dublin Zoo - An Illustrated History*. Cork: The Collins Press. p.311.
- Geisler, J.H. and Uhen, M.D., 2003. Morphological support for a close relationship between hippos and whales, *Journal of Vertebrate Paleontology*, [e-journal] 23(4), pp.991–996. doi:10.1671/32.
- Gongora, J., Cuddahee, R.E., Nascimento, F.F.D., Palgrave, C.J., Lowden, S., Ho, S.Y.W., Simond, D., Damayanti, C.S., White, D.J., Tay, W.T., Randi, E., Klingel, H., Rodrigues-Zarate, C.J., Allen, K., Moran, C. and Larson, G., 2011. Rethinking the evolution of extant sub-saharan African Suids (Suidae, artiodactyla). *Zoologica Scripta*, [e-journal] 40(4), pp.327–335. doi:10.1111/j.1463-6409.2011.00480.x.
- Groves, C.P., 2001. Mammals in Sulawesi: Where did they come from and when, and what happened to them when they got there? In: I. Metcalfe, J.M.B. Smith, M. Morwood, and I. Davidson, eds., 2001. *Faunal and floral migration and evolution in SE Asia-Australasia*. Lisse: A.A. Balkema Publishers. pp.333-342.
- *Ingenious Animals*, 2016. Episode 2. [TV Programme] BBC, BBC One, 8 September 2016.
- Leus, K., Bowles, D., Bell, J. and Macdonald, A.A., 1992. Behaviour of the babirusa (*Babyrousa babyrussa*) with suggestions for husbandry. *Acta Zoologica et Pathologica Antverpiensia*, (82), pp.9-27.

- Leus, K., Macdonald, A., Burton, J. and Rejeki, I., 2016. *Babyrousa celebensis*. *The IUCN Red List of Threatened Species*. 2016: e.T136446A44142964. Available at: <https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T136446A44142964.en>. [Accessed 7 April 2024].
- Leus, K., Miller, P., Ida, F., Mardiasuti, A., Masnur, I. and Prastiti, S., 1996. Population Biology and Modelling of the Babirusa. In: J. Manansang, A.A. Macdonald, D. Siswomartono, P. Miller and S. Seal, eds., 1996. *Population and Habitat Viability Assessment for the Babirusa (Babyrousa babyrussa)*. Apple Valley: IUCN/SSC Conservation Breeding Specialist Group. pp.31-41
- Macdonald, A.A., Burton, J. and Leus, K., 2008. *Babyrousa babyrussa*. *The IUCN Red List of Threatened Species*. 2008: e.T2461A9441445. Available at: <https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T2461A9441445.en>. [Accessed 7 April 2024].
- Macdonald, A.A., 1993. The Babirusa (*Babyrousa babyrussa*) In: W.L.R. Oliver, ed., 1993. *Pigs, Peccaries and Hippos: Status Survey and Conservation Action Plan*. Gland: International Union for Conservation of Nature. pp.161-170. Available at: Google Books <<http://books.google.com>> [Accessed 1 May 2024]
- Macdonald, A.A., Bowles, D., Bell, J. and Leus, K., 1993. Agonistic behaviour in captive Babirusa (*Babyrousa babyrussa*). *Z. Säugetierkunde* 58, pp.18-30
- Macdonald, A.A. and Leus, K., 1995. Creating a public understanding of the biology of the babirusa (*Babyrousa babyrussa*) within a caring zoo environment, *IBEX Journal of Mountain Ecology*, (3), pp.37–40.
- Macdonald, A., Leus, K., Masaaki, I. and Burton, J., 2016. *Babyrousa togeanensis*. *The IUCN Red List of Threatened Species*. 2016: e.T136472A44143172. Available at: <https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T136472A44143172.en>. [Accessed 7 April 2024].
- Meijaard, E., d'Huart, J.P. and Oliver, W.L.R., 2011. Family Suidae (Pigs). In: D.E. Wilson and R.A. Mittermeier, eds., 2011. *Handbook of the Mammals of the World: Vol 2. Hoofed Mammals*. Barcelona: Lynx Edicions. pp.248-291
- Meijaard, E. and Groves, C.P., 2002. Proposal for taxonomic changes within the genus *Babyrousa*. *IUCN/SSC Pigs, Peccaries, and Hippos Specialist Group (PPHSG) Newsletter* 2(1), pp.9-10.
- Melisch, R., 1994. Observation of swimming babirusa *Babyrousa babyrussa* in Lake Poso, Central Sulawesi, Indonesia. *Malayan Nature Journal*, 47, pp.431-432.
- Naish, D., 2010a. The many babirusa species (babirusas, part VI). *Tetrapod Zoology, ScienceBlogs*. [blog] 23 February. Available at: <https://scienceblogs.com/tetrapodzoology/2010/02/23/many-babirusa-species> [Accessed 15 May 2024].
- Naish, D., 2010b. Babirusas can get impaled by their own teeth: that most sought-after of objects does exist! (babirusas, part VIII). *Tetrapod Zoology, ScienceBlogs*. [blog] 8 March.

Available at: <https://scienceblogs.com/tetrapodzoology/2010/03/08/babirusa-impales-own-head> [Accessed 7 April 2024].

- Patry, M. Leus, K. and Macdonald, A.A., 1995. Group structure and behaviour of babirusa (*Babirusa babirusa*) in northern Sulawesi. *Australian Journal of Zoology* 43, pp.643–655.
- Riley, J., 2002. Current Wildlife Conservation Society research and conservation of Sulawesi's suids. In: *Asian Wild Pig News* 2(2), pp.26-30.
- Rowlands, T., Treanor, A., Edge, K. and Ankers, F., eds., 2018. *EAZA Best Practice Guidelines Babirusa (Babirusa)*. [pdf] Amsterdam: European Association of Zoos and Aquariums. Available at: <https://www.eaza.net/assets/Uploads/CCC/BPG-new-version/2018-Babirusa-EAZA-Best-Practice-Guidelines-Approved.pdf> [Accessed 7 April 2024].
- *The Opportunists*, 2003. The Life of Mammals, episode 6 [TV programme]. BBC, BBC One, 8 January 2003.
- Thomsen, P.D., Schauser, K., Bertelsen, M.F., Vejlsted, M., Grøndahl, C. and Christensen, K., 2010. Meiotic Studies in Infertile Domestic Pig-Babirusa Hybrids, *Cytogenetic and Genome Research*, [e-journal] 132(1–2), pp.124–128. doi:10.1159/000320421.
- Tiergarten Nürnberg, 202?. *European Conservation Breeding Programs*. [online] Translated from German. Available at: <https://tiergarten.nuernberg.de/zoowissen-co/arten-und-naturschutz/erhaltungszucht.html> [Accessed 9 April 2024].
- Wallace, A.R., 1869. “Physical Geography”. *The Malay Archipelago*. New York: Harper & Brothers. pp.23–30.
- Whitten, A.J., Mustafa, M. and Henderson, G.S., 1987. *The Ecology of Sulawesi*. [e-book] Yogyakarta: Gadjah Mada University Press. p.779. Available at: Google Books <<http://booksgoogle.com>> [Accessed 26 May 2024]
- World Association of Zoos and Aquariums, 201?. *Anoa, Babirusa and Banteng*. [online] Available at: <https://www.waza.org/priorities/conservation/conservation-breeding-programmes/global-species-management-plans/anoa-babirusa-and-banteng/> [Accessed 7 April 2024].

Thank you for reading



+



=

