

Suiform Soundings



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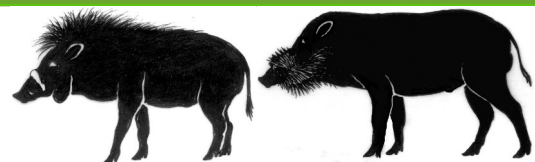
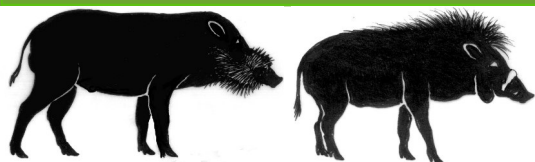
Newsletter of the IUCN / SSC Wild Pig, Peccary and Hippo Specialist Groups



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Photos front page:

above left: female babirusa from east Buru, in late pregnancy. Photo: Eki Kailuhu

above right: Adult male wild *Sus* pig, contract-captured for crop raiding near Namrole, east Buru. Photo: Alastair A. Macdonald

center: Landsat/Copernicus image of the north of Buru. Source: Google Earth Historical Imagery

below left: Domestic pigs in the village of Mngeswaen, illustrating morphological differences due to mixed breeding. Photo: Alastair A. Macdonald

below right: Juvenile domestic *Sus* piglet (left) and domesticated wild *Sus* sow (right). Photo: Alastair A. Macdonald

Please email all contributions to future issues to Thiemo Braasch, email: salvanius@gmail.com. Articles, photos and comments are welcome and appreciated. **Please follow the guidelines for authors**, which can be found on the website listed above.



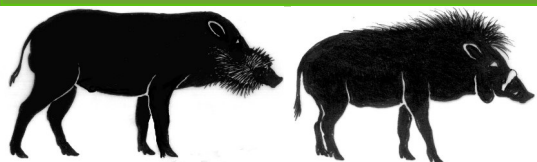
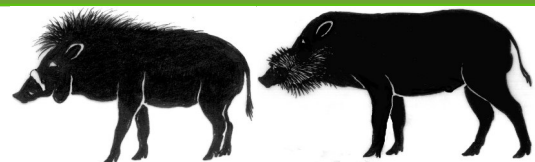
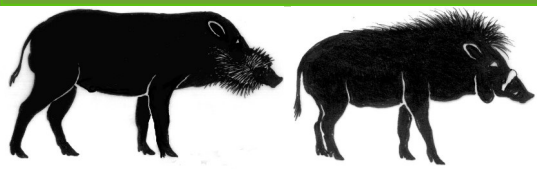


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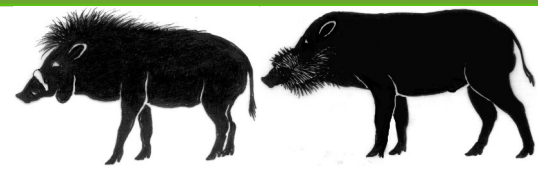


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Editorial



From the Chief Editor

Dear reader,

I am pleased to present you the latest issue of *Suiform Soundings*. It contains articles on: babirusas and other pigs on the island of Buru (including the first photo of a wild babirusa taken on this island, see front page and page 8); babirusas kept in Chester Zoo; white-lipped peccaries in the Brazilian state of Paraná; and Chacoan peccaries. Furthermore, we show peccary art and provide a summary of a conference held on hippos that was held in Czech Republic this year. Another article describes the ecomorphology of prehistoric African pigs.



Turopolje pig. Photo: T. Braasch

I recently visited a breeding centre for endangered old farm animal races in Northern Germany. This centre is breeding a variety of old pig races, such as the Turopolje race from the Save flood plains in Croatia, Swedish Linderöd pigs, Blond Mangalitza woolly pig from Hungary and Husumer red-coloured pig from Northern Germany (see photos on this page). Although all these races belong to one species, *Sus scrofa* f. *domestica*, they remind us of the genetic diversity, the adaptability of boars and their enduring relationship with people. The different pig races are kept as a genetic backup for the highly inbred modern pigs and as a cultural heritage. Watching the different ancient pig races reminds me of the diversity of wild pig species ranging from the tiny and cute Pygmy hog to the incredibly large Giant forest hog.



Blond Mangalitza woolly pig. Photo: T. Braasch



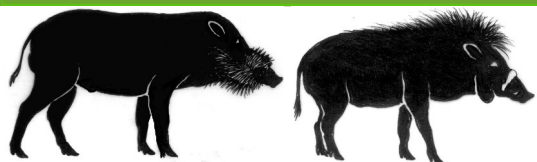
Husumer red-coloured pig. Photo: T. Braasch

I would like to thank to all the authors who contributed to this issue of *Suiform Soundings*, and the editorial team as well! It is always a pleasure to work with dedicated scientists like these authors and share in their passion for wild pigs, peccaries and hippos!

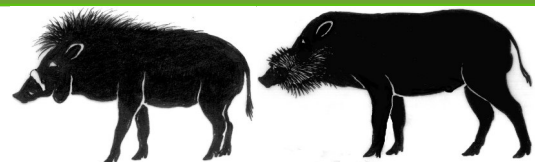
With warm regards,

Thiemo Braasch





Ecology and Conservation



Babirusa and other pigs on Buru Island, Maluku, Indonesia – new findings

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Abstract

The pigs on Buru Island, Maluku, Indonesia represent the genera *Babyrousa* and *Sus*. The babirusa (*Babyrousa babyrussa*) were reputedly once widespread over the whole island, but deforestation has now restricted them to three main areas; the forested mountainous countryside of the west, west-centre and east of the island. In addition, strips of forest are present on the south of the island; these seem rich in the fruit and vegetable foodstuffs said to be appropriate to the babirusa. However, the human population is making inroads into this habitat. The wild *Sus* pigs are numerous and are found over the whole of the island. The largely Muslim population on the north of the island perceive them to be a dangerous agricultural pest; they are fenced out of farmed land, and are contract-hunted. Beyond the coastal periphery of the island, the villages of the 'mountain people' contain large numbers of free-roaming domestic *Sus* pigs, the appearance of which suggested a mix of Chinese pig breeds and the wild *Sus* pigs in the forest. The personal observations made and the interviews of islanders conducted between February and April 2017 have shed some light on the largely undescribed biology of the babirusa of Buru.

Introduction

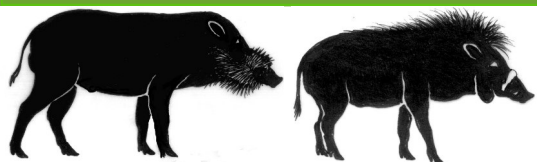
Buru Island is located in the Maluku province of Indonesia, between the Banda Sea to the south and the Seram Sea to the north. It is 9,505 km² in area and lies about 80 km west of Ambon and the Seram Islands. The surface geology of Buru is complex, consisting of older metamorphic schists and gneiss, younger volcanics, and recent alluvium (Monk et al. 1997). The rainy season can last from November until May. There are currently two protected areas, Kaka Pala Madat (1,380 km²) in the mountainous west, and Waeapo (50 km²) in the east.

The human population of 162 thousand (in 2010) is largely distributed around the coast. Most citizens of northern villages are now Muslim whereas those in the south of the island are largely Christian; this is partly historical and partly as a consequence of the recent violent troubles of 1999-2001 (Sidel, 2008; Anonymous, 2017).

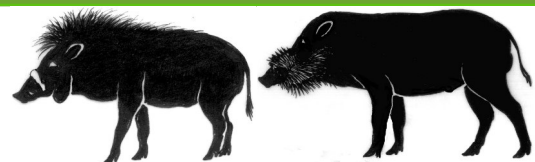
Two genera of pigs are present on the island, *Sus* and *Babyrousa*. The wild *Sus* pigs have been reportedly 'abundant' on Buru for some time (Bickmore, 1868). Bickmore found them 'in great droves' on the prairie-lands, and observed that frequently an area of a quarter of an acre was so completely rooted up by them that it looked as if it had been ploughed. Due to the religious faith of the people in the north of the island they were seldom taken. Indeed there generally seemed to be no dietary interest in pig meat except among the hill peoples in the centre of the island, who keep domestic pigs. With most of the island's population living beside the sea, fish represent their main source of animal protein. Most villagers also rely on garden crop production.

The first description of babirusa (*Babyrousa babyrussa*) on Buru may be found in a letter written in 1584 by Fr. Bernardino Ferrari describing the wildlife on Buru (Jacobs 1980, Tjiu and Macdonald, 2016). The hair colour of these babirusa has regularly been described as white or





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grey since then, with occasional mentions of animals with a reddish and black under colour. The female and juvenile babirusa have sometimes been described as having black hair (Deninger, 1910).

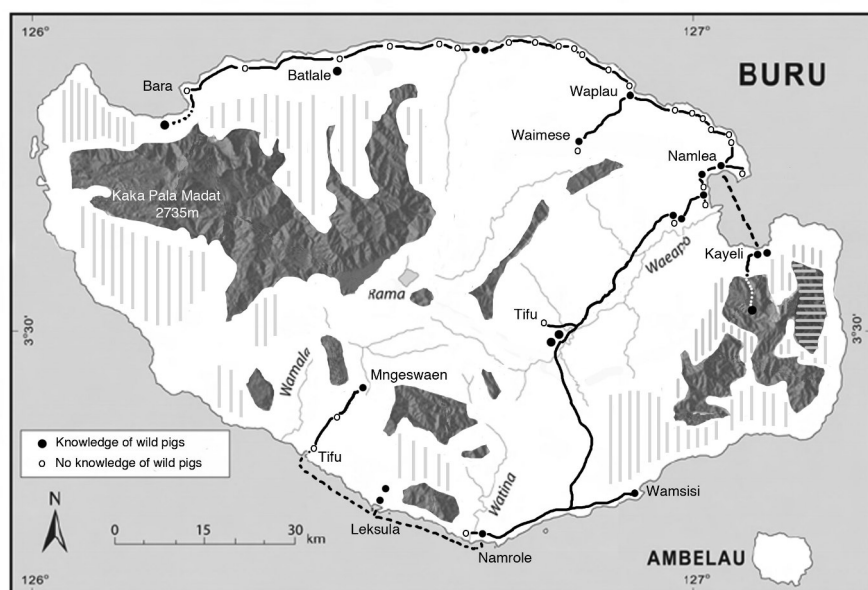
There is almost no historical data on the numbers or distribution of babirusa on Buru (Macdonald et al, 2008). They have been reported in the east of the island, in the region of Kayeli, since 1726 (Valentijn, 1726; Tjiu and Macdonald, 2016). Their presence in the west of the island has also been reported (Deninger, 1910). A survey in 1990 of respondents in the villages of north Buru revealed that babirusa were present in the hills of the east of the island, the west-centre and in the west of the island, but absent from the northern coastal region (Tjiu and Macdonald, 2016). The results of a subsequent survey in 1995-1996 confirmed reports by Tjiu (1991) of babirusa in west Buru (Persulesy and Poulsen, 1996); Verbelen (2003) reported two sightings of babirusa there in 1999. Babirusa were also said by Deninger (1910) to be present in the forested hills and mountains of south-eastern Buru, and this was confirmed by Dammerman (1929) and more recently by Persulesy and Poulsen (1996). However, this latter, bird-focused, survey suggested that they were absent from the forests of central and north-eastern Buru. More recently, Eaton and Hutchinson (2015) reported that they had failed to find any signs of babirusa on Buru. The need for a more pig-focused survey was agreed by the IUCN/SSC Wild Pigs group at a meeting held in November 2013 at Cikananga Conservation Breeding Centre, Java. Despite having been known for over 400 years, almost nothing of the biology of the Buru babirusa has been described. Since about 1827 scientific attention has focused on the Sulawesi babirusa (Deninger, 1910; Macdonald, 2017).

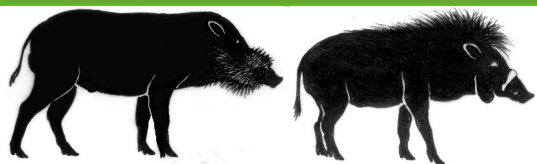
Materials and Methods

A preliminary investigatory visit to Buru was made between 26th January and 3rd February 2017. The second visit to Buru was made between 28th March and 16th April, 2017. The villages where questions about wild pigs were asked are indicated in Figure 1. An Indonesian language questionnaire was used by a local Maluku interviewer, and the responses were either written down or voice recorded for subsequent transcription.

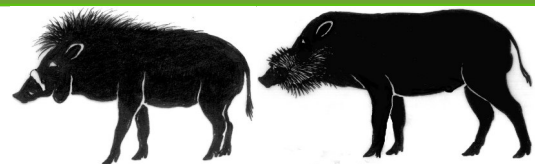
Observations were made of the surrounding countryside throughout the travel routes indicated in Figure 1, and photographs taken. Journeys were made along dirt roads into the interior of the

Fig. 1: Map of Buru Island showing the road and boat travel routes taken by the team along the north coast, through the centre and along the south coast of the island, as well as the routes into the interior from the north and south coasts. Filled black circles indicate villages where information about babirusa and other wild was collected. Open circles indicated where there was no personal knowledge of wild pigs; these were largely Muslim communities. Vertical shaded areas summarise forested land; dark mountainous areas indicate *protected* forest; horizontal banded dark area (in the east) indicates the only area of conservation forest.





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island from the north and south coasts as far as villages with potential local knowledge, our time, and wet weather permitted.

Time-dated images of Buru Island have been taken by Landsat/ Copernicus satellites since 1984 (Google Earth Historical Imagery). We selected images taken in December 2016 and examined these for changes in vegetation cover of the island with the images taken in December 1986, 1991, 1996, 2001, 2006, 2011 and 2015.

Skeletal Material

Six babirusa skulls (five male and one female) found in the hills near the town of Kayeli were examined and compared with data from 33 male babirusa skulls from Buru held in international museum collections (Macdonald, 2016).

Skins from Buru Island

We examined the two museum babirusa skins from Buru, both female, the adult one in the Museum Zoologicum Bogoriense, and the subadult one in Leiden's Naturalis museum collection. In order to avoid repetition and avoidable confusion, the results for each type of wild pig will be presented together with a review of other observations relevant to that animal on Buru.

Results and observations

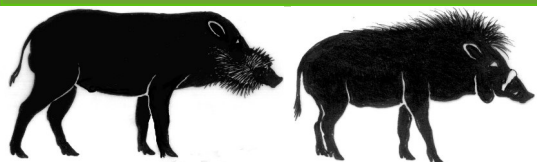
Babirusa babirusa

Babirusa are present on the island of Buru. Respondents accurately described the differences between the two wild pig species on the island. The babirusa was identified by the respondents' morphological description of the animal as white/grey in colour and was generally named 'faf donit' in the Buru language and 'faf ronit' in the area of north-east Buru around and stemming from Kayeli. In the south it can also be called 'fafu botit' = white pig, and the equivalent term in the north is 'fafu gawat' (Grimes, 2017). Another term, 'faf bile' has been reported by (Grimes, 2017) and 'may be another name for babirusa, but others said it is different and has shorter legs and finer hair'.

The survey results indicated that babirusa were present up to at least 490 m in the east of the island and Deninger (1910) suggested that they may be found up to at least 1000 m in the west. They may be found in the more mountainous, forested parts of the island (Figure 1). These comprise three main areas; in the east, west-centre and west of the island. Wide areas of flat agricultural land and deforested hillsides measuring approximately 2000 km² separate the east and west-central forested regions. The mountainous west-central forest area is narrowly connected to the western Kaka Pala Madat forest (Figure 1). The human inhabited forests alongside the eastern (north to south) trans-island road have been logged and no longer provide appropriate habitat for babirusa.

The area in the east of the island that was deemed to deliver an appropriate habitat for the babirusa was estimated to be approximately 500 km² in size. However, on the western edge of this area 'artisanal' gold-mining activity on mount Botak has been reported in the scientific and popular press, as well as on social media (Male et al, 2013). Government action was said to have stopped this illegal activity, but there were other reports that it had resumed. The forest-habitat in west-central Buru was estimated to be about 200 km², and around the mountain, Kaka Pala Madat, the forest-habitat was estimated to be about 600 km² in size. It was estimated that there may be a further 300 km² of forest-habitat, partly on the south coast and partly in other areas





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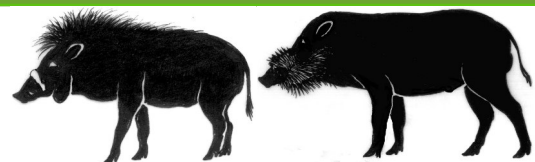


Fig. 2: Photograph of a female babirusa from east Buru, in late pregnancy.

Photo: E. Kailuhu

isolated from the larger zones of appropriately forested land. No estimates of babirusa population numbers could be made in any of these forested areas because there were very few reports in the coastal villages of hunting activity. However, there have been published reports that among the people in the interior of the island 'survival is dependent on continuous hunting and foraging in the jungle (sometimes for three to five months at a time) ...' (Grimes and Maryott, 1994).

Appearance, size and weight

Respondents described the adult babirusa hair coat as being soft and

white or grey in colour, and short (ca. 2 cm). This was confirmed in our observation of an adult female (Figure 2). It is also consistent with earlier reports of observations (Seba, 1734; Goch, 1736; Stressman, 1925; Verbelen, 2003), although mention had also been made of brown hair colour (Piso, 1658; Nieuhof, 1682; Deninger, 1910; Tjiu and Macdonald, 2016). Stressman (1925) also said that in 1910 he had seen a white-haired babirusa in Cologne zoo. Analyses of these reports suggested that the white/grey coloured babirusa tended to be found in the east of the island, and those with brown or black hair came from the mountainous west of the island. For example, two females from west Buru had dark brown skin and black hair that was longer than on the male (Deninger, 2010). The Bogor museum skin was collected in 1891 and is (now) a pale yellow in colour; the Naturalis museum skin of an 11 month old female has black hair. A juvenile female in the eastern forest was also reported to have had black hair. Male Buru babirusa were said to have a shoulder height of about 55-60cm. Female babirusa were said to be smaller, about 45-50cm in shoulder height.

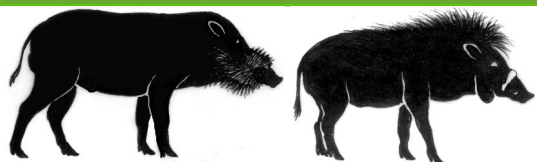
Anatomy

The skull of the adult male Buru babirusa (Figure 3) has been an object of biological collection for over four centuries and has been described in detail (Seba, 1734; Bergen, 1753; Stehlin, 1899; Macdonald et al, 2016). Several respondents reported that the babirusa was better able to run swiftly up-hill than down hill, which

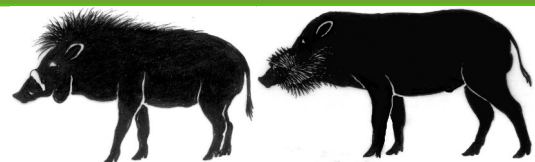


Fig. 3: Skull of an adult male babirusa from east Buru. Photo: A.A. Macdonald





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was ascribed to their perception that babirusa had longer hind limbs; this was also the opinion of Christman (1777). There was very little additional information on the functional anatomy of the animal. However, two respondents did report that the babirusa had a much larger stomach than the wild (*Sus*) pig, and that it more closely resembled the size of the deer stomach.

Reproduction

Respondents indicated that in August and September, a rapid 'cluck, cluck, cluck, cluck, cluck, ...' vocalisation of the male babirusa could be heard in the forest. This sound was recognised by them to be associated with female babirusa being nearby, in oestrus and about to be mated. Van Balen (1914) reported that the sow delivers one or two young around February, and that the piglet(s) are defended fiercely by the sow. On April 8th we observed a female babirusa in late pregnancy (Figure 2). Babirusa were said by respondents to produce one or two piglets. There was no local information concerning lengths of oestrus or lactation. Van Balen (1914) has commented that if Buru babirusa are caught young, they are easily tamed.

Behaviour

Respondents said that babirusa were usually seen singly or more rarely in small groups of three or four animals. These observations corresponded to earlier findings (Deninger, 1910; Verbelen, 2003; Tjiu and Macdonald, 2016). There was one report of observed agonistic behaviour between male babirusa, with babirusa standing on their hind limbs. There were no reports of agonistic behaviour between female babirusa. It has been known for some time that Buru babirusa can stand upright on their hind limbs (Rumphius, 1743). This is to feed on tree fruit and leaves (Tjiu and Macdonald, 2016).

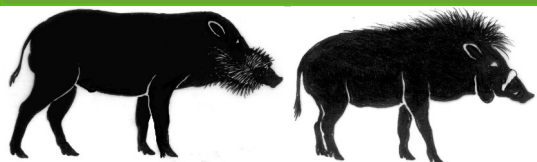
In east Buru there were no reports of babirusa wallowing; they were said to bathe in the rivers. We noted that the soil in the eastern hills was quite gritty (Figure 4). In the west of the island, however, there have been accounts of babirusa bathing in mud wallows (Deninger, 1910; Verbelen, 2003).



Fig. 4: Ground surface grit on east Buru hillside.

The marks of babirusa teeth on the sides of these mud wallows (Deninger, 1910) suggests that the adult males marked these places in a way similar to that seen in North Sulawesi (Macdonald et al, 1996). Recent studies have shown that canine tooth wear in adult male babirusa most probably results from rubbing eye-gland and mouth secretions against soil and other structures. Respondents in the east of the island said that they had never seen evidence of 'ploughing' by babirusa (Leus et al, 1996). This may have been due to the gritty soil structure and the 'soft' nose of the babirusa (Macdonald, 2016). However, respondents did show us five trees, in two groups approximately four kilometres apart, measuring from 5.0 to 7.0 cm in diameter, against which babirusa were said to rub. The freshly worn area in one 5cm diameter tree extended from ground level up to 150 cm (Figure 5). The other trees were 6cm and 7cm in diameter and fresh marks were at 60-70 cm above ground level; abrasive bark wear extended to about 145 cm. Tooth scrape-marks suggested that these were being used as





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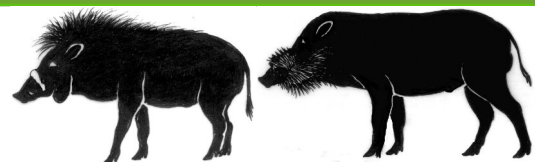


Fig. 5: Babirusa teeth marks on a rubbing post (tree).

Photo: M. J. Pattikawa

and are particularly fond of the elodi, which are the 'winged' fruit of the 'Meranti' tree (*Shorea* spp.). Many of the respondents commented that babirusa ate rotting wood, but did not show us examples. Deninger (1910) indicated that this behaviour related to the presence of invertebrate larvae.

Nests

There was no information forthcoming from respondents on the construction of nests by babirusa for weather protection or parturition. Respondents in the west and south of the island stated that only the head was covered with plant material at night. However, we observed that large-leaved bilam huka plants (Figure 6A), growing at lower altitudes, provided several square metres of ground-covered areas and stood on stems about one metre in height. Deninger (1910) reported seeing cut branches in the forests in west Buru, and suggested that these may have been used as cover by babirusa.

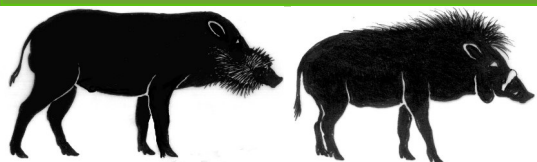
marking posts where adult male babirusa eye gland and/or mouth secretions were being deposited.

Diet

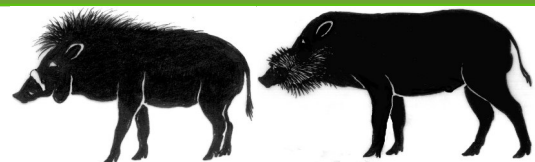
Respondents pointed out and named a number of plants eaten by babirusa (Figure 6A-6F). These included the broad pale green leaves of the bilam huka plant (*Homalomena alba*) which grow from one metre long stems; the clusters of green fruits of the posot trees (*Ficus* sp.) that hang in clusters up to two metres high from the trunk of the tree [and the nearby and larger white kofnokot fruits (*Ficus* sp.) which had appeared earlier in the year]; the sweet olot (*Hornstedtia rumphii*) arises from the ground on a 10-20 cm stem; the pohit tree (species to be identified) with its cascades of soft, ripe berries; the little yellow-skinned wahae gula fruit (*Passiflora foetida*) found growing as 'ground-cover' in sunlit areas; and the sweet red gahum (*Rubus fraxinifolius*) clambering up to 150 cm high through other bushes. One respondent in the 1990 survey commented that babirusa only eat food from a tree branch (fruit and leaves); they only eat clean food (Tjiu and Macdonald, 2016).

Rumphius (1743) first reported that babirusa were very fond of the canary tree nut (*Canarium indicum*), and this was confirmed by respondents. They are also said to like the brown rotan seeds (*Daemonorops robusta* and *Calamus zollingeri*),





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Predators

Pythons (*Python reticularis*) are present on the island and have the ability to take babirusa of all ages (de Jong, 1926).

Disease

A pig disease epidemic swept through eastern Indonesia in the late 1990s, killing many of the domestic pigs on Buru (Grimes, 2017). This may have been an extension of the epidemic of Classical Swine Fever reported from Sumatra to Flores in the preceding years of that decade (Leslie, 2012). There appear to have been no reports of the effect of the disease epidemic on either of the wild pigs.

Art

No figurative representation of the babirusa was found. However, in Wasbata village we recorded Mr. L. L. presenting the words and music of a song describing the mythical origin of the babirusa. Further east along the coast, in Waemangit village, an elder of the Masbait family recounted the same tale.

Wild *Sus* spp.

Distribution

The wild *Sus* pig was identified morphologically, and was generally referred to as black in hair colour; it was named 'faf aba' (Grimes, 2017). Respondents also used the term fafu n̄si (=tusked pig; Grimes, 2017) when referring to a wild *Sus* boar. There were reports of wild *Sus* pigs in all parts of the island visited. Fencing surrounded many garden plots in an effort to restrict their access to crops. Footprints and uprooted areas of earth were found from sea level to 490 m. In the mountain forest on the east side of the island wild *Sus* pig sounds (vocalisation and movement) was heard four times in two hours along a transect of 3 km. Wild pigs were also reported in the savannah areas of the east and centre of the island, and are found on the coast.

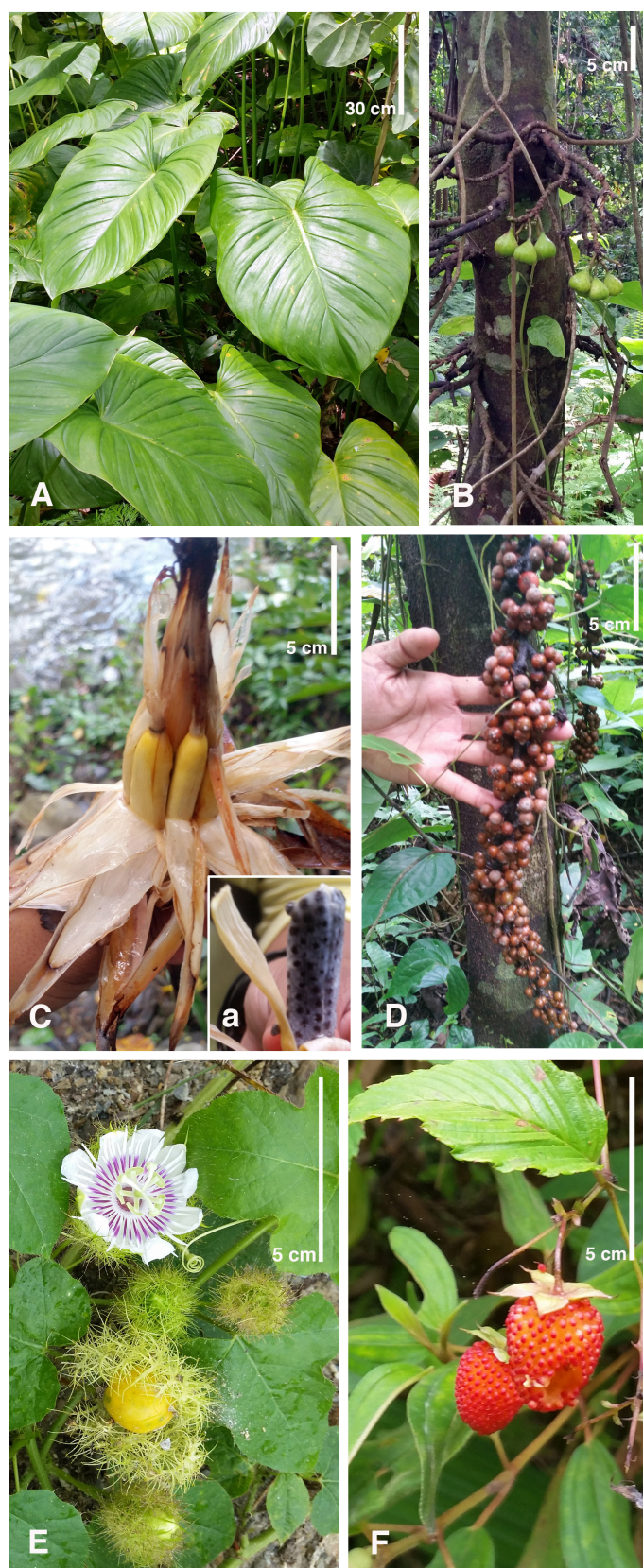
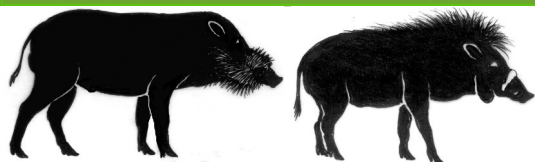


Fig. 6: Respondent reported food items taken by babirusa on Buru. A: bilam huka plant (*Homalomena alba*); B: fruits of the posot trees (*Ficus* sp.); C: sweet olat (*Hornstedtia rumphii*); D: pohit tree berries (species to be identified); E: wahae gula fruit; F: red gahum fruit (*Rubus fraxinifolius*). Photos: A. A. Macdonald





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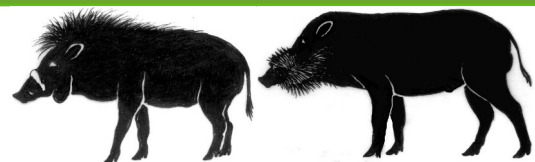


Fig. 7: Adult male wild *Sus* pig, contract-captured for crop raiding near Namrole, east Buru. Photo: A. A. Macdonald

70 cm horizontally. The base of the narrow stem arising from the tree root of one was also marked. There was no additional information about the numbers or distribution of these marked trees.

Diet

The food reportedly eaten by wild pigs included tubers, bilam huka, elodi as well as carrion. On 1st April, in the hills of east Buru, a wild pig attacked and killed a young hunter aged about 30 years. The hunter's body had been almost completely eaten that morning before villages arrived to rescue him.

Reproduction

The wild pig was reported to produce more piglets in a litter than the babirusa.

Nests

The wild pig was reported to build a nest of leaves for the night.

Predators and diseases

Same as for babirusa.



Appearance and size

The four wild *Sus* seen were grey to black in colour (Figures 7 and 8). Respondents usually referred to them as black pigs. The adult male wild pig stood about 70 cm at the shoulder. The female was smaller (60 cm at shoulder).

Behaviour

Respondents indicated that wild *Sus* pigs used trees in specific areas to rub their bodies against (Figure 9). The marks on two of these large trees extended from ground level to 50 cm and 60 cm vertically, and 60 cm and

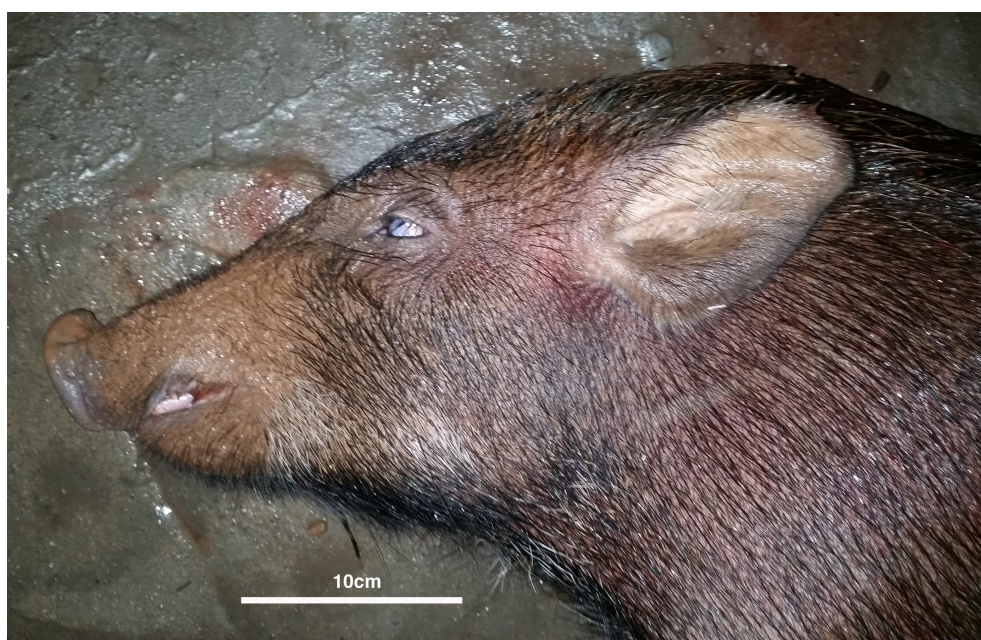
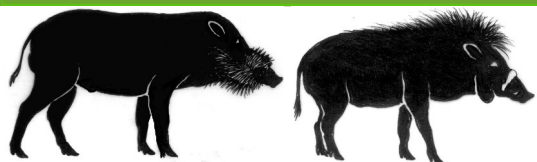


Fig. 8: The head of a young male *Sus* pig shot near Kayeli, east Buru.

Photo: A. A. Macdonald



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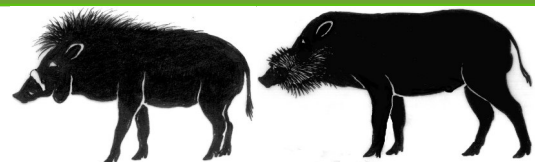


Fig. 9: Trees in the east Buru hills showing effects of rubbing behaviour by wild *Sus* pigs. Photo: A. A. Macdonald

Domestic *Sus* spp.

Distribution

Domestic pigs were found loose in Christian villages and in the villages in the interior of the island. Sometimes they were present in very large numbers. Residents of the hill village of Mngeswaen (Figure 1) said that they had 'hundreds' of domestic pigs; these animals were seen to be freely roaming around the village (Figure 10). Precise numbers in each village were not known; the descriptive quantitative term used by respondents was 'many'.

Appearance and size

Domesticated pigs are referred to as 'faf fena' (Grimes, 2017). These have a wide range of body shapes. Some, showing a very clear 'small Chinese domestic pig' morphology with respect to size, 'hang-belly' and colouration are referred to as 'faf Bali', but this term can also refer to animal stock from Europe or Australia, as well as Bali (Grimes, 2017). Other domestic pigs more closely



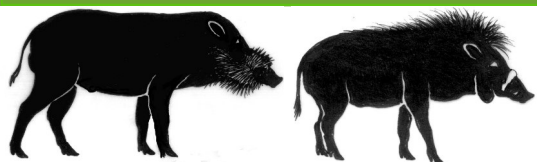
Fig. 10: Domestic pigs in the village of Mngeswaen, illustrating morphological differences due to mixed breeding. Photo: A. A. Macdonald



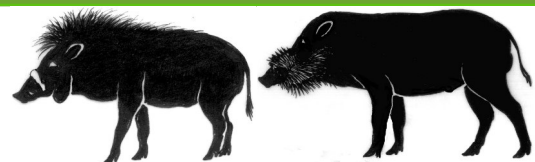
Fig. 11: Juvenile domestic *Sus* piglet (left) and domesticated wild *Sus* sow (right). Photo: A. A. Macdonald

resembled the Buru wild *Sus* pigs. An example of a domesticated wild *Sus* pig, locally called 'faf melaban' (Grimes, 2017), was the sow present in Mngeswaen village (Figure 11). A domestic sow that has gone feral is referred to as 'faf mlahat' (Grimes, 2017). The white skin and hair seen above the feet of wild *Sus* pigs suggested that





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domestic pigs have significantly contributed to the wild *Sus* pig gene pool. The domestic boar, sow and piglet are termed 'fafu bhasat', 'fafu tinan' and 'fafu anan' respectively (Grimes, 2017).

Discussion

It was noteworthy that there were fewer people who knew about babirusa in the villages along the north coast this year than there were in 1990 (Tjiu and Macdonald, 2016). The evidence to explain this would seem to be two-fold. The violence on Buru and elsewhere in Maluku from 1999-2001 led to large-scale shifts in population on Buru (Sidel, 2008; Anonymous, 2017). There has been a shift in people of Christian faith to the south of the island and the gathering of people of the Muslim faith in the north. The second explanation is the removal of large numbers of trees from the foothills of the western part of the north coastal area (Figure 12). Over the last twenty or so years the forest edge has been pushed about 4 km south of the coast, where most of the villages are situated. The coastal people are now largely fishermen and farmers.

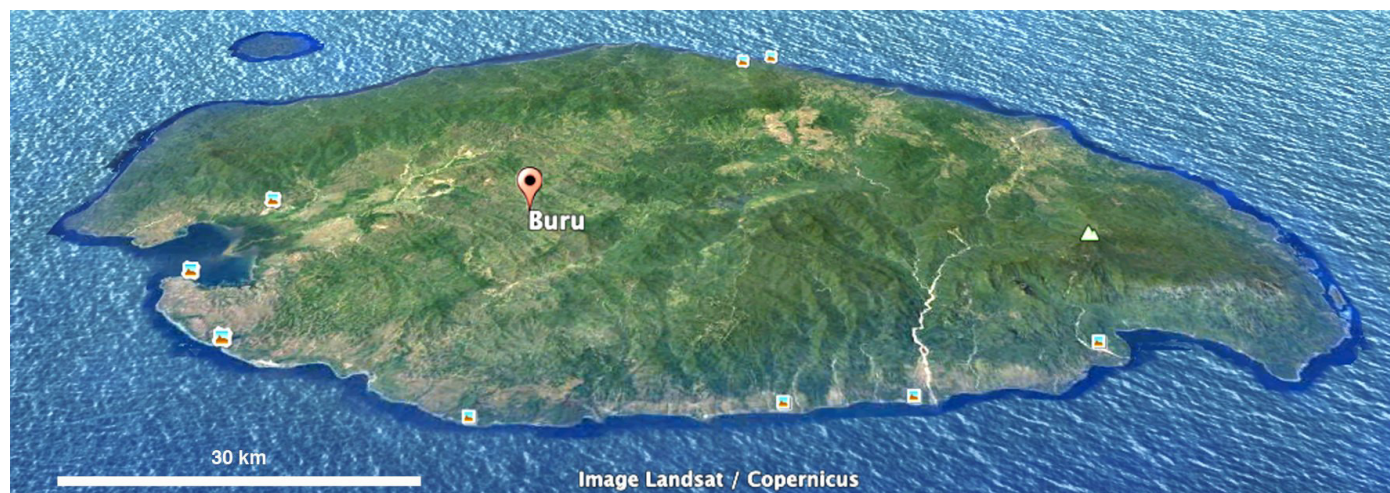


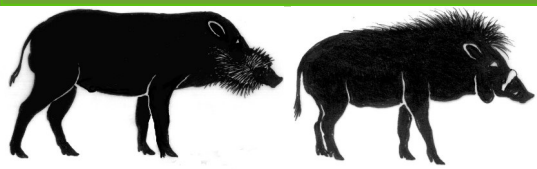
Fig. 12: Landsat/Copernicus image of the north of Buru illustrating the 4 km extent of deforestation from the shore line.

On the western part of the south coast there has been a much larger removal of forest (Figure 13). As we did not visit this area, it was not clear to what extent this has created a buffer between the forests of the mountain Kaka Pala Madat and the largely Christian communities along the coast.

There has been an additional loss of forested land due to the expansion of farming and commercial cropped areas by the rapidly expanding and available-land encroaching human population. It was evident from respondents' reports that babirusa were absent from those forests that had been 'selectively' logged. It was also clear that the hill people often had garden sites located at some distance from their home village. When asked about other villages in the centre of Buru, the answer was that there were many, and that they only remained in the one place for several years (Figure 14).

The remaining populations of babirusa on Buru seem to be largely isolated from one another and appear to be concentrated in the three mountain forest regions (Figure 1). Time allowed us to access the eastern population and its habitat, both of which looked good [with the caveat that mercury is contaminating the environment downstream of the gold mining area]. The more westerly populations were not personally investigated due to time constraints.





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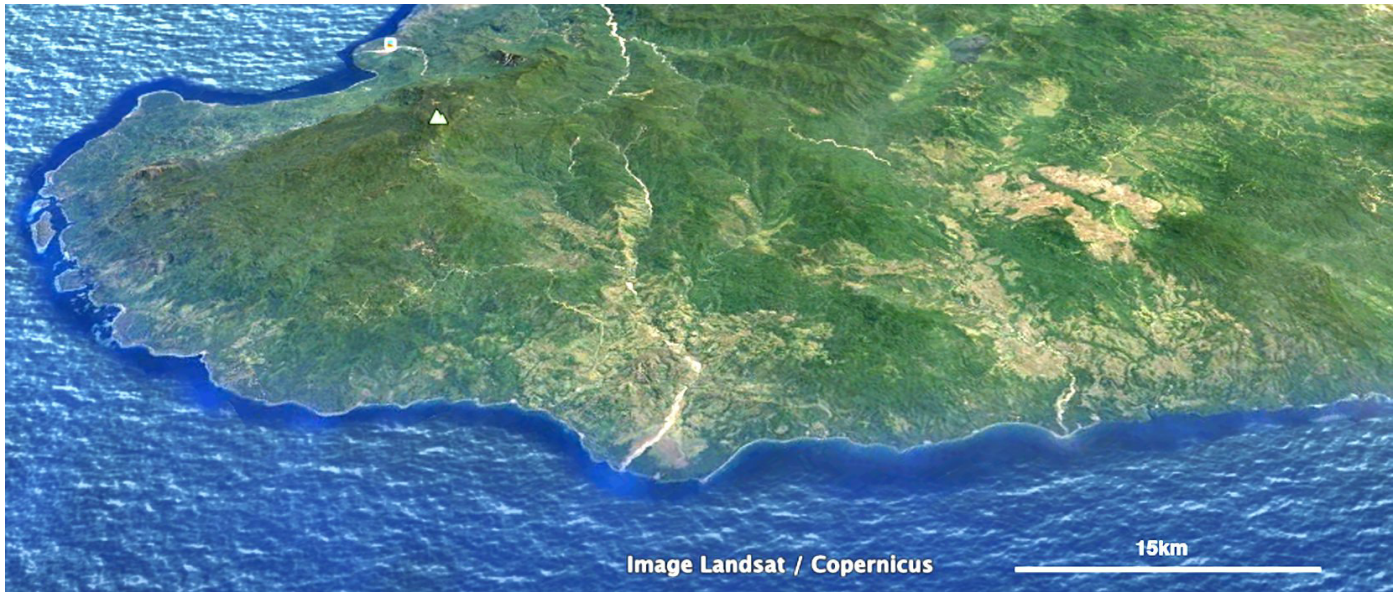
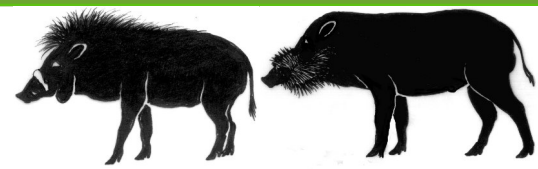


Fig. 13: Landsat/Copernicus image of the south-west of Buru illustrating the extent of deforestation from that shore line.

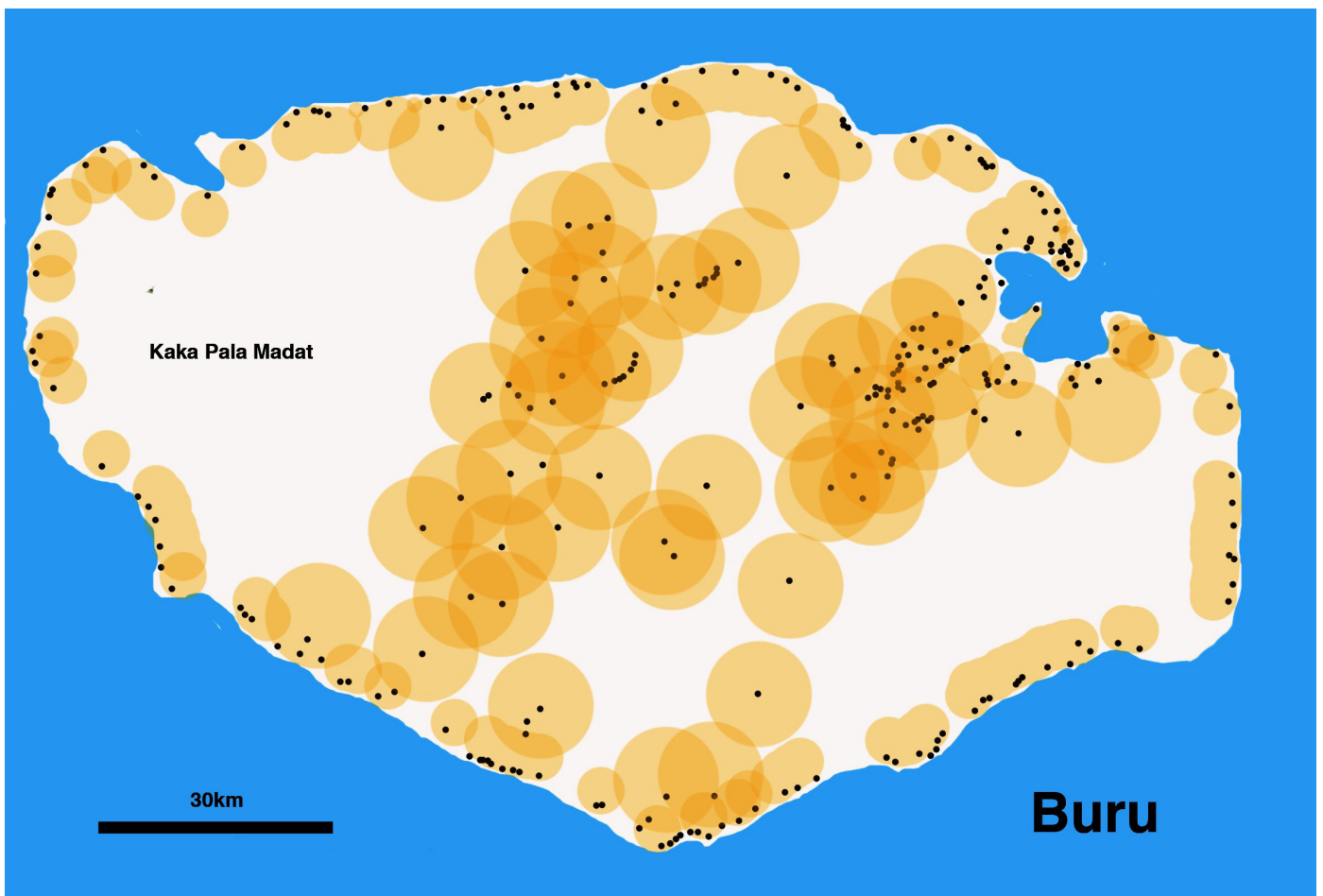
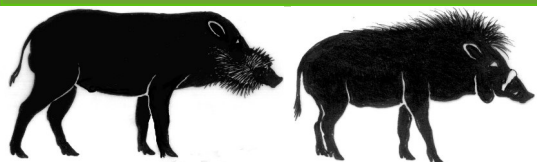


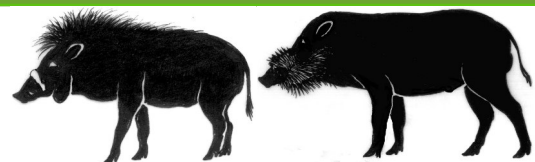
Fig. 14: The location of towns and villages on Buru. We estimated that human influence (e.g. agriculture and firewood collection) might extend for about seven kilometres from each place of habitation (coloured circles).

Those aspects of the biology of the Buru babirusa that were observed were very similar to those of the babirusa from Sulawesi (Macdonald, 2017). Many details still remain to be discovered, however. More information is needed on babirusa numbers and distribution in the mountainous





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centre-west and west of Buru. Further details of food plants used by Buru babirusa would be helpful. The relative lack of information on babirusa behaviour reflected a reduction in hunting (which is to be welcomed), and a need to communicate with those people on the island (in the interior) who still engage in this activity – skill with the Buru language would be critical in this regard.

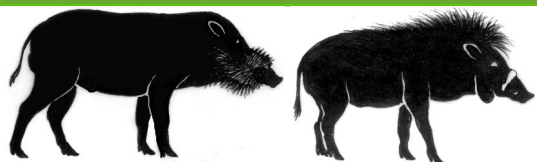
Studies by anthropologists have revealed that the people in the mountainous interior of Buru are native to the island. They have also shown that the people along the west and south coasts were from the 'Buton' area off south-east Sulawesi; the human population along on the north coast was largely derived from people migrating from the Sula Islands (Grimes and Maryott, 1994). Some individuals from each coastline could trace these migrations back twelve to fourteen generations. Dammerman (1929) commented that several of the anatomical characteristics of the skull of the Buru babirusa - its shortness, breadth and the less straight profile line - were the same characteristics that domestic *Sus scrofa* show in contradistinction to wild *Sus scrofa*. He implied that the Buru babirusa might once have been domesticated. The observation that the babirusa on Buru are the same species (*Babyrousa babyrussa*) as those on the Sula Islands would suggest that this short sea voyage might have been the route taken to bring babirusa to Buru. Sanana and Buru Islands are within sight of one another. They form part of the ca. 40,000 year old human migration path to the New Guinean coast of Sahul suggested by Birdsell (1977) and recently updated by Kealy et al (2016, 2017).

Acknowledgements

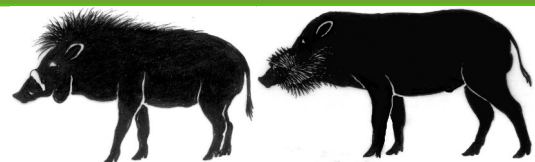
The team members were Bapak Eki Kailuhu, Bapak Ino Baltazar, Bapak Bobo Balun, Bapak Emang, Bapak Renol and Bapak Melli, each of whom contributed to the success of the visits. We gratefully thank all correspondents from around Buru Island that gave encouragement, guidance, information, stories, accommodation, food, shelter and friendship during our travels.

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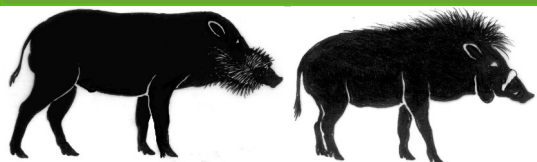
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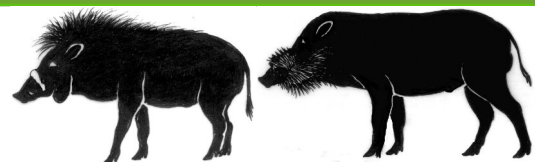
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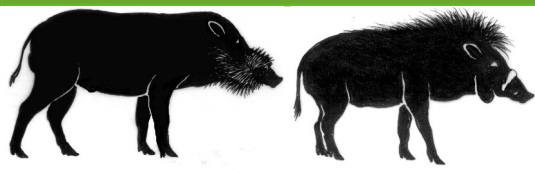


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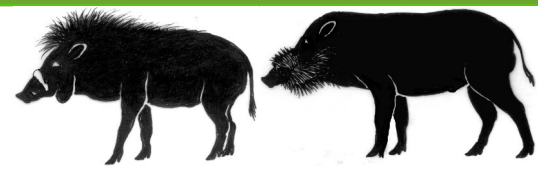


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Teaching pigs to fly: Integrative conservation breeding of babirusa – an example by Chester Zoo

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³IUCN/SSC Wild Pig Specialist Group

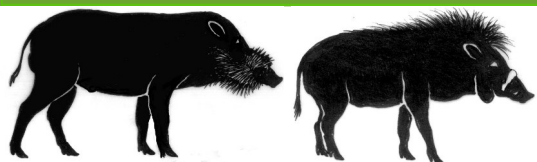
Introduction

Traditionally, species conservation in the field and in captivity have been largely operating on their own, despite both sides following the goal of achieving long-term viable populations. Only recently, more integrated approaches have been followed where *ex situ* conservation breeding and *in situ* conservation activities have been connected and coordinated to maximise conservation benefits (Redford et al. 2012, Byers et al. 2013, Barongi et al. 2015). One of these approaches is the One Plan Approach, a term introduced by the IUCN Captive Planning Specialist Group in 2013 (Byers et al. 2013). Captive conservation breeding will still play an important role for many species where situations in the wild have deteriorated so much that a safe insurance population is the only hope (examples in CBSG 2017). The babirusa (*Babirusa* ssp.) is one of the species where an *ex situ* insurance population combined with integrated conservation activities *ex situ* and *in situ* is suggested to be the best strategy for conservation (Leus et al. 2017). This idea was used in the recently established Babirusa Global Species Management Plan (GSMP) that follows the One Plan Approach (Leus et al. 2017). Here, we aim to share Chester Zoo's experience in breeding babirusa for conservation purposes, and how actively supporting the Babirusa GSMP can help to actively integrating *ex situ* breeding with *in situ* conservation activities.

Taxonomy and distribution of babirusa

The babirusa is positioned within the order Cetartiodactyla (even-toed ungulates) and the suborder of Suina which is made up of two families: Tayassuidae (peccaries) and Suidae (pigs); of which babirusa is placed within the family Suidae. There has however been ongoing dispute regarding the correct placement of the babirusa within this family; Suinae had been considered the only subfamily of Suidae with babirusa classified as a tribe within this clade (Babyrousini), a view supported by Meijaard et al. (2011) due to 'shared morphological characteristics'. A study conducted by Gongora et al. (2011) looking into the genetics of existing genera of Suidae from Eurasia and Africa challenged this view putting forward that the babirusa should be recognised as a second subfamily within Suidae as Suinae and Babyrousinae had shown to have diverged from their common Southeast Asian ancestors. In this view, the genus *babirusa* is considered to be monotypic within the subfamily of Babyrousinae. Initially there were three extant subspecies that came under the classification of *Babirusa*; however, following a proposal from Meijaard and Groves (2002) all three of the subspecies were upgraded to species level with the Moluccan babirusa from the Buru and Sula Islands retaining the taxonomic identity of *Babirusa babirusa*. The distinction between species is based on features of their skull and teeth.





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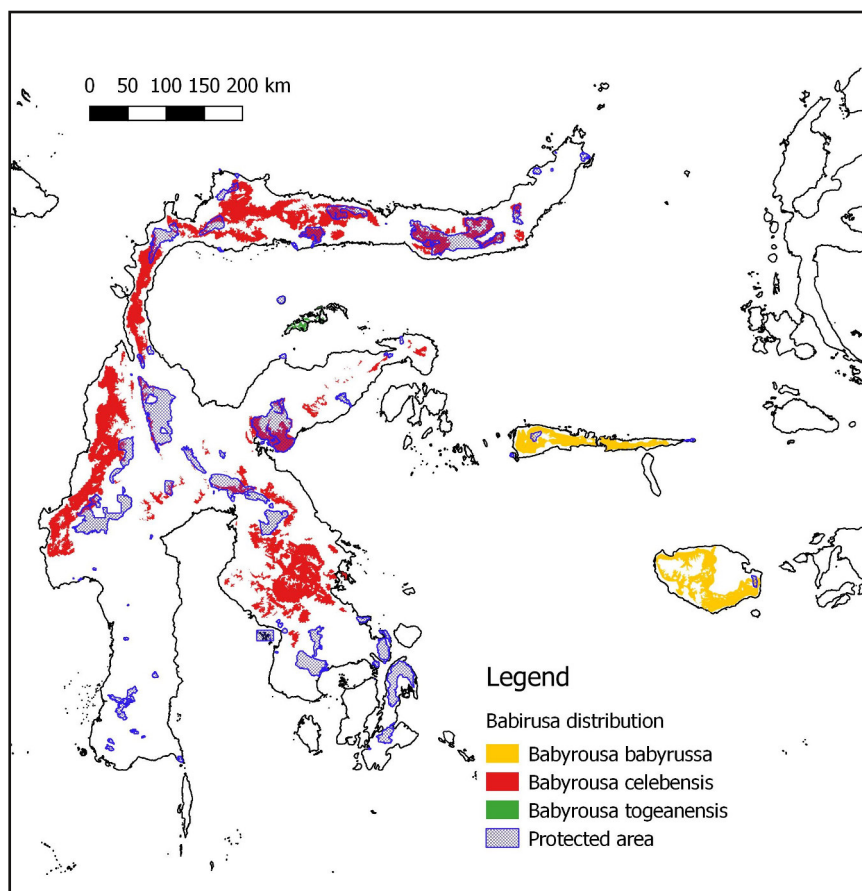
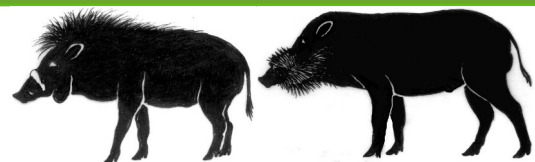


Fig. 1: Distribution of babirusa (*Babyrousa* spp.). Data taken from IUCN (2017) and protectedplanet.net (2017).

Babirusa are endemic to various islands of Indonesia (Figure 1) though they are not as widely distributed across the islands today as they have been historically. The hairy babirusa (*B. babyrussa*) originates from the Moluccas archipelago and is known to only reside on Buru and two of the Sula islands, Mangole and Taliabu (Macdonald et al. 2008). It is thought that historically the species would have also been found on the island of Sulabesi but is now extinct in that region (Macdonald 1993). The Sulawesi babirusa is found on the island of Sulawesi and the neighbouring islands of Muna, Buton and Lembeh. The Togian Islands babirusa (*B. togeanensis*) is found within the Togian Archipelago, specifically on the islands of Batudaka,

Togean, Talatakoh and Malenge (Akbar et al. 2007) and more recently Kadidiri (Meijaard et al. 2011).

Threats and conservation status

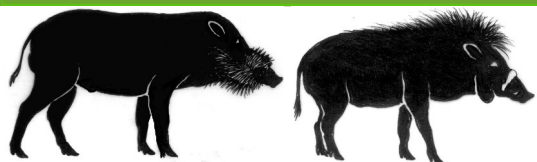
The main threats to the babirusa populations are deforestation causing significant loss of habitat, and hunting by humans usually for meat, though the latter is less of an issue for *B. babyrussa* and *B. togeanensis* due to there being only a small number of non-Muslim communities residing within their range. The hairy and the Sulawesi babirusa are currently listed as Vulnerable and the Togian Islands babirusa as Endangered by the IUCN Red List of Threatened Species, but with decreasing population trend of all three species (IUCN 2017).

Captive conservation efforts

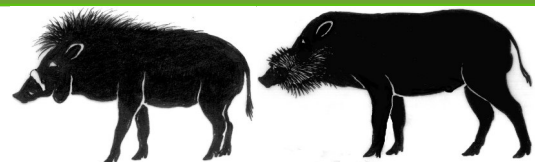
History of babirusa in zoos

Babirusa have been kept in captivity since the early 19th century and possibly before. It is documented that they were given as diplomatic gifts by the kings (rajas) of Sulawesi (Macdonald 1993). The first babirusa known to be brought into Europe were a male and a female in 1820, received by Menagerie du Jardin des Plantes in Paris, the pair successfully bred a year later (Boitard 1851 as cited in Macdonald 1993). However, it was not until the 1970s that the captive population began to increase significantly when six male and six female babirusa were imported from Indonesia into Europe. The first studbook for the babirusa was published in 1988, by this





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time the total number of babirusa recorded in captivity included 60 males, 60 females and 3 individuals of unknown sex across Europe, America and Indonesia (Piasa 1991 as cited in Macdonald 1993).

Global captive breeding stock

The international studbook for babirusa is currently kept by Dr Thomas Kauffels, Opel Zoo records a total of 190 animals in 34 institutions as of 31st of December 2015. The European Association for Zoos and Aquaria (EAZA) holds 23 animals (7 males and 16 females), the American Association for Zoos and Aquaria (AZA) and other North American institutions 60 animals (28 males and 32 females), the South East Asian Zoo Association 32 in Singapore (12 males and 20 females) and the Indonesian Zoo Association (PKBSI) 75 animals (30 males and 45 females). According to the Zoological Information Management System (ZIMS), that includes older records, but may not include data from some of the institutions captured by the international studbook, there is a total of 129 specimens as of June 2017. Based on these ZIMS data (Species360 2017), the number of holding institutions has steadily dropped in the last 20 years (Figure 2).

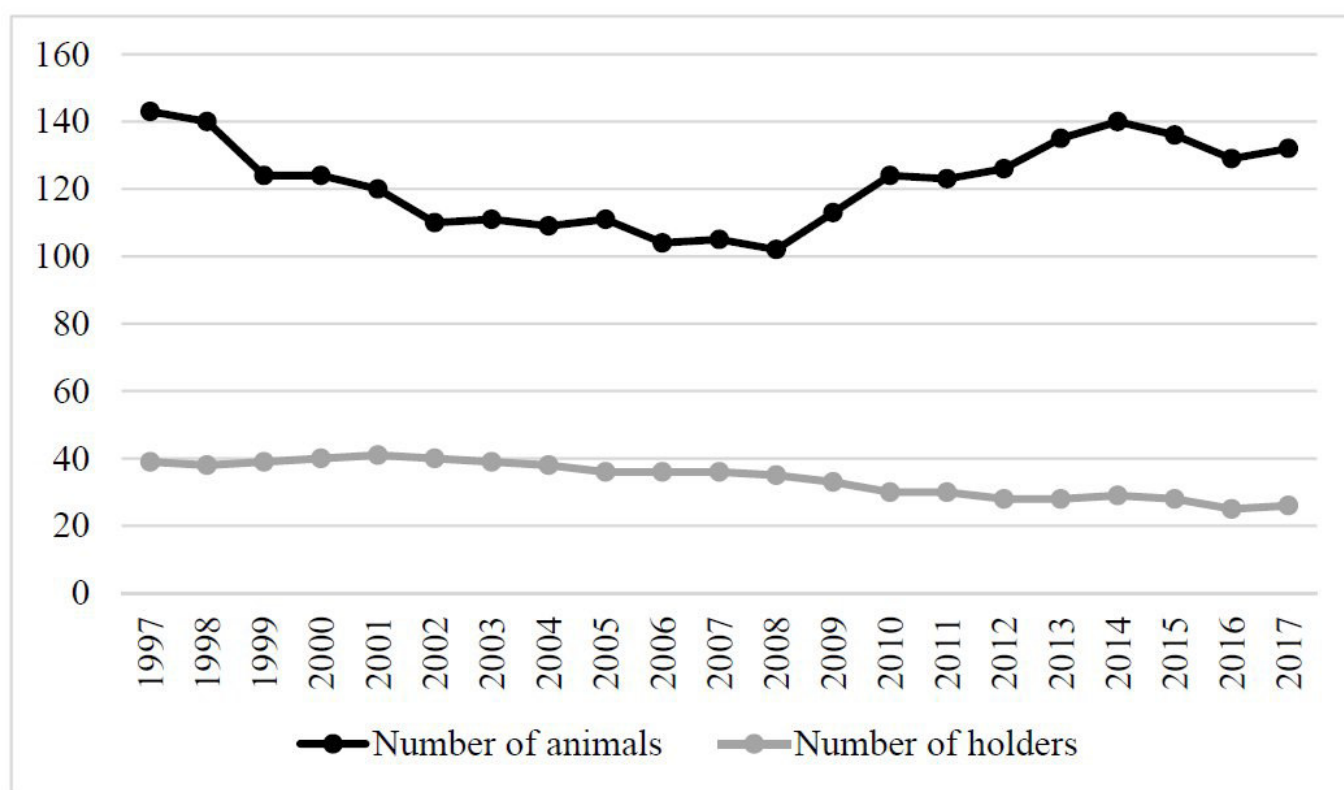
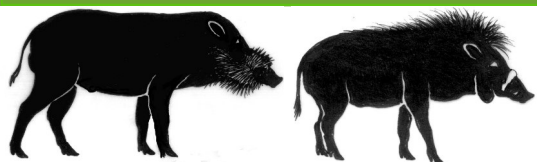


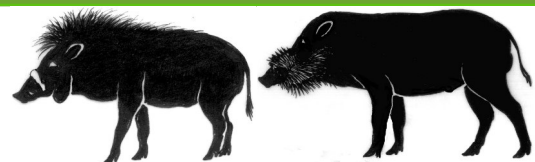
Fig. 2: Number of institutions holding babirusa and number of individuals recorded by Zoological Information Management System (ZIMS) for the last 20 years (1997 – 2017, Species360 2017). Please note that numbers may differ from numbers recorded by the international studbook.

The accuracy of the data taken from ZIMS is reliant upon the institutions keeping their records up to date. ZIMS is not currently linked in with studbook data. Being interested in the number of animals in the global captive breeding stock, and ZIMS being the record system used by most institutions that join cooperative breeding efforts, it is safe to assume that numbers in ZIMS are close to numbers of animals in the breeding pool.





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The most recent version of the European Stud Book (ESB) available for babirusa showed that at the end of 2015 eight institutions held babirusa in Europe with a total of 23 individuals (7 males and 26 females) between them. Similar to the global trend, the number of institutions holding babirusa has almost halved since the late nineties resulting in the European population being at its lowest in 20 years. With numbers being so small the focus now needs to be on improving reproductive success and bringing fresh genes into Europe. Chester Zoo has imported a male and a female into the European stock from Saint Louis Zoological Park in June 2017.

General husbandry and social groupings at Chester Zoo

At Chester Zoo, the babirusa are mainly split between a single species enclosure and a mixed species enclosure with Asian small-clawed otters (*Aonyx cinerea*), there are also a number of holding areas that are not on display. The single species exhibit is the most recent babirusa enclosure which opened in spring 2015 and was specifically designed to be used as a breeding facility. Chester Zoo's social groupings of the babirusa are based on the reproductive status of each animal and whether or not young are present. If not mixed with a male for breeding purposes or with offspring, adult females are kept alone. Babirusa are omnivorous and in the wild they would feed mainly on leaves, roots and fruit, while in captivity they have also been observed consuming small mammals and birds (Meijaard et al. 2011). At Chester Zoo the captive diet consists of pasture nuts (split into a morning and afternoon feed) and green vegetables, root vegetables and various fresh fruits, fed out as scatter feeds throughout the day. Water is always available from self-filling water troughs within the house and browse is offered on a daily basis to provide enrichment and promote natural behaviours.

The windy road to successful breeding at Chester Zoo

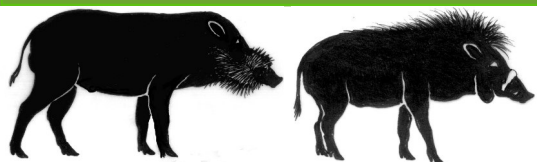
The first pair of babirusa in Chester Zoo, a male and a female, were received from Twycross Zoo in 1997. Chester Zoo currently holds a breeding group of eight babirusa, five females and three males.

The first birth of babirusa at Chester Zoo occurred in 2006. Although having gone full term the piglet appeared to have suffered a head trauma during the birth and was still born. In the following years despite successful litters being produced more than half of the piglets born did not survive. The main causes of death were parental neglect or trauma caused by the mother. The suspected reason for the female not rearing her piglets was that she did not feel safe and comfortable in her surroundings, leading the keepers to believe that husbandry changes needed to be made. The key to successfully breeding this species seems to be in the detail and even small husbandry changes can result in success.

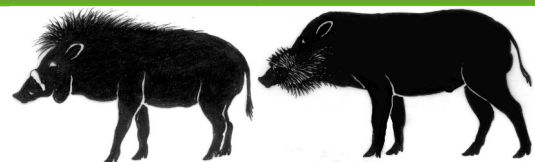
a) Disturbance: Any disturbances in or around the house might trigger parental neglect. In 2009 for instance a piglet suffered an injury after being spooked by noise from maintenance work being conducted in the vicinity of the enclosure, and the piglet died a few days later. The animal team should always be informed of any work happening around the enclosure. The keeping team may also use signs around the enclosure to indicate if a birth has occurred to prevent unnecessary disturbance.

b) Access to outdoor enclosure: Another litter was thought to have been lost because the mother





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and piglets were kept inside too long after birth. It is important to keep them inside initially as environmental factors such as temperature can be controlled, feeding can be monitored and distractions or disturbances can be kept to a minimum. Providing this safe controlled environment also allows the mother to bond with her offspring. However once piglets are feeding regularly and appear strong, access outside should be given as soon as possible. If this is delayed the mother can become stressed which will increase the likelihood of piglets being injured or rejected.

c) Diseases: The bacterium *Streptococcus suis* was found during post-mortem in a couple of the litters that did not survive, with one piglet also showing signs of septicaemia. Though parental neglect was stated as the cause of death for these cases, it is possible that the female rejected the piglets because she was aware they were not healthy. In order to limit the chances of such diseases occurring in new-borns it is important that areas are kept as clean as possible after birth, and biosecurity measures need to be strictly adhered to. Ideally spot cleaning needs to be happening about a week after birth, this can be sooner if piglet appears to be strong and feeding well. At Chester Zoo both babirusa houses have more than one pen so animals can be moved around after about 2 weeks to allow for cleaning to occur.

Today's successful breeding of babirusa in Chester Zoo

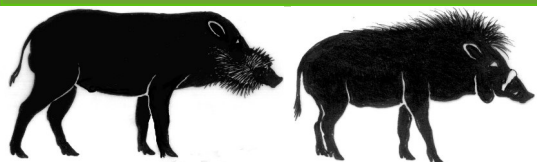
Once the decision to breed from a pair has been made, the male will be introduced to the female when she is known to be in oestrus. The male may remain in the same enclosure as the female throughout the pregnancy up until a few weeks before birth. The male will then be removed from the enclosure and he will be kept away until the young are around eight months old. He will be moved between females, remaining with them for one or more oestrus in order to maximise reproductive success. There is no seasonality with regards to mating, as there is no seasonality in the females' oestrus. Young will remain with the female and male in a "family" group from eight months of age to around one year before they are separated due the mother becoming aggressive towards her offspring.



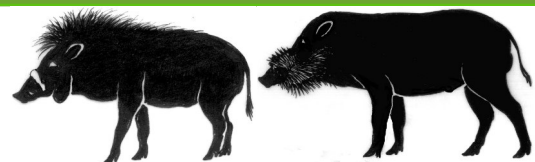
Fig. 3: Twins Marisa and Masamba, born in 2015. Marisa moved to Stuttgart Zoo and Masamba to Wuppertal Zoo, both Germany.

Learning from previous births over the next few years a lot of work went into getting the husbandry and breeding facilities correct. The main changes included alterations to the nest area to provide more privacy for the female, separating the pregnant female from the male and/or other animals earlier on to give her the time and privacy to build her nest, and using cameras to monitor pregnancy progress so that keepers do not need to physically enter the enclosure. Finally once the female has given birth it is extremely important for





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the area to remain as quiet and as undisturbed as possible, this means limiting entry to the area and ensuring an absence of noisy activities (e.g. maintenance works) being carried out near the enclosure.

By making changes in husbandry based on previous births both before and after parturition, along with careful monitoring of the environment of the breeding area, survival rate of piglets increased dramatically. For the past six years Chester Zoo's babirusa group have produced nine healthy individuals, some of which have been moved to other institutions around Europe (Figure 3).

Case study: the birth of Sula

The most recent birth at Chester Zoo was the female Sula, born on the 8 November 2016 to dam Majene (14 years) and sire Sausu (male, 13 years), who are Chester Zoo's most experienced and successful breeding pair (Figure 4). Both animals were sharing an enclosure along with their last offspring, a female named Matano. When Majene came into oestrus, keepers closely monitored the pair and noted full matings observed, in order to give an accurate due date if Majene became pregnant. Gestation for babirusa can range between 150 and 164 days and Majene's gestation period has been 161 days for her previous 3 litters, so it was possible to predict with relative accuracy her due date.

Throughout the pregnancy Majene was weighed fortnightly. Non-pregnant females weigh around 60 kg.

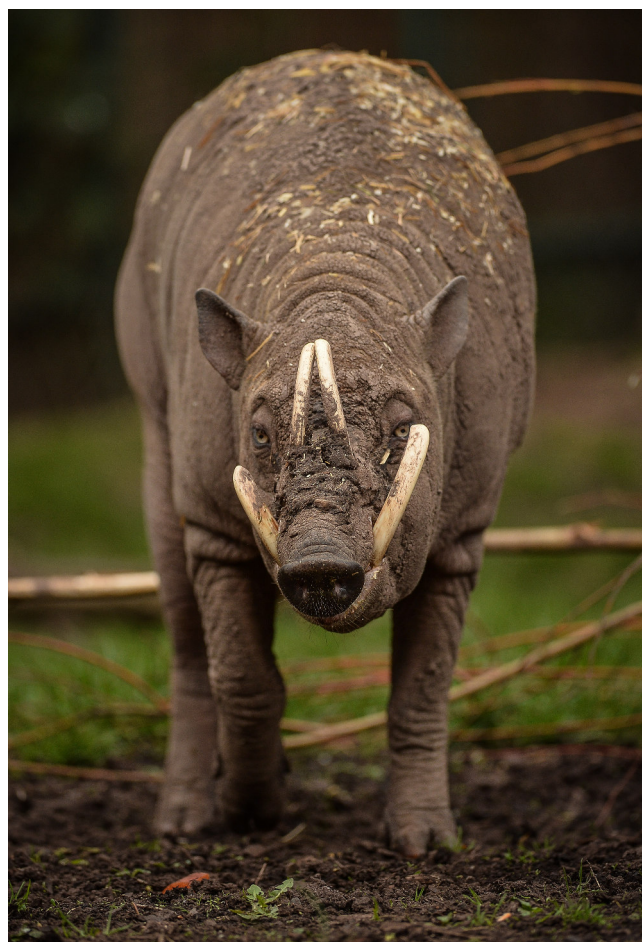


Fig. 4: Breeding male Sausu

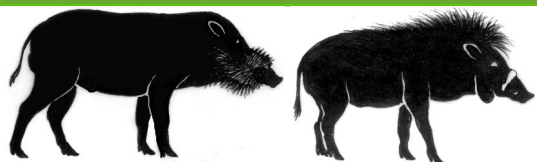


Fig. 5: Pregnant Majene

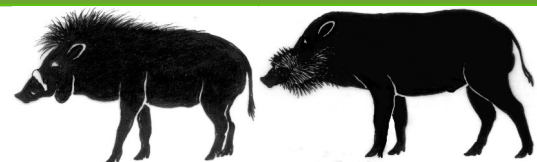
Majene gained a mean of 5.6 ± 1.4 kg (range 4.1 to 7.4) during her four pregnancies (Figure 5). Two of her litters were twins. For the pregnancy reported here, faecal analysis at the onsite endocrinology lab was used to confirm pregnancy and was continued to be used to track pregnancy progress.

A few weeks prior to parturition the female usually becomes aggressive





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towards the male and any other animals in her enclosure. This is when the female should be separated. The point at which separation should occur can vary depending on individual temperaments. Leaving the male in with the female too long could cause unnecessary stress on the lead up to parturition, which could potentially lead to her rejecting the piglets once born. Approximately five weeks before Majene was due to give birth she was separated from Sausu and Matano and moved to another enclosure on her own to give her privacy.

The enclosure has an area partitioned off with plywood to form a private nest area where the female can feel safe (Figure 6). Prior to birth CCTV cameras were installed above the nest area with a monitor located in a separate keeper area so the dam and piglet could be observed without disturbance. The nest area has a built in creep for the piglets (a safe area that the mother cannot enter) to reduce the risk of the piglets being accidentally crushed by the mother. The enclosure also has a quiet, secure off-show corral area outside so that piglets can adjust to an outdoor environment without being exposed to the public straight away and the female receives some privacy after birth. Temperatures within the house are maintained at a minimum of 21°C, with heat lamps positioned above the nest to maintain the temperature at 25°C.

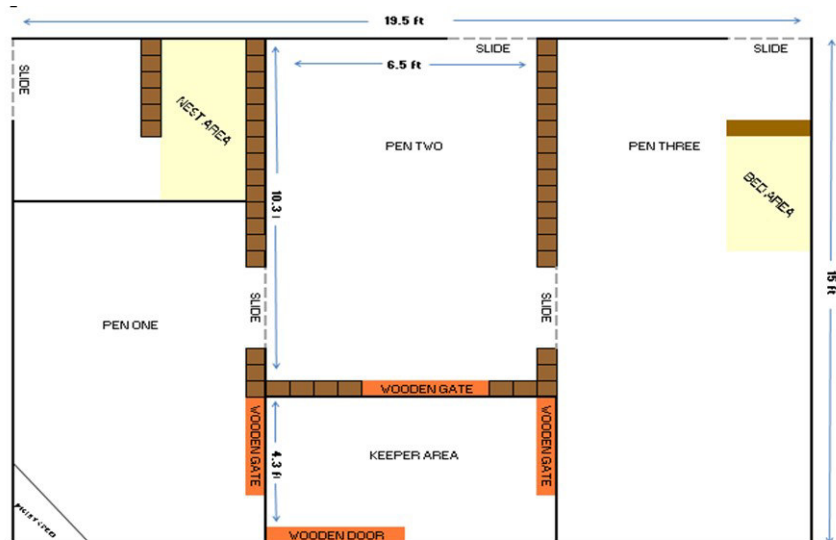


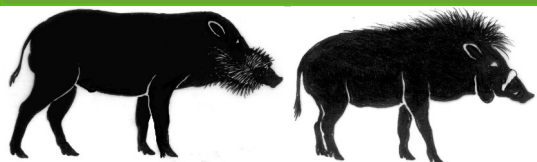
Fig. 6: Example of babirusa house at Chester Zoo.

Majene gave birth to a female piglet (Figure 7) overnight on the 8th November 2016, which was, as predicted exactly 161 days after copulation. After the birth it is important that disturbance and noise around the dam and piglet are kept to an absolute minimum, as it can lead to rejection and even infanticide. Babirusa piglets are very small and it is important that they feed as soon as possible after birth to keep up their energy levels. Majene is an experienced

mother so feeding has usually occurred within an hour of birth. For the first few days keepers would enter the enclosure twice a day to put the food in and leave straight away. Once it had been established that the piglet was feeding regularly and looking strong, the pens were spot cleaned, and feeding times and visual checks were increased (about one week after birth). Dams are aggressive towards keepers for a few weeks postpartum, so extra care is taken. Birth weight of a babirusa is generally less than 800g. However, it is usually not possible to obtain a birth weight of a newly born piglet unless something has gone wrong, e.g. piglet has died and been retrieved, or dam has rejected her piglet and it has been taken for hand rearing.

After 2.5 weeks Majene and her piglet were given access to the outside corral area, initially for short periods of time but increasing gradually. Two months after birth the piglet was big enough to be caught by keepers to allow a quick health check by the vet and to be microchipped (Figure 8). Only at this point could it be fully confirmed that the piglet was female, and it was decided to





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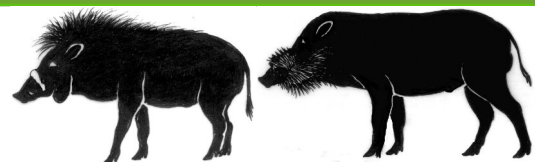


Fig. 7: Sula at 3 weeks of age.

name it Sula, after the Sula Islands in North Maluku, Indonesia. Majene and Sula started to be separated for independent feeding between four and five months after birth. Although piglets will start to eat soft fruit at around one month old they usually will not be fully weaned until about five months.

Integrative conservation of babirusa – the Global Species Management Plan for babirusa

Babirusa are fully protected under Indonesian law, and are listed on

CITES Appendix I. The species is also listed as one of the 25 threatened animal taxa that are given national priority for conservation by the Indonesian Ministry of Environment and Forestry (*Keputusan Direktur Jenderal – Konservasi Sumber Daya Alam dan Ekosistem – Nomor: SK.180 /IV-KKH/2015*). In 2013, the Indonesian Ministry of Forestry published a Strategy and Conservation Action Plan for Babirusa 2013-2022 (*Strategi Dan Rencana Aksi Konservasi Babirusa Babyrusa 2010-2020; Direktorat Konservasi Keanekaragaman Hyati 2015*), with the vision of stable, ecologically functional, populations of babirusa in their wild habitat. Besides conservation activities that aim for reduced poaching (hunting) and illegal trade and the maintenance of existing habitat, one part of this action plan is the establishment of a demographically and genetically healthy global *ex situ* population of babirusa that can serve as an insurance population.

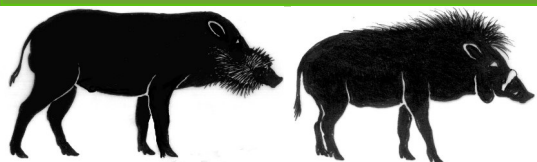
Until recently, the captive babirusa populations that are held in various zoos around the world were managed separately by the respective regional zoo



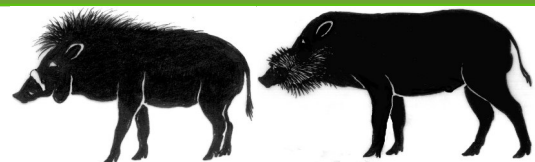
Fig. 8: Babirusa piglet caught for its first health check at two months of age

associations, while the Indonesian Zoo Association (PKBSI), holding a very important part of the global population, had not kept a studbook for babirusa. The sizes of each single of these regional populations are not large enough to guarantee a sustainable population. However, managed globally with an international studbook the global captive population of 190 animals





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could be viable and guaranteeing a demographically and genetically healthy insurance population for the wild.

Recognising this, PKBSI, EAZA, AZA, IUCN Species Survival Commission (SSC), IUCN/SSC Asian Wild Cattle Specialist Group (AWCSG) and IUCN/SSC Wild Pig Specialist Group (WPSG) have initiated the Babirusa Global Species Management Plan, which was approved by WAZA in 2016. The GSMPs are a framework for global cooperation for the integrated *ex situ* and *in situ* conservation of a species, following the One Plan Approach (Byers et al. 2013, Barongi et al. 2015). By creating the first Indonesian transfer and breeding plan (to be followed by a global transfer and breeding plan) and offering capacity building for Indonesian zoos, the GSMP tries to promote a self-sustaining insurance population (Leus et al. 2016, 2017). To follow the One Plan Approach, the conservation strategies developed in the GSMP also include in-country support for rescue and rehabilitation centers, awareness raising/conservation education in-country and abroad, and identification and support of conservation projects *in situ* (Leus et al. 2017).

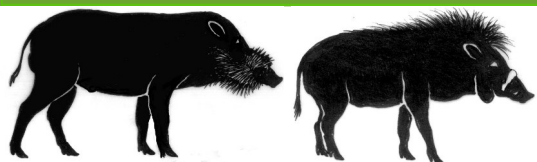
The involvement in these activities by anyone can be manifold and includes from financial support, providing staff for planning workshops, capacity building events and *in situ* surveys, to staff time working on various activities and providing expert advice on a number of topics. Due to the diversity of activities, any institution can support the GSMP, e.g. zoos, NGOs, universities, laboratories, etc.. Each of the supported activities is extremely important for the success of this integrative programme, and the combined efforts and synergetic effects are the key to success.

Chester Zoo as an example for an institution supporting the GSMPs tries to integrate the *ex situ* and *in situ* approach by being successful in captive breeding and also assisting activities in Indonesia. In 2016 for example we have co-financed the chair of the AWCSG and an AWCSG programme officer, sent two members of staff out to Indonesia for a planning workshop and *in situ* surveys, and provided finances for *in situ* projects. A zoo survey for Indonesian zoos was designed by the Learning and Discovery (education) Department and the Field Programmes Department to establish a baseline of keeper skills, husbandry practices and enclosure characteristics in Indonesian zoos, in order to design effective training events. The survey was then conducted by an international team in Indonesia, including Chester Zoo's mammal curator (TR) and South East Asia Programme Coordinator (JRM), and analysed back in the UK. Another example of cross-departmental involvement is the design of effective zoo education materials (e.g. signage) by the education department, to be provided to Indonesian zoos. Other departments give advice on various tasks of the GSMP, e.g. the accounting team for managing finances, or the fundraising and marketing team for helping with promotion and PR of the GSMPs. This shows how a zoo can not only give support by providing money or by travelling to Indonesia, but also by using the skills and assets of their different departments and providing staff time, to accomplish a variety of tasks supporting the conservation of babirusa.

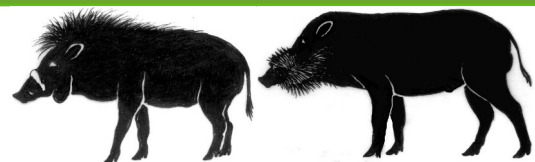
Conclusions

By successfully breeding animal species a zoo can be part of the bigger picture of maintaining demographically and genetically healthy insurance populations. To ensure the integration of the captive population into regional and global conservation plans, the respective zoos, as well as all other interested institutions, should to their best of abilities get involved in supporting ongoing capacity building and *in situ* conservation activities.





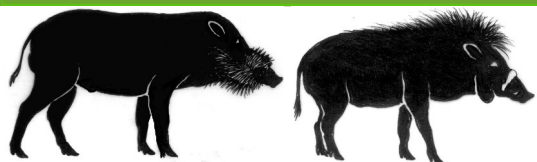
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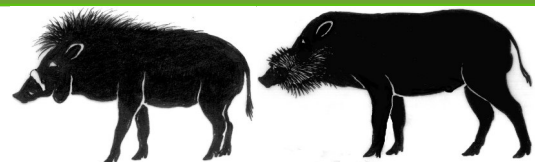
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Ocorrência de queixada (*Tayassu pecari* Link, 1795) em remanescentes florestais do Estado do Paraná, Brasil

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Resumo

Este estudo teve como objetivo mapear as áreas de ocorrência do queixada, com ênfase nos remanescentes florestais nativos do Estado do Paraná. Foi realizado o levantamento das informações contidas nos Planos de Manejo das Unidades de Conservação, bem como dos relatórios de monitoramento de fauna e publicações científicas, estudos de impacto ambientais entre outros documentos do tipo, arquivados e disponibilizados para consulta pública nos órgãos ambientais. Também foram consideradas as informações provenientes de uma pesquisa realizada pelos autores em propriedades situadas no Corredor Ecológico Araucária, cujos métodos de amostragens consistiram no levantamento expedito nas áreas de estudo, entrevistas não estruturadas com os proprietários, comunidades locais e observação de vestígios. Foram levantados dados históricos e atuais da ocorrência deste pecarídeo, identificando-se, desta forma, os locais onde a espécie foi extinta localmente e onde, ainda, existem populações remanescentes.

Abstract

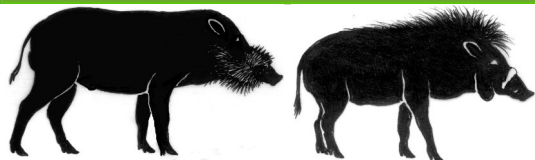
This study focused on native forest remnants in the state of Paraná. Its aim was to map areas of occurrence of the white-lipped peccary. The sources were the collection of information from the conservation units' management plans, from fauna monitoring reports and other scientific papers, and from environmental impact studies among other documents. All of the sources were available for public consultation. Research about the Araucaria Ecological Corridor was also made by the authors. Methods of sampling consisted of an expeditious survey in the study areas, unstructured interviews with land owners and local communities, and observation of vestiges. Historical and current data regarding the species occurrence were collected and places were identified where the species was extinguished locally and where there are still remnant populations.

Introdução

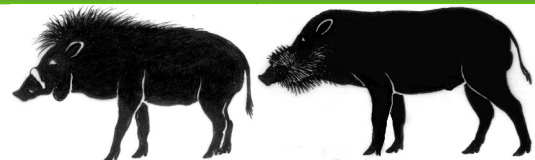
A perda e a conversão de habitats representam uma grande ameaça para todas as espécies florestais dos neotrópicos, contudo para o queixada (*Tayassu pecari*) essas transformações representam uma ameaça ainda maior a médio e longo prazo, tornando este pecarídeo ameaçado nas florestas tropicais. No Estado do Paraná ocorria em todas as formações vegetais, mas atualmente suas populações estão distribuídas de forma descontínua e fragmentada, tendo desaparecido na maior parte de suas áreas de ocorrência original (Mikich & Bérnils, 2004). Atualmente a espécie está restrita a algumas Unidades de Conservação e propriedades privadas (Margarido *et al.*, 2009).

Sua situação de conservação no Paraná se torna tema ainda mais preocupante quando se considera o intenso processo de degradação e supressão dos remanescentes florestais,





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sobretudo da Floresta Semidecidual Estacional (FES) e da Floresta Ombrófila Mista (FOM), restando apenas pequenos fragmentos antropizados, isolados e empobrecidos floristicamente. Em função disto o queixada está categorizado no Estado sob o status de “criticamente em perigo” (Decreto n.º 3.148, publicado no Diário Oficial n.º 6.750 de 15/06/2004).

Cabe ressaltar que a ausência de queixadas pode causar rompimentos de alguns processos ecológicos, tais como predação e dispersão de sementes e de ciclos de nutrientes, os quais ajudam a manter a integridade e funcionalidade dos ambientes (Janzen, 1978).

Como uma parte das ações de planejamento estratégico de conservação deste pecarídeo em ambiente natural no Estado do Paraná foi realizado o levantamento de dados secundários e primários disponíveis sobre a ocorrência do queixada no Estado, objetivando gerar informações que sirvam como catalizadoras da necessidade de adoção de estratégias de ações voltadas à proteção desta espécie e das áreas aonde ainda ocorre.

Material e Métodos

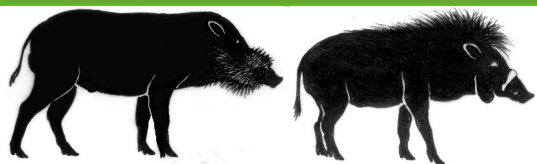
Foi realizado o levantamento das informações contidas nos Planos de Manejo das Unidades de Conservação existentes no Estado do Paraná, bem como dos relatórios de monitoramento de fauna e publicações científicas, estudos de impacto ambientais entre outros documentos do tipo, arquivados e disponibilizados para consulta pública nos órgãos ambientais (Instituto Ambiental do Paraná – IAP e Instituto Chico Mendes de Conservação da Biodiversidade - ICMBIO). Foram consideradas, além dos registros confirmados da presença da espécie nas áreas estudadas, as citações bibliográficas e museológicas que inferiram sobre a potencial ocorrência da espécie.

Também foram considerados os dados primários de um estudo conduzido em propriedades situadas no Corredor Ecológico Araucária, criado pelo Governo do Estado do Paraná, mediante o Programa Paraná Biodiversidade, em uma parceria com o Governo de Estado e o Banco Mundial (GEF). Este estudo foi realizado no período de 18 meses (anos de 2007-2008) e as campanhas de campo tiveram duração de quatro a cinco dias consecutivos. A metodologia utilizada seguiu os seguintes passos: (a) levantamento expedito nas áreas de estudo, a fim de compor um banco de dados de ocorrência atual do queixada. Nestas áreas realizaram-se entrevistas não estruturadas com os proprietários e comunidades locais para determinar a presença ou ausência da espécie; (b) constatação da presença da espécie, mediante a observação de vestígios como pegadas, material escatológico, carreiros, restos alimentares, além de visualizações e vocalizações dos animais e outros sinais que atestassem a sua presença. Estes dados podem ser considerados como atuais, já que a ocorrência do queixada é ainda constatada nestas áreas (Vidolin, observação pessoal).

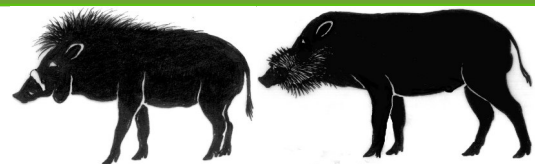
Todas as informações adquiridas foram compiladas e organizadas em planilhas eletrônicas, configuradas em planilha de dados Microsoft Excel.

A gestão e a conservação efetivas das populações de queixada no Estado do Paraná dependem de medidas de conhecimento e da capacidade de predição das relações entre este pecarídeo e seu habitat. Estas informações, no entanto, são escassas ou estão dispersas em inúmeros documentos. O cruzamento das informações contidas nestes diversos documentos irá compor um cenário que certamente contribuirá para o auxílio de novas pesquisas, alicerçadas em uma base de conhecimento já existente, embora não disponível de maneira tabulada. A partir do momento que esta base de dados esteja estruturada será possível priorizar a tomada de decisões no que concerne à proteção do queixada e de seu habitat, bem como orientar a implementação de políticas públicas sobre o tema.





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1. Ocorrência em Unidades de Conservação

No Estado do Paraná há 85 unidades de conservação, sendo 68 estaduais e 17 federais, que somam 2.942.285,68 hectares de áreas conservadas. Considerando-se as 261 RPPNs (estaduais, federais e municipais) cadastradas e averbadas que perfazem um total de 54.153,23 ha neste computo a área conservada no Estado é de 2.996.438,91 ha (IAP, 2017; ICMBio, 2017). Infelizmente, uma pequena parcela destas Unidades de Conservação possuem planos de manejo, sendo que a grande maioria, dos que são disponibilizados, estão desatualizados. A ocorrência do queixada em Unidades de Conservação, segundo seus Planos de Manejo e publicações científicas provenientes de pesquisas realizadas em algumas Unidades, foi citada para as seguintes áreas:

- a) Citações em Planos de Manejo, baseadas em informações disponíveis em literatura para a macro-região em que a Unidade de Conservação está inserida e que foram consideradas constatáveis para as respectivas áreas: APA Federal de Guaraqueçaba, Parna Guaricana, RPPN Federal Salto Morato, APA Estadual da Escarpa Devoniana, APA Estadual da Serra da Esperança, PE Pico do Marumbi e RPPN Estadual Morro da Mina.
- b) Citações em Planos de Manejo, baseadas em informações coletas in loco e que confirmaram a presença da espécie: REBio das Perobas, RPPN Federal Iguaçu, EE do Caiuá, APA Estadual de Guaratuba (regiões de Descoberto, Cubatão, Serra da Prata e Colônia Maria Luiza), PE das Lauráceas (localidade João Surrá), PE Rio Guarani, RPPN Estadual Fazenda São Bento.
- c) Citações em Planos de Manejo de extinção local da espécie: EE do Guaraguaçu e PE de Vila Velha.
- d) Citações provenientes de pesquisas realizadas nas Unidades de Conservação e em áreas de conservação do Paraná que atestaram in loco a presença da espécie: RPPN Federal Fazenda Monte Alegre (Rocha *et al.*, 2003), Parna Saint Hilare Lange (Mazzolli & Hammer, 2008), Corredor Ecológico Caiuá-Ilha Grande (Abreu *et al.*, 2009), RPPN Estadual Rio Cachoeira - porção norte (Fusco-Costa, 2014), Parna do Iguaçu (Brocardo *et al.*, 2016).
- e) Informações provenientes de estudos de campo realizados pelos autores: PE Vila Rica do Espírito Santo e RPPN Estadual Fazenda Barbacena. No município onde está inserido o PE Vila Rica do Espírito Santo corroborando a informação, Rocha-Mendes *et al.* (2004) obteve informações mediante entrevistas com a população local da extinção local deste pecarídeo em alguns fragmentos florestais ou a presença constante da espécie na região.

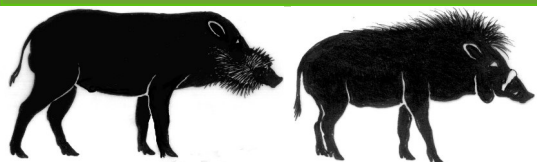
2. Ocorrência em áreas do Corredor Ecológico Araucária

O Corredor Ecológico Araucária está localizado no Terceiro Planalto do Estado, entre as coordenadas geográficas 50°55'39" e 52°23'37" de longitude W, e entre as latitudes Sul 25°34'35" e 26°43'28". Abrange 11 municípios da região Centro-Sul, totalizando uma área de 12.472 km². Faz divisas a leste com a Serra da Esperança, ao sul com o Estado de Santa Catarina, e a oeste e norte com outros municípios paranaenses. Seu eixo principal de conexões é o Rio Iguaçu e seus tributários. Além da Floresta Ombrófila Mista, há na região do Corredor a influência da Floresta Estacional Semidecidual pelo vale do rio Iguaçu, bem como de campos limpos nas regiões mais elevadas do Terceiro Planalto (Paraná, 2006).

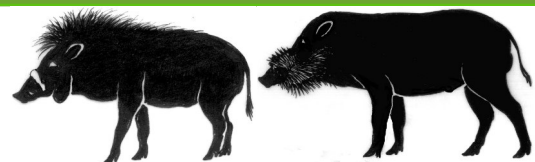
Dados históricos da ocorrência do queixada foram obtidos para as seguintes localidades (Vidolin, 2008):

- a) Fazenda Slavieiro: Nesta área houve o relato da presença da espécie na região há 20 anos





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atrás, sendo a caça citada como o principal fator de seu desaparecimento local.

b) Municípios de Inácio Martins e São Domingos: Houve o relato da presença de queixadas há mais de 30 anos, sendo a implantação de indústrias na região citada como a principal causa de desaparecimento local da espécie, juntamente com seus habitats naturais.

c) Reserva Indígena de Mangueirinha: Embora seja uma área de ocorrência original do queixada, a espécie foi extinta localmente, sendo a caça citada como a principal causa de seu desaparecimento local.

d) Assentamento Rural Rondon: Nesta localidade a presença do queixada é citada para o período que antecede a desapropriação da Fazenda para o movimento dos trabalhadores rurais sem terra. A caça foi citada como o principal fator de desaparecimento local dos queixadas.

Os dados da ocorrência atual da espécie foram obtidos para (Vidolin, 2008):

a) Fazendas Lageado Grande 1, Lageado Grande 2, Etiene, Santa Gema Geyer e Faxinal dos Santos: Vidolin (2008) identificou o uso destas áreas por um grupo de queixadas (Grupo 1), com uma média de 56 indivíduos, que ocupa uma área estimada em 12.457 ha (124 km²); e a área de uso central em 3.076 ha (31 km²), da qual a Fazenda Lageado Grande 1 constitui 71,81%. Este índice de abundância relativa e cálculo do polígono de área de uso dos animais foram calculados com base em todos os eventos em que a espécie foi visualizada e que os animais puderam ser contabilizados, considerando-se os registros individualizados para cada propriedade. Procedeu-se o cálculo da média de indivíduos observados em cada propriedade (número total de indivíduos visualizados/ contabilizados dividido pelo número total de visualizações), e na sequência calculou a média geral (soma de todas as médias divididas pelo número total de propriedades onde houve registros visuais da espécie), obtendo-se, assim um índice de abundância relativa de indivíduos por grupos. Os registros confirmados foram plotados em um mapa de uso do solo da região, e os pontos extremos foram unidos, resultando em um polígono de área de uso dos animais, a qual teve sua área calculada no programa ArcMap versão 9.2.

b) Fazendas Santa Cruz, São Lourenço, Santana, Santa Bárbara, Santa Lúcia e Assentamentos rurais Margens do Iratim, Paraíso do Sul e São Lourenço: Vidolin (2008) identificou o uso destas áreas por um grupo de queixadas (Grupo 2), com uma média de 63 indivíduos, que ocupam uma área estimada em 7.397 ha (73 km²). O índice de abundância relativa e cálculo do polígono de área de uso dos animais foram calculados conforme citado no item “a”.

c) Fazenda Palmital: Vidolin (2008) verificou que esta Fazenda é utilizada esporadicamente pelos animais que constituem o Grupo 1.

d) Reserva Legal da Swedish Match: Nesta área foi citado o registro visual em maio de 2008 de um bando de queixadas de cerca de 60 indivíduos, sendo a maioria deles adultos.

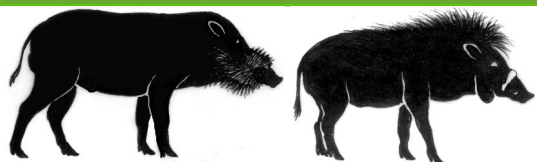
e) Quarteirão dos Vieiras, localidade de Três Antas: Nesta área foi relatado o registro visual em junho de 2008, de um bando de queixada formado por cerca de seis indivíduos.

f) Foz do Areia, no município de Faxinal do Céu: Nesta área houve o relato do registro auditivo em junho de 2008, de vocalizações características de queixada. Segundo o entrevistado os animais estavam dentro de uma caverna situada na represa de Foz do Areia.

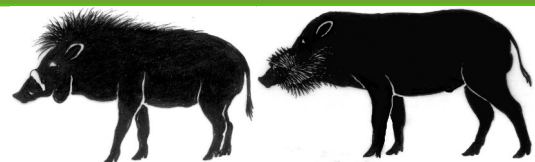
3. Outros registros

Outros registros da ocorrência do queixada foram obtidos de pesquisas realizadas em remanescentes de vegetação nativa no Estado do Paraná, cuja presença da espécie foi confirmada in loco, sendo eles:





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a) Fragmentos São João, Piquiri e São Francisco: Brocardo & Delgado (2014) registraram a espécie nestes fragmentos situados próximos ao Parna do Iguaçu, mediante fotografias e informações da população local.

b) Mata do Rio d'Oeste e Mata do Rio Tormenta: Brocardo & Cândido-Júnior (2012) obtiveram informações sobre a ocorrência histórica (cerca de 10 anos antes do estudo) de queixada nestas áreas, sendo a caça citada como um fator que contribuiu para a sua extinção local.

c) Região de Porto Rico no Alto Rio Paraná: Aguiar *et al.* (2007) obtiveram informações mediante entrevistas com a população local sobre a ocorrência de queixada. Está região é zona de contato entre a Mata Atlântica e o Cerrado, com influências do Pantanal.

d) Fazenda Rio das Cobras: Margarido iniciou estudos com queixada nesta área nos anos de 1996, quando também houve a primeira invasão pelo Movimento dos Trabalhadores Rurais Sem Terra (MST). Em 1997 e 1998 houve a desapropriação de parte da área. Após a desapropriação ocorreram três novas invasões, entre 1999 e 2000, verificando-se novamente a completa devastação devida ao desmatamento e às queimadas provocadas. Com a alta pressão de caça exercida pelos invasores, não restaram muitas chances de sobrevivência para a população do queixada (Margarido, 2001). Cabe ressaltar que este foi o pior impacto sofrido pela espécie e que possivelmente tenha afetado toda a estrutura da população no Estado do Paraná. Anteriormente a estas invasões Margarido (2001) estimou a população de queixadas em 1.000 indivíduos (a maior conhecida para o Estado) para uma área de 79.494 ha, dos quais 26.252 ha foram desapropriados e deixaram de ser floresta. Atualmente nesta Fazenda está inserida a RPPN Iguaçu (ver item “ocorrência em unidades de conservação”).

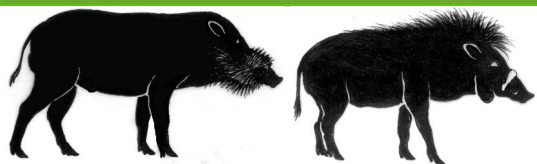
A Figura 1 detalha a localização das áreas de registros históricos e atuais de queixada em remanescentes florestais do Estado do Paraná.

A maior parte dos remanescentes florestais onde o queixada ocorre apresenta problemas relacionados ao tamanho insuficiente das áreas para manutenção de populações viáveis, além do alto grau de isolamento na paisagem que pode levar à ocorrência de gargalos populacionais, ou seja, à redução drástica do tamanho populacional, aumentando assim o risco de sua extinção local.

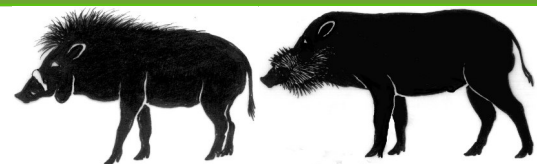
As baixas densidades relativas obtidas por Vidolin (2008) chamam a atenção para as possibilidades desta espécie estar em “extinção ecológica” em algumas áreas, ou seja, ter sofrido uma redução no número de indivíduos tão drástica, que embora continue presente, não desempenha mais suas funções ecológicas, submetendo estas áreas ao conceito de “florestas vazias” (Redford, 1992). Estas funções incluem a dispersão e predação de sementes, as quais são definidas por Terborgh (1988) como “estabilizadoras”, pois ajudam a manter a integridade e funcionalidade dos ambientes.

Também chama a atenção os registros atuais de Brocardo *et al.* (2016) da espécie para o Parque Nacional do Iguaçu após 20 anos, retratando movimentos de migração entre diferentes áreas. Estes movimentos descritos como migratório (Bodmer, 1990) ou nômade (Kiltie & Terborgh, 1993) são comuns para espécies que necessitam de uma grande área de vida como os queixadas. Nesse contexto, Southwood (1977) cita que o habitat ocupado pelas espécies é dinâmico e que possui certa plasticidade, ou seja, muda nas escalas temporal e espacial conforme a necessidade das espécies. Estes movimentos são, inclusive, extremamente





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importantes para a manutenção de cenários metapopulacionais.

Por outro lado, estes movimentos podem revelar as consequências de interações extrínsecas com fragmentação ou destruição de habitats, a baixa disponibilidade de alimento ou pressões sofridas que levam a espécie a buscar novos habitats, que nem sempre podem ser favoráveis à sua sobrevivência. Desta forma, a compreensão e o monitoramento desses eventos são fundamentais para a sua conservação e também para apontar necessidades de manejo paisagístico que favoreçam a conexão entre áreas conservadas e favoreça o trânsito dos animais entre estas áreas de forma segura, por exemplo. De acordo com Soulé *et al.* (1992), as alterações na estrutura da paisagem interferem na dinâmica das populações e alteram os riscos de extinção e a probabilidade de deslocamentos dessas populações. Nesse sentido, estudos que enfoquem o conhecimento dos padrões de deslocamento da espécie são de extrema importância.

O fato é que se atitudes eficazes de proteção da espécie e de seus habitats não forem adotadas, a curto, médio e longo prazos, suas populações poderão se reduzir ainda mais, seja pela escassez progressiva de recursos ambientais ou pelo impacto da caça que é bastante expressiva sobre a espécie. Assim, pressões antrópicas expressivas sobre a espécie precisam urgentemente ser atenuadas, sendo as atividades de fiscalização e coibição da caça, bem como a educação ambiental da população residente, essenciais para reverter o quadro de ameaça sobre esse pecarídeo.

Atualmente, como uma iniciativa de conservação da espécie e seu habitat, está em execução um projeto onde o queixada é considerado uma espécie-paisagem, cujas interações existentes entre os seus processos comportamentais (movimento) e a estrutura física da paisagem serão utilizados como indicadores da funcionalidade dos mosaicos paisagísticos estudados. Os resultados obtidos poderão substanciar um planejamento estratégico de conservação deste pecarídeo em ambiente natural, bem como da necessidade de manejo das paisagens locais, o que inclui a identificação de áreas prioritárias de conservação para manter populações viáveis da espécie, a modelagem de corredores de fauna, e o estabelecimento de zonas de conservação da biodiversidade no entorno das UCs, que viabilizem uma melhor estrutura e função dos ecossistemas naturais (Vidolin, em andamento, previsão de término 2019).

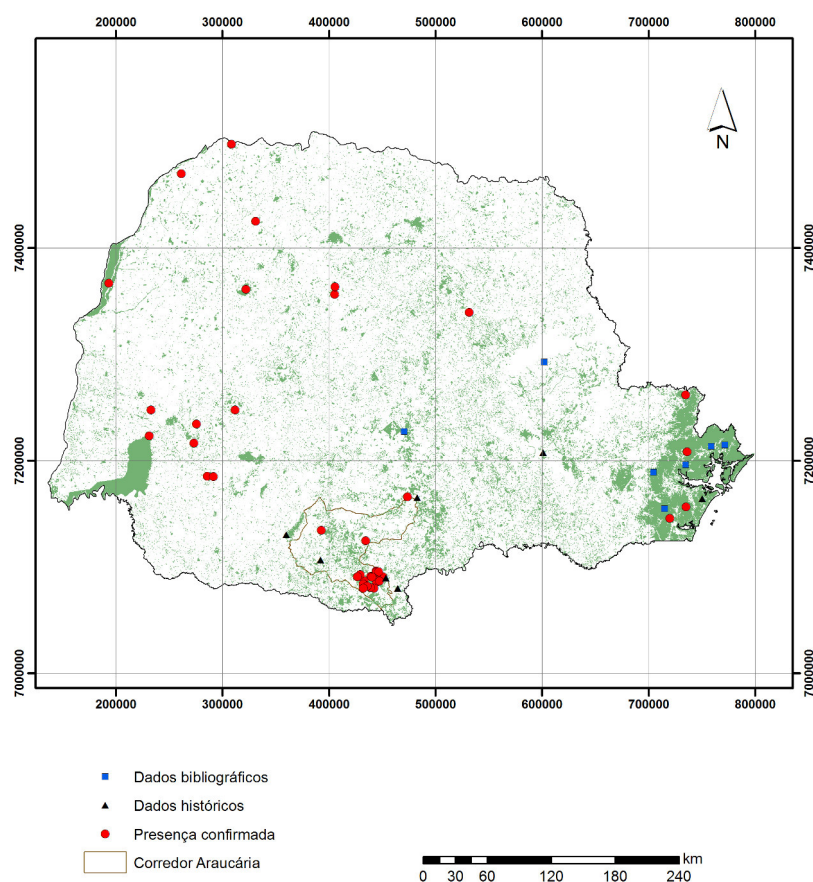
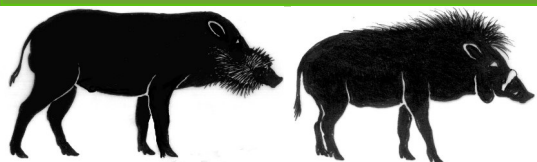
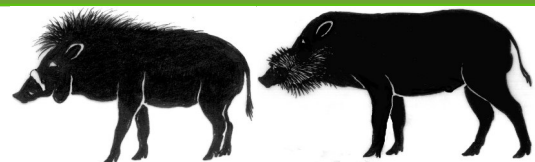


Fig. 1: Ocorrência de *Tayassu pecari* em remanescentes florestais do Estado do Paraná.





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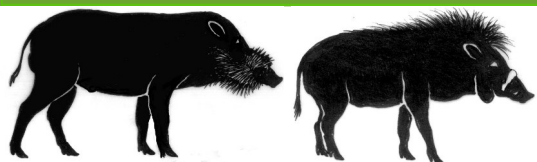
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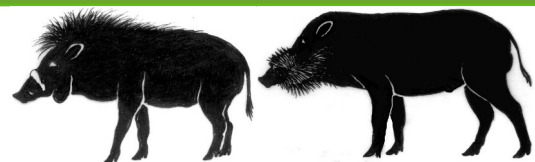
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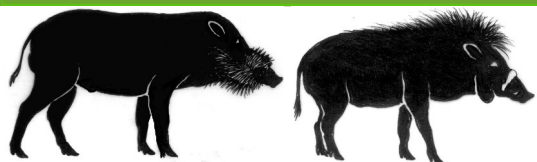


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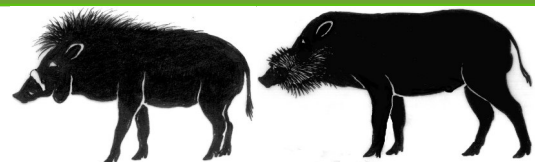


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Ecology and Conservation

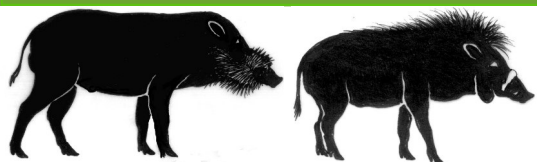


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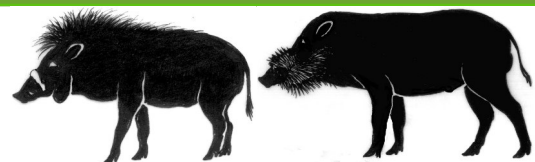


White-lipped peccaries. Photos: G. P. Vidolin





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A Range-Wide Survey to Determine the Current Distribution and Population Status of the Chacoan Peccary in the Paraguayan Chaco

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Abstract

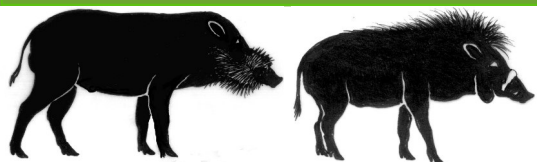
The Chacoan Peccary was thought extinct until it was rediscovered as a living species in the Chaco region of Paraguay in the 1970s. At present, the region is going through an unprecedented wave of deforestation, with over 1000 hectares of forest cleared daily. Wild populations of the endangered Chacoan peccary are currently facing the fastest and most extensive habitat loss ever recorded in recent history. To better understand the current conservation status we carried out surveys and interviews throughout the species former range in the Chaco region of Paraguay. From gathered location data, an ecological niche model was created using the Maxent program, to create an updated distribution map. The model showed that most of the species former range remains the same. However, the central southern portion of its range has suffered intense land transformation, which has negatively affected the presence of the species. On the other hand, the northern portion of its range, consisting of national parks and private lands that still mostly remain undeveloped, currently has the highest probabilities of occurrence of Chacoan peccaries. Our survey offers vital information, giving us the ability to create an updated species distribution map for Paraguay. Helping identify habitat limits, boundaries and possible barriers as well as, specific sites that need immediate attention. Similarly, our interviews have provided important information that needs consideration when implementing conservation policies, management plans, or community work to raise awareness regarding the importance of conserving the Chacoan peccary and the rich Gran Chaco biodiversity.

Introduction

The existence of the Chacoan peccary (*Catagonus wagneri*), (Figure 1) was known only from fossil records (Rusconi 1930; Kraglievich and Rusconi 1931) until it was rediscovered alive in the Gran Chaco of Paraguay by Wetzel (1975). At present, due to the continuing decline in numbers and range size it is considered “Endangered” by the IUCN Red List Threatened Species (Altrichter et al 2015). In addition, it is listed as Appendix I CITES species and in Paraguay; it is listed as endangered and protected by Law (SEAM). The actual conservation status and distribution of the Chacoan peccary in the Chaco region of Paraguay is based on previous estimates made by Taber 1991, Handen et al 1994 and more recently by Neris et al 2002. However, current population numbers are still unknown.

The Chacoan Peccary or Taguá as the Guarani know it is the largest among the living species of peccary. It is endemic to the dry Chaco of northwestern Paraguay, Argentina and Bolivia (Wetzel 1977; SOWLS 1984; Mayer and Wetzel 1986; Redford and Eisenberg 1992; Taber et al 1993;





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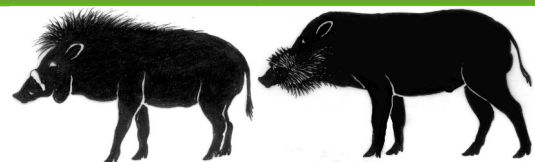


Fig. 1: Two adult Chacoan peccaries (*Catagonus wagneri*).

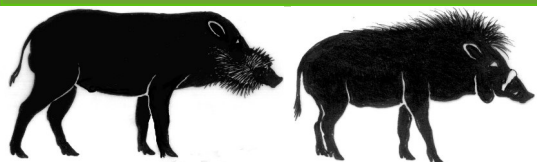
Altrichter 2004; Neris et al 2002). It occurs in areas of low rainfall and high temperature and is restricted to the driest parts of the Gran Chaco biome (Sowls 1984, 1997). The prime habitat for the species is xerophytic thorn forest characterized by emergent trees a dense shrub with ground cover of bromeliads and cacti (Mayer and Brandt 1982). The primary food source of Chacoan peccaries are several species of cactuses, roots of bromeliads, fruit from various species of *Acacia* and *Prosopis*, and occasionally they browse on forbs (Mayer and Brandt

1982; Wetzel 1977; Sowls 1984; Taber et al. 1993; Neris et al 1993). Chacoan peccary are territorial and their home range sizes reaches 1,100 ha and contains a core area of about 600 ha in the Paraguayan Chaco (Taber et al. 1993).

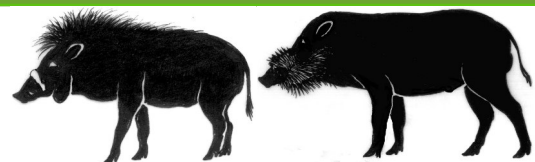
The Paraguayan Chaco, home of the Chacoan peccary is a vast alluvial plain and one of the major wooded areas in central South America, bordered on the west by the Pilcomayo River and on the east by the Paraguay River. It is divided into three main ecoregions. The Low Chaco, a plain predisposed to flooding with precipitation generally >1000 mm/ly (Redford et al. 1990; Mereles et al. 1992) characterized by palm forests with natural humid grasslands, and annually flooded savannas and swamps (Redford et al. 1990). The transitional Chaco with annual precipitation between 600 and 1000 mm/ly and the High Chaco or semiarid Chaco with precipitation <600 mm/y (Adamoli et al 1990; Vargas-Gil et al 1988). Characterized by thick, xeric thorn forest (Holdridge 1969; Gorham 1973; Redford et al. 1990; Glatzle 1999) with abundant standing water during the rainy season (November to May) which diminishes greatly or disappears entirely during the dry season (July to September) (Hueck 1966; Eidt 1968). The uniquely harsh environment of the Paraguayan Chaco ecosystem has allowed it to remain mostly undeveloped and immune to modern anthropogenic land modification until 60 years ago, when deforestation began for farming and cattle production (SENACSA 2016).

Over the last four decades, pasture production in the Chaco region of Paraguay has steadily increased. Currently approximately 1000 ha of forest are cleared daily (Huang et al 2007, 2009; Caldas et al 2013). Since 2000, the region has lost nearly 3.5 M hectares of forest, predominantly to pasture for cattle production (Huang et al 2009; Caldas et al 2013). According to Caldas (2013), the Chaco public pressures and patterns of conversion have changed over the last decade. As well as, pattern of change in satellite imagery from 2011, showing changes that are so widespread that it is difficult to identify focal areas of deforestation as in previous times. With recently deforested areas appearing more square with deforested areas much larger and cleared over shorter period, suggesting that a change in technology used to remove the forest, from small-scale chain saws to bulldozers and other heavy machinery. The region now holds more than 6 millions of cattle and steadily continues to increase (SENACSA 2016). On the other hand, the Chaco also has approximately 15.000 km² of protected areas in public and private hands.





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Despite this, most of these areas are merely big remnant forest that in the vast majority have little to no rangers, wildlife population estimates few active research and management programs and nearly all have no enforced control over illegal hunting (Figure 2). Nevertheless, these reserves and National parks are vital for the future of many species included the Chacoan peccary. Our goal for this work was to collect vital information through intense surveys and interviews to settlers, with the objective of acquiring data that allowed us to update the species distribution map for Paraguay. Identifying habitat limits, boundaries and possible barriers as well as, specific sites that need immediate attention regarding Chacoan peccary and the Gran Chaco biodiversity conservation.



Fig. 2: Hunted Chacoan peccary remains, skulls found on a Chaco public road with fresh track from the family group still visiting the area.

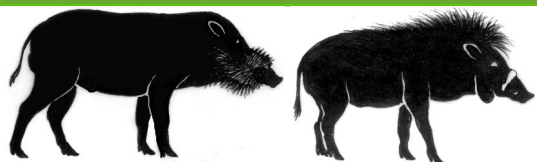
Material and Methods

Survey area

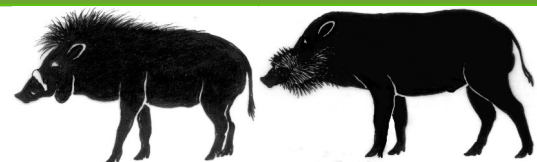
We surveyed throughout most of the former Chacoan peccary distribution in search of remains, signs or direct observations on public and private roads and paths, from August 2012 to September 2013. We carried out 22 survey trips, traveling more than 15.000 km, covering an area of approximately 180.000 km² corresponding to the species estimated former distribution and beyond, which included the northern areas of the department of President Hayes, the entire department of Boquerón and Alto Paraguay (Figure 3). We obtained 56 new presence location records based on direct observation, tracks, body remains and trusted source of direct observation records (Table 1). To ensure that all the records were independent, and to minimize the effects of spatial autocorrelation on future modeling analyses, all account have a unique exact location recorded using a global positioning system (GPS) unit. Location records that were closer than 50 m were not included in the Niche Model analysis to compensate for biases in data that frequently occur when some areas in a landscape are sampled more intensively than others (Elith et al 2011).

Despite our intense survey due to the dense characteristics of the Chaco forest, it was extremely difficult to observe Chacoan peccaries in the forest, except on open road, old paths or forest edges. To overcome this we carried out interviews to local settler and workers in search of information on the occurrence of the species and hunting practices. We interviewed 72 individuals throughout the Chaco. It was clear that there were three very distinct types of settlers. Inhabitants of small settlements and Amerindians in which the great majority rely on day-to-day-subsistent hunting for their source of protein. On the other hand, settlers from well-established medium to large cattle ranches in which hunting is more opportunistic or in most cases prohibited by the owners. Finally, fence and wood post workers, in areas in which new ranches are beginning to be established, relying exclusively on wildlife for their everyday meat source.





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Respondents were questioned in Spanish or Guaraní to prevent miss communication. The interviewed were asked to identify species through high-resolution color pictures and questioned according to their answers. If they identified the species correctly, we asked general questions about the species such as, if they considered the species to be common in the area, in what type of habitat and how long has it been since the last time they had seen or hunted one. We asked information about animal group size and if they considered the species to be more common now, or the same as in the past. In addition, we asked questions regarding what animals they hunt the most and how often they hunted.

Table 1. Detailed Chacoan peccary present locations collected during this work.

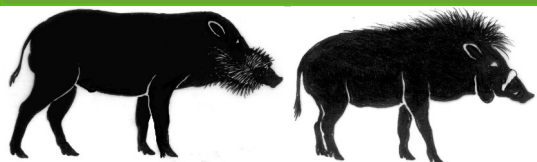
	Present locations.		Geographic locations		found
	Department	Location area or name	Latitude	Longitude	
1	Alto Paraguay	4 de Mayo area	19,97902	60,67605	Tracks
2	Alto Paraguay	Kuarahy reta area	19,98491	60,64295	Tracks
3	Alto Paraguay	Lagerenza area	19,79799	60,86158	Tracks
4	Alto Paraguay	Lagerenzai area	19,72468	60,85325	Tracks
5	Alto Paraguay	Lagerenzai area	19,80022	60,86179	Skull
6	Alto Paraguay	Los Laureles Ranch	19,67344	60,91458	Alive
7	Alto Paraguay	Madreñón a Línea 1	19,68451	60,99142	Tracks
8	Alto Paraguay	North of Línea 1	19,99134	60,93618	Tracks
9	Alto Paraguay	North of Línea 1	20,06050	60,03827	Tracks
10	Alto Paraguay	Route Línea 1	20,15291	60,96729	Tracks
11	Alto Paraguay	Route Línea 1	19,98327	60,41700	Tracks
12	Alto Paraguay	Route Línea 1	19,98356	60,23691	Tracks
13	Alto Paraguay	Route Línea 1	19,88908	60,14323	Tracks
14	Alto Paraguay	Route to Sierra León	19,98384	59,97506	Skull
15	Alto Paraguay	Route to Sierra León	19,82543	59,75862	Skull
16	Alto Paraguay	Route to Sierra León	20,12361	59,75866	Alive
17	Alto Paraguay	San Alfredo area	19,61329	59,38155	Tracks
18	Alto Paraguay	San Alfredo area	20,40450	60,47423	Tracks
19	Boquerón	4 de Mayo	20,20132	60,53254	Tracks
20	Boquerón	Don Gerardo area	20,37670	60,53285	Tracks
21	Boquerón	Estancia Gran Siete area	20,59469	60,53800	Tracks
22	Boquerón	Estancia Mariposa area	21,37319	60,55966	Tracks
23	Boquerón	Estancia Samuhu	21,41221	60,55980	Tracks
24	Boquerón	Estancia Samuhu	22,55066	60,63195	Tracks
25	Boquerón	Estancia Tagua area	22,65468	61,99213	Tracks
26	Boquerón	Estancia Tagua area	22,24492	60,41774	Tracks
27	Boquerón	Estancia Tagua area	21,63255	59,93435	Tracks
28	Boquerón	Faro Moro Ranch	21,27788	61,33019	Alive
29	Boquerón	Faro Moro Ranch	22,66316	61,19254	Tracks
30	Boquerón	Laguna Negra Indian reserve	22,45938	60,53161	Alive
31	Boquerón	Pozo Hondo area	22,63776	61,48587	Tracks
32	Boquerón	Route Línea 22 area Pozo Hondo	22,10820	62,19321	Tracks
33	Boquerón	Route Línea 6	21,34575	61,12839	Skull
34	Boquerón	Route Línea 6	21,28278	61,26268	Tracks
35	Boquerón	Route Línea 6	21,19153	61,60089	Tracks
36	Boquerón	Route Línea 6 Leitekue area	21,89525	60,58403	Skin
37	Boquerón	Route Línea 6 Ovelarkue area	21,72407	60,09923	Skull
38	Boquerón	Route Michel	21,74642	59,96393	Tracks
39	Boquerón	Route to Estancia Santa Tereza	21,68926	61,27982	Tracks
40	Boquerón	Teniente Enciso National Park	22,00968	60,70704	Tracks
41	Boquerón	Toledo area	22,02186	60,90850	Alive
42	Boquerón	West of Mariscal Estigarribia	22,34725	60,32753	Skin
43	Boquerón	West of Mariscal Estigarribia	21,42168	59,82782	Tracks
44	Boquerón	Campo Loa area	21,26581	59,59841	Tracks
45	Presidente Hayes	Campo María reserve	22,57316	65,34563	Tracks
46	Presidente Hayes	Estancia Itakabo area	22,51209	59,07519	Tracks
47	Presidente Hayes	Estancia Itakabo area	22,96605	60,40754	Tracks
48	Presidente Hayes	Estancia Tomboli area	23,29832	60,47652	Tracks
49	Boquerón	Picada 108	21,15633	60,80202	Skull and skin
50	Boquerón	Picada 108	21,28287	61,10626	Alive
51	Boquerón	Picada 108	21,05196	60,38397	Tracks

Ecological Niche Modeling and Environmental Layers

Ecological niche modeling (Busby 1991; Stockwell and Peters 1999) uses the fundamental niche of a species (Hutchinson 1957) to determine suitable habitat and distribution of species by correlating occupancy and environmental data to predict the distribution of a species (Franklin 1995; Hirzel et al. 2002). Ecological niche modeling has been successfully used to predict the distributions of vectors, threatened plants and animals, as well as invasive species (Peterson 2001; Peterson and Vieglais 2001; Soberon & Peterson 2005; Graham et al. 2006; Monteiro de Barros et al. 2007; Costa et al. 2008, Ferraz et al 2016).

Predictive modeling of species distributions represents an important tool in biogeography, evolution and conservation (Peterson & Vieglais 2001). We used a maximum entropy algorithm implemented in the software Maxent 3.4.0. (Phillips et al. 2006). This program uses species presence records in combination with the distribution of environmental variables over the study area to estimate a probability distribution for species. The extent of occurrence for the species within the Chaco





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Table 1 continued

51	Boquerón	Picada 108	21,40230	61,12360	Skin
52	Boquerón	Picada 108	21,19471	61,60688	Tracks
53	Boquerón	P. Smith data.	21,46546	60,55538	Alive
54	Boquerón	P. Smith data.	21,58082	85,40721	Alive
55	Boquerón	P. Smith data.	20,41684	59,53169	Alive
56	Boquerón	P. Smith data.	20,46535	59,53286	Alive

region of Paraguay was determined using newly recorded occurrence location points. Within the distribution limits of the study area, we used six environmental

datasets. All environmental layers were resolved to a 1 km pixel resolution by using ArcGIS version 10.0. Datasets included vegetative land cover from historical images from 2010 (Land sat), soil type (FAO. UNESCO 1971), average annual precipitation (Gorham 1971), average annual temperature (The Food and Agriculture Organization of the United Nations 1964; Holdridge 1969) and altitude (D. S.G.M. 1998). To estimate our species distribution we considered that soil, altitude, rainfall and

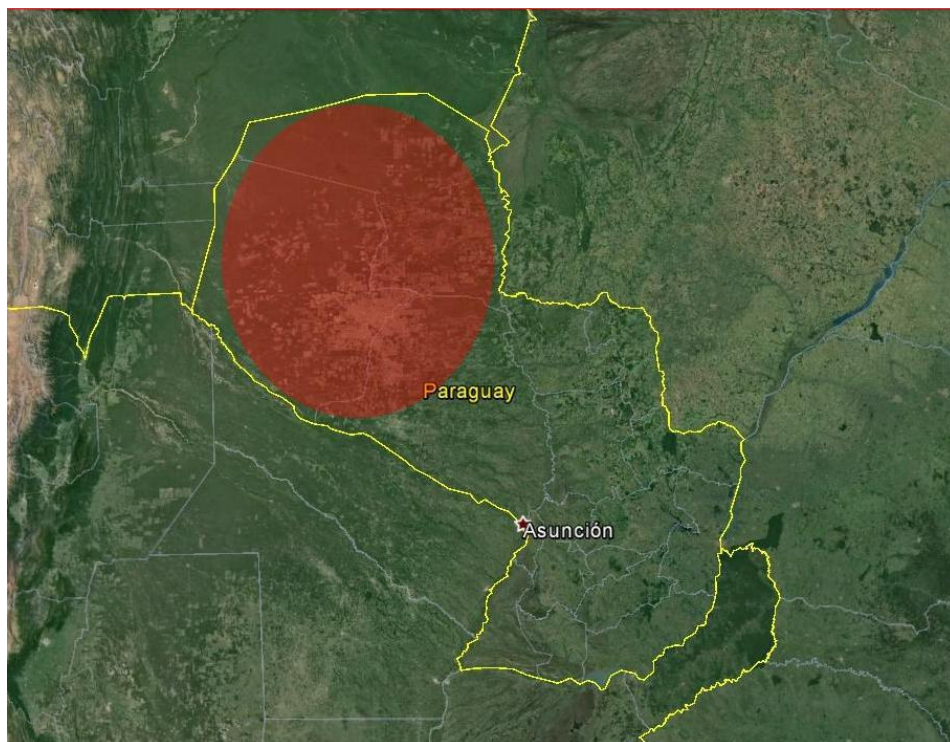


Fig. 3: Country of Paraguay. Red area shows survey area. In red circle darker green represents forest, light green represents cleared forest converted to grassland.

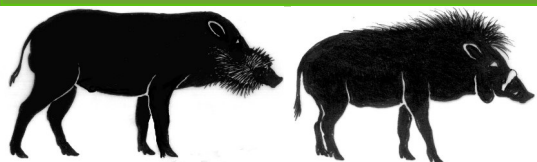
temperature are not likely to significantly change in short periods. For each model run, 25% of the occurrence records were set aside for external validation, and the maximum number of background points was set at 10.000. The occurrence records that were set aside for validation were chosen at random by Maxent. The remaining 75% of the records were used in the construction of the Maxent niche models. The area under the curve (AUC) of the receiver operating characteristic plot was used as a measure of model performance, and the outputs were projected onto a digital map, exported as an ASCII raster grid, and imported into ArcView 10.0 using the Spatial Analysis Extension for visualization and interpretation.

Results

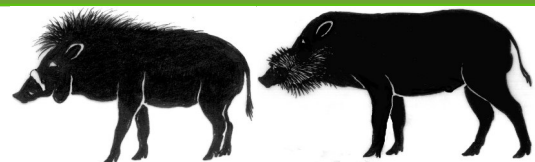
Interviews Results

In total, we interviewed 72 individuals throughout the survey area. Though it may seem a low number, the area we surveyed is very sparsely populated. Interviewees were asked their origins, (44 %, n = 72) answered of being from the Chaco, and (56 %, n = 72) were not originally from the Chaco region. All interviewees were asked to identify species of peccaries from pictures and among them the Chacoan peccary, (30 %, n = 72) knew the species well and was able to identify it without doubt. At that time, all interviewees were asked several questions about hunting and their knowledge of Chaco wildlife. We asked those that identified the Chacoan peccary correctly,





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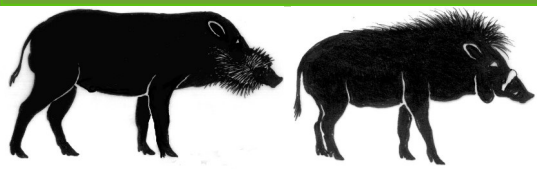
if they see more Chacoan peccary now than years before, (89 %, n = 28) answered less now. Interviewees were asked where have they seen Chacoan peccaries, (57 %, n = 28) answered on roads, (25 %, n = 28) on forest edges, (11 %, n = 28) in the forest and (7 %, n = 28) on pastureland. Similarly, all interviewees were asked if they knew or heard that the Chacoan peccary is a protected species and that it is threatened of extinction, (53 %, n = 72) did not know that the species is threaten. We continued asking questions related to wildlife, such as if they actively hunt, (64 %, n = 72) answered yes. Asked how often do you hunt (56 %, n = 46) answered when the opportunity presents (28 %, n = 46) once a week and, (15 %, n = 46) answered every day. Asked what animal do you hunt the most, (52 %, n = 46) answered Deer (*Mazama gouazoubira*), (35 %, n = 46) peccarys (*Catagonus wagneri*), (*Tayassu pecari*) and (*Pecari tajacu*). (13 %, n = 46) birds like the Chaco Chachalaca (*Ortalis canicollis*), picazuro pigeon (*Patagioenas picazuro*) and small game like three-banded armadillos (*Tolypeutes matacus*), Chacoan mara (*Dolichotis salinicola*) and Tegu (*Tupinambis rufescens*).

Distribution Maps

Our ecological niche model created an updated distribution map based on new present Chacoan peccary locations (Figure 4). Of our six environmental layers used to model its distribution, soil type, average annual rainfall, and altitude were significant, single variable predictors. However, the best fitting models were obtained using all environmental layers. For our distribution map, the model predicted the presence of Chacoan peccary in an area of over 130.000 km² corresponding strongly to its previously estimated former distribution in Paraguay (Taber et al 1991) and by our recently published Gran Chaco distribution maps (Altrichter et al 2016; Ferraz et al 2016). However, our map is restricted to Paraguay, highlighting areas with high probabilities of occurrence in the northern Chaco. Which is not unexpected, considering that the northern Chaco region has yet seen little deforestation, it is still sparsely populated and holds the largest Chaco National Parks (Defensores del Chaco with 720.000 ha and Timane-Cabrea with 125.823 ha). In addition, it still holds large tracts of undeveloped privately owned native forest. On the other hand, the northwest of the Chaco is rated with low values in terms of probability of occurrence. This could be a result of the different habitat type in the area, characterized by very sandy soil and dunes with a much more open savanna type vegetation. However, it is important to mention that the Medanos National Park has 514.233 hectares located in that area, has very few roads covering the area. Consequently, our survey was restricted to those roads and due to the inaccessibility and the sandy soil; it was extremely difficult to find signs of the species. Because of this, we recommend that in the future more extensive studies should be conducted to better elucidate Chacoan peccary presence and population density in the area.

On the other hand, most of the central west Chaco that in the past was the region with the highest populations of Chacoan peccaries, currently has lower probabilities of occurrence, visibly associated with high habitat modification and fragmentation, accentuated by the fast development in the region. The map as well, identifies small pockets with high probabilities of occurrence distributed along the central and northwest of its range, probably as a direct effect of habitat fragmentation with consequently negative effects for the Chacoan peccary populations in those areas. As expected, the southern Chaco and areas near the Paraguay river predict very low occurrence probabilities. However, we did find animals that were outliers much further south than expected.





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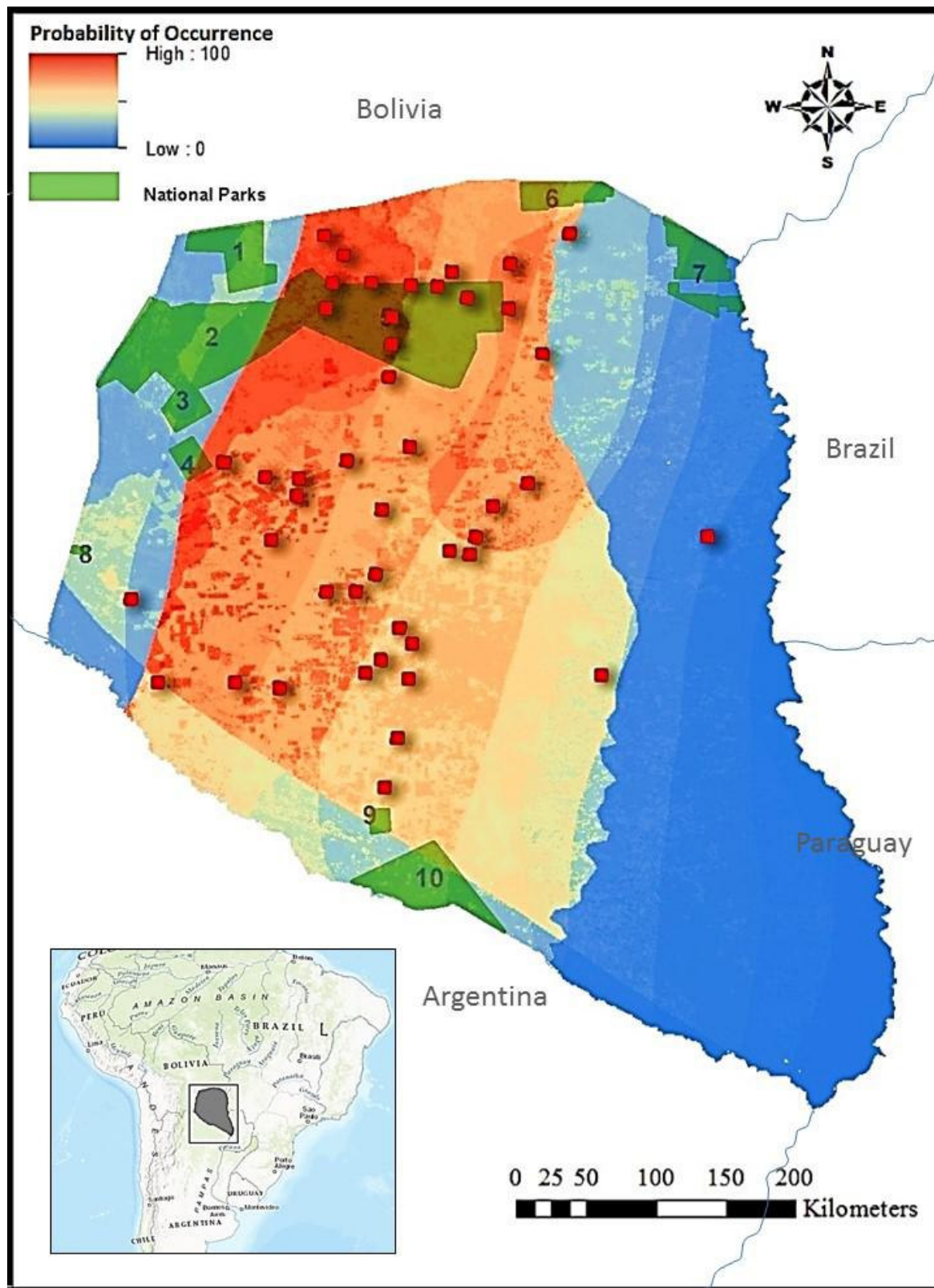
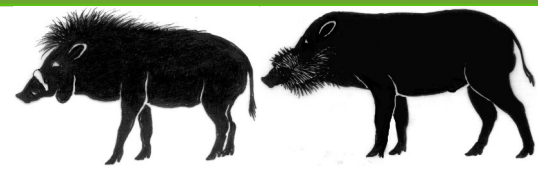
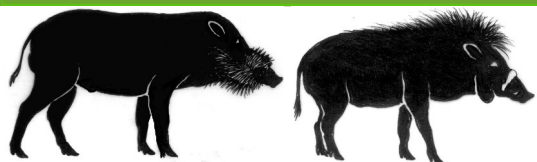
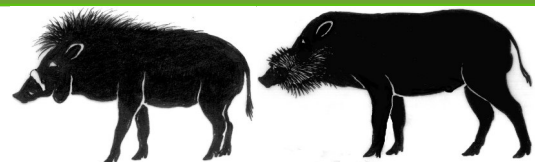


Fig. 4: Chacoan peccary distribution according to our Niche model results. Squares represent location points.





Ecology and Conservation



Discussion

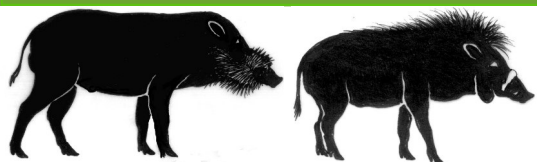
Population Status

Throughout our survey, we sighted Chacoan peccary in five occasions, found six skulls, four skins, and registered 38 sites with clear tracks. Because of the size of its distribution range, the low detectability and the scarcity of the species, it is extremely difficult to acquire sufficient data to accurately estimate population numbers in the wild. However, based on estimate made by Taber (1991) and Handen (1994), the total population of Chacoan peccary was estimated to be in the order of 5000 individuals. Taking in consideration that more than twenty years has passed since those estimates and that the Chaco development has not stopped and furthermore, it has increased drastically in recent years. In one decade 3.5 Million hectares of Chaco forest have been cleared (Huang 2009, Caldas 2013), in its great majority ideal Chacoan peccary habitat. Considering the enormous habitat loose, hunting pressure, fragmentation and possible disease outbreaks, we can anticipate that the Chacoan peccary population in the Paraguayan Chaco consequently has had to be reduced to at least half of previous estimates. According to our maps, survey and interview results, it is a fact that surviving populations in the central and southwest Chaco are in clear decline, and most likely persist as small isolated and fragmented populations under heavy hunting pressure. On the other hand, our results strongly suggest that the northern Chaco, at present remains relatively isolated and so far holds the highest and healthiest population densities of Chacoan peccaries

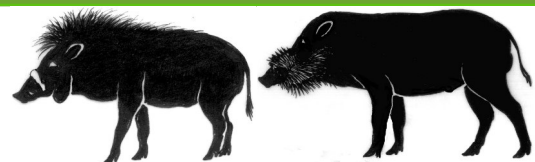
Previous reports of herd sizes in the Paraguayan Chaco vary between one and nine (Mayer et al 1982; Sowls 1985), with an average of 4.5 according to Taber (1990, 1993, 1994). Our recent survey results based on direct observation, tracks and interviews suggest that heard size are much smaller now, with pairs and solitary animals being most common. Herds of more than five are at present very infrequent. Similarly, throughout the Chaco, populations appear to be fragmented and in a constant decline as a direct consequence of rapid and large-scale habitat loss.

Nearly all hunting in the Chaco occurs on roads due to the thickness of the Chaco forest, making it virtually impossible to move through it in search for prey. In recent years, Paraguay has started assembling Chinese motorcycles, making them available at very low cost. This has significantly increased the mobility of local settlers and greatly increased their hunting possibilities, by giving them fast and cheap transportation. In the recent past hunters moved mostly by walking, horseback or bicycles. At present, it is common to find hunters on motorcycles as far as 100 kilometers from their settlement. Likewise, old habits of leaving the fur and skull of hunted animal are disappearing, making it harder to find remains of hunted animals on the roads. It is evident that hunting pressure in areas surrounding human settlements, ranches and throughout most of the Chaco has increased. In addition, accompanying the expansion of cattle ranching and agriculture in the region are the opening of new roads and the improvement of old. Remote areas that had month traffic of a handful of truck now have several hundred. The majority of these trucks carry guns that are ready in case an unaware prey is spotted. Most common preys are mazama deer (*Mazama guazubira*), collar peccaries (*Pecari tayacu*), white-lipped peccaries (*Tayassu pecari*), tapirs (*Tapirus terrestris*) and the Chacoan peccary. Among all, the Chacoan peccary is probably one of the easiest preys, because of its careless and curious behavior (Altrichter and Boaglio 2004; Bellassai 2014). It is common for hunters to kill more than one





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Chacoan peccary if the opportunity presents, taking advantage of the protective behavior the animal has toward fallen members of its family group (Sowls 1984).

If land conversion rates continue as in present, we expected that in the short future only protected National Parks, private reserves and legally conflicted lands would probably remain untouched. Also, it is likely that the entire region will resemble the Central Chaco, in which small islands of heavily exploited and degraded Chaco forest remain, surrounded by large grassland, agriculture fields and roads, harboring only a minimum percentages of the great diversity it once had (Areskoug 2001). Furthermore, if conservation programs and species management plans are not effectively implemented it is very likely that most medium and big mammals will be greatly diminished or locally extirpated and among them the Chacoan peccary (Decarre 2015).

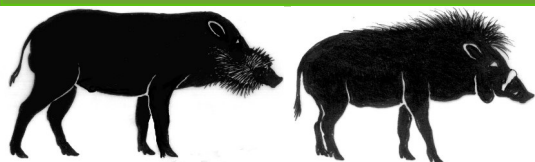
It is also a fact that many species can take advantage of anthropogenic habitat transformation (Campos et al 2011). However, a greater number of forest specialized native species such as the Chacoan peccary are very sensitive to habitat damage. Yet, it is not impossible to carry out a rational and harmonic development taking in consideration not just profit but as well, the ecology balance preserving the habitat and its wildlife. It is important to promote cattle and agriculture practices that take in consideration and implement conservation measurements to reduce negative impacts toward wildlife. As many Chaco cattle ranchers have already and are strong advocates of wildlife in their land. Similarly, at present the Paraguayan government through, the Ministry of Environment (SEAM) is starting to implement the newly regulated Law for environmental services Law 3001/06 (SEAM), which requires landowners that have cleared more than what is legally allowed on Paraguay (75 percent) of their land to acquire certified forest stocks or to reforest. If this new law is correctly implemented it can give a significant monetary value to the Chaco forest, which in turn will reduce deforestation and promote long-term forest and wildlife conservation.

Conclusion

This project provides additional data to better understand the current distribution of the Chacoan peccary in the Chaco region of Paraguay, providing essential information that will help implement effective conservation and management strategies. As the recently updated and published Chacoan peccary action plan after the successful *Catagonus wagneri* conservation-planning workshop carried out on Feb 29th to March 3rd, in Asunción, Paraguay. (Altrichter et al 2016). Similarly, during the workshop a vortex population viability analysis model for the Chacoan peccary was created showing how critical the situation of the species in the Gran Chaco region (Leus et al 2016).

Estimating a species, distribution not only gives information on their occurrence but can identify habitat limits, boundaries and barriers as well as areas that hold populations that are vital for the survival of the species. Likewise, we have identified weakness in public communication concerning awareness about the Chacoan peccary critical conservation status and the importance of instructing the general public to identify the species throughout the Chaco region. In that regard we were aware that identification of the species is always confusing for the general public, in particular for the non-locals and non-hunters. To improve its identification and conservation posters were placed thorough our trips in local schools, military, police posts and local stores and in national parks (Figure 5).





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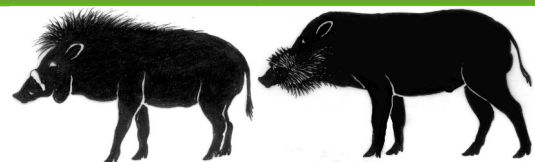


Fig. 5: Poster created by the CCCI with support of the Rufford Foundation distributed throughout the survey area, to promote awareness of the critical conservation status of the Chacoan peccary.

With respect to efforts toward the conservation of the Chacoan peccary there is only one conservation project that is fully dedicated to the conservation of the species. Proyecto Taguá founded at the Chaco region of Paraguay in 1985 by the Zoological Society of San Diego, San Diego, California, USA. (Byrd et al 1988, Benirschke et al 1993). At present, the project has grown to become a non-for profit organization, named Centro Chaqueño para la Conservación e Investigación - Proyecto Taguá (CCCI). The CCCI is the only in-situ conservation and captive breeding effort for the Chacoan peccary in Paraguay. However, this effort is not sufficient to save the species. Currently wild populations of Chacoan peccaries are facing the fastest and most intense habitat loss in recent history. The fact is that development of the Chaco is unstoppable, strongly stimulated by high meat prices in the international market and the trend is that cattle ranching and production will keep increasing. If we do not take conservation steps to address this wave of progress with well-established development criteria and actions, we expose ourselves to an irreversible ecological damage as well as the high possibility of losing species like the Chacoan peccary. In fact, the measures and action plans to prevent the extinction of the Taguá and many other Chaco species have been already written many times. However, now is the time to take action, if we do not take the necessary steps the Chacoan peccary, symbol of the Gran Chacá will be ever closer to extinction.

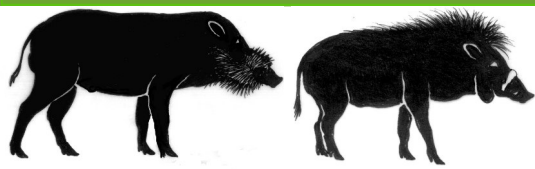
Acknowledgments

We would like to thank settlers, local communities and military personal for their hospitality, motivation, interest and shared time answering our questions. We thank Eli Leon and Rene Perez for their help and time spent in preparing for the logistics of many trips. Our special thanks to the Rufford Small Grant Foundation that made this work possible and the Centro Chaqueño para la Conservación e Investigación – Proyecto Taguá for providing all the local support and equipment.

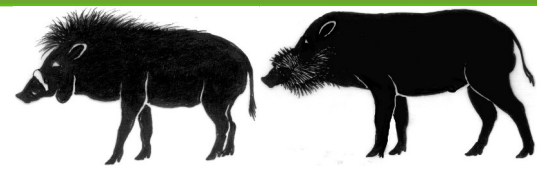
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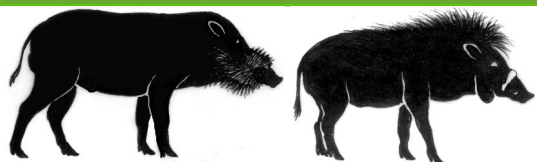


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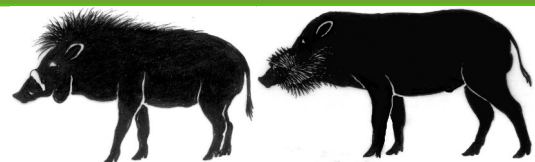


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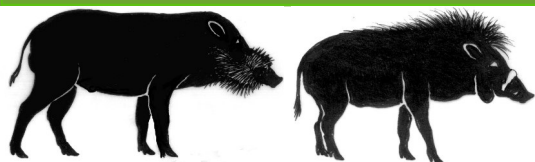


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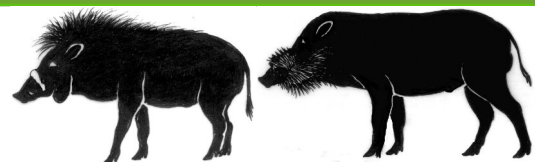


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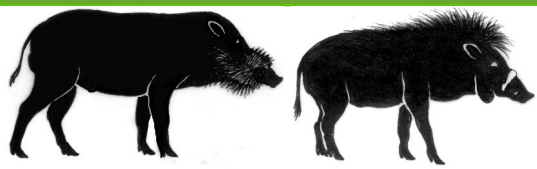


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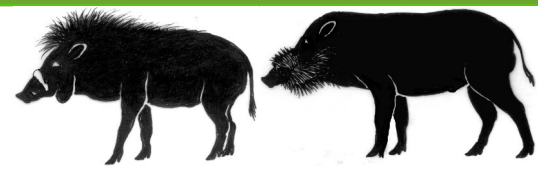


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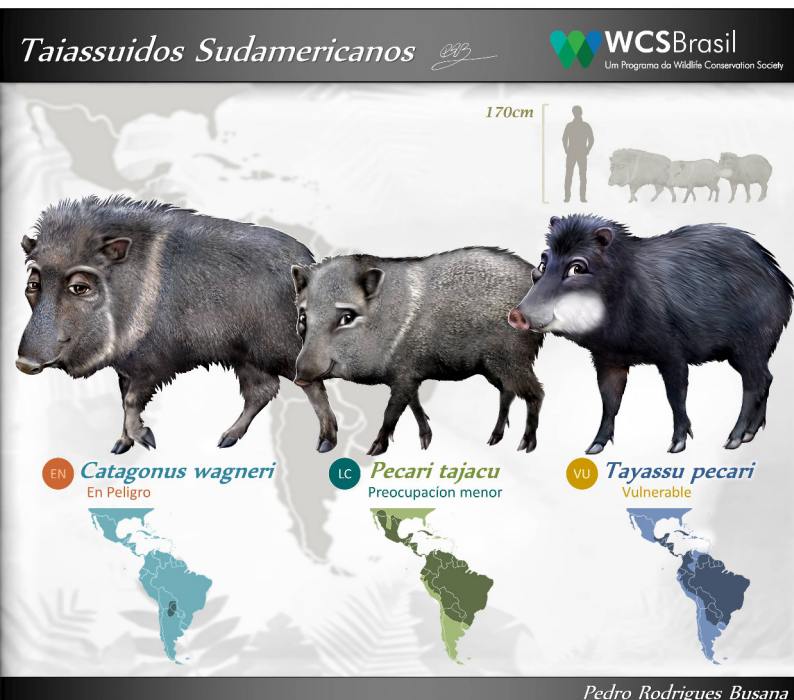
Peccary Art

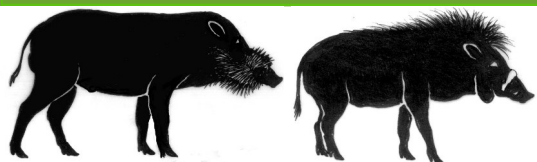
Alexine Keuroghlian

Thanks to a partnership of the IUCN/SSC Peccary Specialist Group with WCS Brasil and our artist Pedro Bossano we were able to produce these posters for environmental education initiatives working with any of the Tayassuidae species.

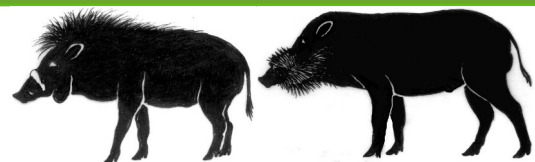
THE ARTWORK IS NOW AVAILABLE FOR EVERYONE in four different languages:

LINK <https://brazil.wcs.org/Initiatives/Peccaries-Illustrations.aspx>





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Conference on Antelope, Giraffe, Hippo in the 21st Century: The first meeting of the IUCN/SSC Hippo Specialist Group



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⁴Derbianus Conservation, Prague, Czechia

From 19th to 25th February 2017 the Czech University of Life Sciences (CULS) in Prague hosted the extraordinary conference Antelope, Giraffe, Hippo in the 21st Century: Conservation Action in Africa. The conference was organised by the NGO Derbianus Conservation in the cooperation with Species Survival Commission of the International Union for Conservation of Nature (IUCN/SSC) Antelope Specialist Group (SG), Giraffe and Okapi SG, and Hippo SG. As the title indicates the conference was focused on the conservation and research of three groups of mostly African ungulates: antelopes, giraffes, and hippos. In total, 121 participants from 23 various countries from Africa, Europe, Asia and North America came to attend the conference and presented 32 various contributions. The pre and post conference tours included trips to Dvůr Králové zoo and Ostrava zoo and also to the farm for breeding common elands in Lány. So why did this group of conservationists decide to join together in one meeting to discuss issues surrounding these three different groups of mammals?

Elegant, tall and chubby

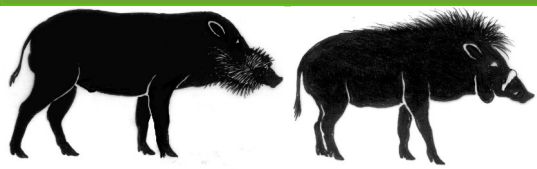
Within the IUCN/SSC antelope, giraffes and hippos are managed by three respective SGs. Each specialist group faces various issues. The Hippo SG has been traditionally joined with the Wild Pig SG and Peccary SG as the hippos have been considered to be the sister group of pigs and peccaries from an evolutionary perspective. This close relationship is still demonstrated in various ways, e.g. by sharing the newsletter *Suiform Soundings*.

On the other hand, antelope, giraffe, and hippo conservation shares a lot of similarities. These animals have highly overlapping distributions (they are confined to Africa except several antelope species). Most of their conservation issues - habitat loss, poaching, and political instability in their range countries are commonly shared. In addition, in many native countries only a few people are involved in checking their status and reporting population trends. Last but not least, these animals represent all recent African terrestrial Cetartiodactyla except suids. Therefore, it would be valuable to share information, the experiences as well as the active people in native countries of these mammals amongst all these three respective SGs. All these reasons gave rise to the idea of a combined meeting of all three specialist groups.

Attractive animals deserve attractive speakers

Large African ungulates attract attention of many various researchers including conservationists, ecologists, behavioural ecologists, molecular biologists as well as ex-situ breeding specialists. Since we tried to involve all of these disciplines in the conference we invited 10 plenary speakers. The first plenary speaker David Mallon, co-chair of the Antelope SG opened the antelope section emphasizing the phenomenal species diversity (at least 77 species and up to 144 taxa) of this





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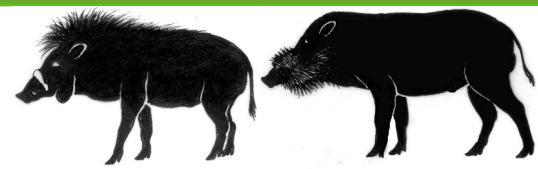
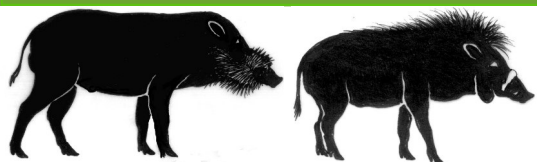


Fig. 1: Attendants of the conference Antelope, Giraffe, Hippo in the 21st Century in Prague, February 2017.

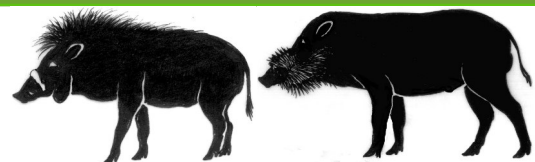
group. Further, Pedro Vaz Pinto from the University of Porto in Portugal demonstrated a very nice example of subspecies conservation showing a case study on the rescue of the Critically Endangered giant sable antelope (*Hippotragus niger variani*). Karolína Brandlová, chair of Derbrianus Conservation, referred to the history and future challenges in conservation breeding of Western Derby eland (*Tragelaphus derbrianus derbrianus*). Problems in conservation of very unique species from Africa horn hirola (*Beatragus hunteri*) were summarised by Abdullahi Ali, from the Hirola Conservation Programme. Predictions and innovations for antelope conservation in Africa were introduced by Mark Stanley-Price from the University of Oxford. Jakob Bro-Jørgensen from the University of Liverpool illustrated the impact of climate change on African antelopes. Julian Fennessy, representative of Giraffe Conservation Foundation and co-chair of the Giraffe and Okapi SG, emphasized the current issues in giraffe conservation. The hippo section was opened by a talk of the co-chair of the Hippo SG, Rebecca Lewison from San Diego State University, who summarised the situation in conservation of both hippo species including some research topics. A success story from Zakouma National Park in Chad was presented by Markéta Antonínová from African Parks. Rob Ogden, programme director at TRACE Wildlife Forensics Network and a member of the IUCN Conservation Genetics SG, talked about conservation genetic management of wildlife.

Another very interesting speaker of the conference was Jonathan Kingdon, a zoologist, artist, scientist at Oxford University, and author of the six-part monumental work Mammals of Africa,





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who talked about the evolution of ungulates in Africa with an insight into the evolution of ecosystems in a wider context and raised the importance of preserving biodiversity.

The hippo section itself was introduced by a talk of Rebecca Lewison, followed by that on pygmy hippo (*Choeropsis liberiensis*) ex-situ population development by International studbook keeper and coordinator of European endangered species programme for this species, Beatrice Steck. Ollo Théophile Dibloni highlighted the conservation issues of common hippo (*Hippopotamus amphibius*) populations in Burkina Faso. This was followed by Jan Pluháček who discussed research results on the secondary sex ratio in both species in captivity. The last presentation in this section came from Deo Kujirakwinja via skype from the Democratic Republic of Congo who could not come due to bureaucratic issues, unfortunately. He compared various methods to count common hippos in his country.

In addition to the presentations, the open and closed meetings of all the three SGs took place. During the last day of the conference, an open workshop for all of the participants was arranged. After many discussions and presentations the experts could share their newly acquired information and plans to move forward in the conservation of antelopes, giraffes and hippos. Since the conference was attended by many people from European zoological institutions, it provided very good opportunity for exchanging experiences and improving cooperation among in-situ and ex-situ working conservationists.

The first meeting of the IUCN/SSC Hippo SG

Whereas the Antelope SG and Giraffe and Okapi SG have met several times in the past together, the Hippo SG has had no meeting before. Therefore, one of the important aims of this conference was the first closed meeting of the Hippo SG. Besides six members of the Hippo SG (Rebecca Lewison, Jan Pluháček, Chris Ransom, Beatrice Steck, Ollo Dibloni, and Annika Hillers), there were two representatives from IUCN Rachel Hoffmann and Mike Hoffmann have been invited for the meeting. The most important topics for discussion involved membership, communication including web pages, Red List assessment including taxonomic issue in case of common hippos, funding possibilities and management, and the strategy for future.

We decided to cancel the division of the SG into two subgroups according to the species and instead work together for both species. One of the major issues that the Hippo SG faces is a lack of data about species population sizes and trends, threats, and conservation actions. Since both species inhabit a total of 39 countries in Sub-Saharan Africa, it remains impossible to have representative in each country. Therefore, we prefer to establish regional action plans with representatives who would gather information and coordinate actions over several neighbouring countries.

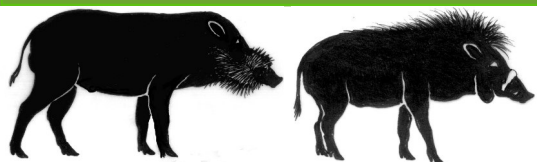
For web pages and funding management we look for partnership with any relevant institution. Such an institution might be a zoological garden which could provide this service in exchange for receiving some exclusive info from SG.

The closed meeting of the Hippo SG was followed by an open meeting. The main topic of this meeting was research, especially molecular biology tools which could be helpful for better population estimates.

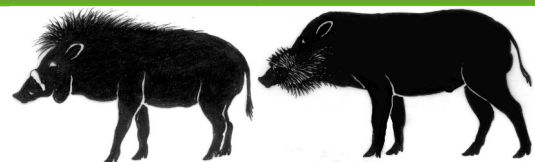
Future directions

The conference is over, however we hope that the effect of this meeting will appear in the future in directing conservation actions for African ungulates. We believe that the meeting will also result





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in better cooperation within as well as among these three SGs.

Abstracts of all talks from the conference could be found at:

[http://derbianus.cz/content/uploads/2017/02/Book_of_Abstacts-](http://derbianus.cz/content/uploads/2017/02/Book_of_Abstacts-AnGiHip_final_web.pdf)

[AnGiHip_final_web.pdf](#)

The programme with the presentations can be downloaded at:

<http://www.anghip2017.com/preliminary-schedule/>

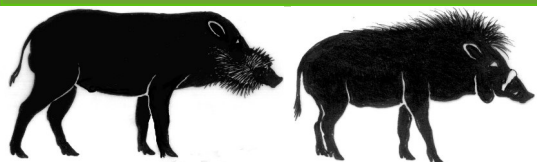
Acknowledgements

Our thanks are due to our friends and colleagues for organizing the conference, namely Karolína Brandlová, David Mallon, Tamara Fedorová, Pavla Hejcmánová, Magdalena Miřejovská (Žáčková), Anna Kubátová, and Pavla Jůnková Vymyslická. We are very grateful to all conference volunteers for their help. The conference would not have been possible without financial support from several institutions: Al Bustan Zoological Centre, Association Beauval Nature, Breeding Centre for Endangered Arabian Wildlife - Sharjah, Dvůr Králové Zoo, Knowsley Safari Park, Liberec Zoo, Marwell Wildlife, Ostrava Zoo, Plzeň Zoo, Prague Zoo, Dietex International Limited (Mazuri Zoo Foods), Jacobs Douwe Egberts cz, Vectronic Aerospace, and VVS Verměřovice. Last but not least we would like to thank all of the participants who came, talked and discussed how to help and improve the conservation of antelopes, giraffes and hippos.

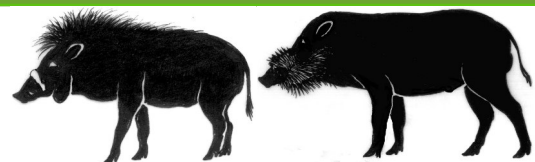


Fig. 2: The members of Hippo SG in the conference at Prague. From left to right: Annika Hillers, Jan Pluháček, Ollo Théophile Dibloni, Rebeca Lewison, and Beatrice Steck.





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Hominin and Suid Environments During the Plio-Pleistocene: A Look at Suidae Mandibular Ecomorphology

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Editor's note

The following article is the abstract of a dissertation, that was published by the author at the Department of Biological / Physical Anthropology of the State University of New York in Buffalo in 2008

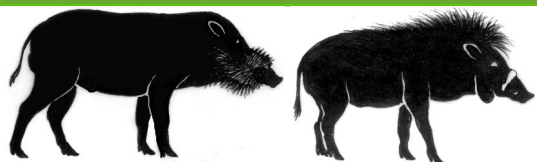
Abstract

At East African fossil bearing localities, pigs (suids) are abundant, ubiquitous, and are frequently associated with fossil hominins. Suid paleoecology has proven particularly useful for understanding hominin paleoecology. With this framework in mind, this dissertation investigated the mandibular and dental dietary adaptations in East African pigs during the late Miocene through early Pleistocene. The first part of this study identifies morphologic characters correlated with both diet and habitat preference(s) in three extant African suid genera (*Phacochoerus*, *Hylochoerus*, and *Potamochoerus*). The second part of this study investigates such relationships in extinct suid genera (*Nyanzachoerus*, *Notochoerus*, *Kolpochoerus*, and *Metridiochoerus*) from the Kanapoi, Koobi Fora, Nachukui, and Nawata Formations.

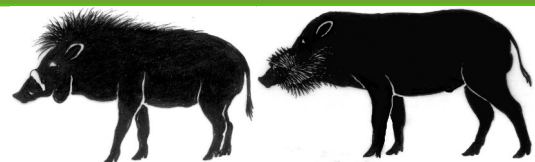
This research aims to: (1) identify the morphologic features of the suid mandible and dentition that reflect dietary and habitat preferences; (2) use fossil suid mandibular ecomorphology as a proxy to reconstruct paleoenvironments; and (3) identify habitats and food resources potentially available to hominins. Because of the common association of pigs (suids) and people (hominids) in the fossil record, this research contributes to a broader understanding of the paleoecology of both families, Suidae and Hominidae.

The paleoecological context for hominin evolution in East Africa is a central theme in human paleontology. Important events in human evolution such as the origin of bipedalism (Dart, 1925), emergence of hominin genera, such as *Paranthropus* and *Homo* (Bobe and Behrensmeyer, 2004), development of stone tools and hominin carnivory (Isaac, 1997; Blumenshine and Pobiner, 2007) and hominin dietary adaptations (Teaford et al., 2002; Ungar and Teaford, 2002; Ungar, 2007 and authors therein) are often investigated within an environmental and ecological framework. Numerous volumes (e.g., eds. Coppens et al., 1976; Behrensmeyer and Hill, 1980; Vrba et al., 1995; Bromage and Schrenk, 1999; Bobe et al., 2007) have addressed these topics, and more, to elucidate hominin origins, their behavior, and paleoecology. Detailed reconstructions of paleoenvironments are critical for understanding hominin evolutionary history, habitat and dietary adaptations (Reed, 1997, 1998; DeGusta and Vrba, 2003). Early hypotheses of key events in our history, such as the divergence of hominids from apes and the origin of bipedalism (Dart, 1925; Jolly, 1970) were interpreted as adaptations to an open grassland environment. Current paleoecological, faunal, and anatomical evidence indicates that hominid divergence and the origins of bipedalism occurred in a more closed or wooded environment (Kingston et al., 1994; Spencer, 1997; Bobe et al., 2002; deMenocal, 2004).





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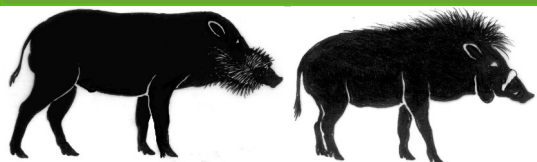
Insights into paleoclimate and the ecological structure of paleoenvironments are gained through studies of fossil fauna associated with hominins (e.g., see Howell, 1999). Hill (2007) argues that for us to fully to understand the environmental context of our origins, we need to continue to study the taxonomy, adaptations, and environments of paleofauna. Because hominin fossils are exceedingly rare and inadequately distributed though space and time (White, 1995), taxa commonly and consistently found at fossil hominin bearing sites are often used as a proxy for hominin paleoecology (Bishop, 1994), and human evolution (White, 1995). Fossil pigs (Artiodactyla, Suidae) are recognized as an important component in reconstructions of hominin paleoenvironments (White and Suwa, 2004) and dating of hominin bearing sites (Cooke, 1976; White and Harris, 1977). At East African late Miocene through early Pleistocene sites, members of the family Suidae (Mammalia, Artiodactyla) are an abundant and ubiquitous group frequently associated with fossil hominins (Cooke, 1978a; Harris and White, 1979; Walker et al., 1986; Harris et al., 1988; White, 1995; Harris et al., 2003); White (1995) recognizes “the zoological families of pigs and people, Suidae and Hominidae, have been inextricably linked in human evolutionary studies” (368). African suids (pigs) and hominins also share similar evolutionary histories, large body size and an omnivorous diet (Bishop, 1999).

Because both families are often found together in fossil assemblages, suid ecology and evolutionary history has therefore been recognized as a valuable way to investigate hominin paleoenvironments (Bishop, 1994; Bishop et al., 1999). With this framework in mind, this dissertation investigates the mandibular and dental dietary adaptations in East African pigs during the late Miocene through early Pleistocene. The first part of this study identifies morphologic characters correlated with both diet and habitat preference(s) in three extant African suid genera (*Phacochoerus*, *Hylochoerus*, and *Potamochoerus*). The second part of this study investigates such relationships in extinct suid genera (*Nyanzachoerus*, *Notochoerus*, *Kolpochoerus*, and *Metridiochoerus*) from the Kanapoi, Koobi Fora, Nachukui, and Nawata Formations.

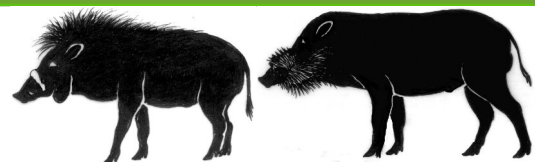
This type of investigation examines the relationship between ecology (habitat and diet preference) and morphology, which is often referred to as ecomorphology (Karr and James, 1975; Leisler and Winkler, 1985; Bishop, 1994; Bock, 1994) or functional morphology [as advocated by DeGusta and Vrba (2003)]. A mandibular ecomorphic analysis of suids, both modern and extinct, has not been done- and data from this study may offer additional insights into suid paleoecology and their dietary behaviors at hominin bearing sites. Therefore, the goals of this dissertation are:

1. To identify the mandibular and dental morphologic features of extant suids that reflect their dietary and habitat preferences, and predict such preferences in East African fossil suids. The theoretical basis for using an organism’s morphology to infer dietary and habitat preference(s) is based on the premise that “there are predictable relationships between morphology and ecology” (Karr and James, 1975: 260); or, in other words, an organism’s anatomy reflects adaptations to both environment (DeGusta and Vrba, 2003) and diet (Mendoza et al., 2002).
2. To use fossil suid mandibular/dental ecomorphology as a proxy to infer paleoenvironments and identify food resources and habitats potentially available to hominins. DeGusta and Vrba (2003), for example, point out once habitat preference has been inferred from a fossil’s functional morphology, the morphology can then be used to reconstruct aspects of the paleoenvironment.
3. To assess changes in functional anatomy against documented changes in both paleoclimate and paleoenvironment across space and through time. Wood (1995) suggested the relationship between masticatory (chewing) morphology and paleoenvironment can be used to “explore the





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impact of external influences, such as climate, on evolutionary history as expressed in morphological changes to the masticatory system” (438). The question of mosaic evolution can also be addressed, as well as how both suids and hominins were adapting to changing environments.

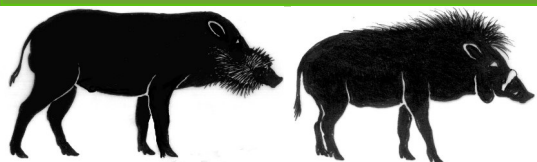
4. To evaluate the results of this study with the findings of previous studies on suid paleoecology. The results of this analysis are compared with other suid based paleoecological indicators, such as habitat and dietary preferences inferred from postcranial limb morphology (Bishop, 1994), dental morphology (Kullmer, 1999), and dental enamel isotopes (Harris and Cerling, 2002).

As previously mentioned, an aim of this dissertation is to identify the morphologic features of the suid mandible that correlate with diet and environment; it is therefore important to distinguish between an ecomorphological investigation and other methods used to study morphology. For example, Bock (1994) identifies the following four approaches or methods, which are not necessarily mutually exclusive, used to investigate morphology within a research framework: (1) descriptive, (2) functional, (3) evolutionary, and (4) ecological morphology. First, descriptive morphology, as the term implies, primarily involves describing an organism’s morphological form, which is therefore necessary for interpreting the functional properties of morphologic features. Second, functional morphology entails both describing an organism’s morphological form and identifying the “correlation between properties of form and function of features” (407). As Bock points out, it is essential to identify form and function correlations in modern species to understand both the functional and adaptational properties of features in fossil fauna. The third area of morphologic research is evolutionary morphology, which includes investigating topics related to systematics, adaptation, homology, evolutionary history and evolutionary change; early workers in this area were primarily interested in either evolutionary or ecological questions (Bock, 1994). The fourth morphological research area is ecological morphology. Bock notes this area was developed by ecologists who were initially interested in ecological topics such as the concept of niche and community structure. Subsequently, the term “ecomorphology” was coined by Karr and James (1975) in a paper that investigated the relationship between morphological features and ecology (as cited by Bock, 1994).

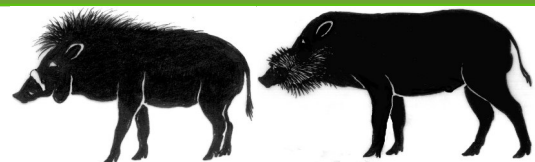
Ecomorphology, as offered by Bock (1994), may be defined as the study “primarily concerned with analyses of the adaptiveness of morphological features and all dependent correlated topics such as the comparisons of adaptations in different organisms, modifications of adaptive features due to competition and other causes, structure of ecological communities, diversity within taxa, etc.” (407). Within an ecomorphological framework, questions and answers are derived primarily from two different methodologies. The first approach was developed from traditional morphological investigations which sought to determine “the adaptiveness of complex morphological features and systems in individual species, followed by comparative analyses of these adaptations in different organisms, be they closely related or not” (Bock, 1994: 409). The second approach explores the patterns of adaptive features in taxa, which as Bock (1994) suggests, “is best done in a group of closely related species such as members of a genus or a homogeneous family” and “deals with the covariation of morphology and ecology” (409). This approach consists of, at least in part, obtaining linear measurements of bony structures, such as length and width.

The research design used to determine how morphology and ecology may covary, as suggested by Bock (1994), following Winkler (1988), includes the following steps: (1) formulating hypotheses





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that predict the correlation between morphological traits and ecological conditions, which includes proper character selection; (2) data collection from both taxa (e.g., linear measurements) and environmental variables (e.g., diet and habitat preference); (3) statistical analysis of the data; and (4) explanation of the correlations found or why the predicted relationship failed in the group in question. Additionally, this research design includes observing organisms living and foraging in their natural environment so that “correlations are made between attributes of the features of organisms and attributes of environmental factors acting on these organisms” (Bock, 1994:410).

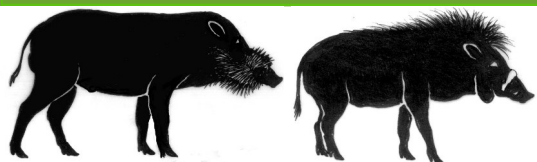
Studies of functional and ecological morphology are methods often used to analyze fossil material and reconstruct paleoenvironments (Plummer and Bishop, 1994; Reed, 1998; White and Suwa, 2004). Cooke (1976) and Kingdon (1979) were both early advocates of using the Suidae to model and interpret paleoenvironments; Kingdon recognized “interpreting the functional and comparative anatomy of pigs in terms of ecological adaptation is equally important for a broader understanding of Plio-Pleistocene ecology and the suids should be examined with this in mind” (4). Bishop (1994) suggests that “comparison between the Suidae and Hominidae assumes that the ecological similarities between the two families increases the likelihood that the suid model would have predictive value for taxonomic and ecological change in the hominid lineage” (14).

In African Biogeography, Climate Change, and Human Evolution [eds. Bromage and Schrenk (1999)] several mammalian lineages (e.g., suids and bovids) are used to: (1) explore climate related morphologic changes, and (2) interpret the environmental context of human evolution. The causal relationship between climate change and evolutionary patterns is a prevalent model in evolutionary theory (Bishop, 1999). Although, as Behrensmeyer et al. (2007) indicate that “the question of climate and its impact on faunal change is fundamentally a paleoecological problem concerning how climate-related natural selection has shaped the course of vertebrate evolution in East Africa” (3).

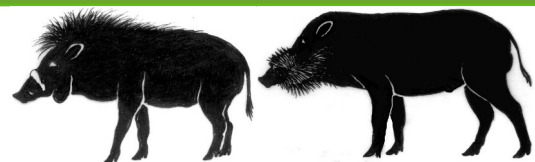
Interpretations and reconstructions of early hominin environments and the ecological structure of these environments are derived from different types of evidence (Behrensmeyer, 2006), including fossil pollen (Bonnefille, 1983; Bonnefille et al., 2004), marine aeolian dust records (deMenocal, 1995; Denton, 1995), planktonic foraminifera and marine diatoms (Prentice and Denton, 1988; Haywood and Valdes, 2004), paleosols (Cerling et al., 1989; Kingston et al., 1994; Sikes, 1994; Cerling et al., 1997; Sikes, 1999; Wynn, 2004), stable carbon and oxygen isotope data from fossil teeth (Cerling et al., 1997; Cerling et al., 1998; Cerling and Harris, 1999; Zazzo et al., 2000; Lee-Thorp et al., 2003; Kingston and Harrison, 2007), and paleofauna ecomorphology (Plummer and Bishop, 1994; Spencer, 1997; Solounias and Semprebon, 2002; DeGusta and Vrba, 2005). Integration of many of these land and marine based methods are in progress and, as Behrensmeyer (2006) points out, integration “will allow rigorous testing of the impact of global change on the environments and evolutionary trajectories of our ancestors” (477). Data from this dissertation, in conjunction with previous studies, can be used to facilitate an assessment of suid evolution in the Turkana Basin and evaluate adaptive shifts against changes in climate.

Detailed studies of modern mammalian faunal behavioral ecology, skeletal and dental ecological morphology, together, allow predictions to be made regarding the paleoecology and behavior of extinct taxa at hominin bearing sites. Ecomorphologic methods have been developed using extant and fossil ungulate postcrania to infer habitat preference and paleoenvironments in bovids (Plummer and Bishop, 1994; Spencer, 1995; Janis, 1995; Kappelman et al., 1997; DeGusta and Vrba, 2003), equids (Bernor and Armour-Chelu, 1999), and suids (Karp, 1987; Bishop, 1994, 1999).





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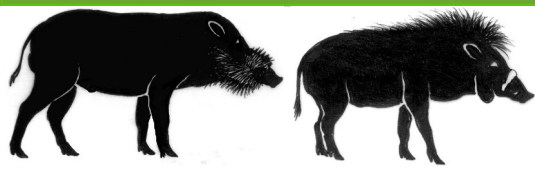


Cranial ecological correlates of diet and feeding behavior have been investigated in a diverse range of taxonomic groups, including birds (Karr and James, 1975), bats (Barlow et al., 1997; Swartz et al., 2003), bears (Sacco and Van Valkenburgh, 2004), lizards (Vanhooydonk and Van Damme, 1999), and monkeys (Cardini and Elton, 2008). Previous work on ungulate cranial ecomorphology has demonstrated that morphology is significantly correlated with diet and habitat preference (e.g., Kiltie, 1985; Janis, 1990; Janis, 1995; Spencer, 1997; Perez-Barberia and Gordon, 2001; Mendoza et al., 2002). For example, craniodental analyses of diet and feeding behavior have been investigated in fossil bovids (Spencer, 1997; Sponheimer et al., 1999), equids (Bernor and Armour-Chelu, 1999), and camels (MacFadden et al., 1999; Mendoza et al., 2002).

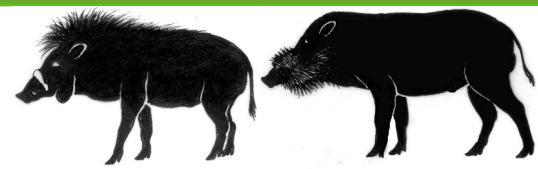
With respect to suids, relatively few ecomorphological studies have been published to date. Although, numerous studies have investigated both dental morphology and the composition of stable isotopes in dental enamel; this difference is related to the differential preservation of dental structures over other skeletal elements. Harris and White (1979), for example, extensively looked at the evolution of suid dental morphology; Kullmer (1999) investigated occlusal surface morphology, wear patterns and evolutionary stages in fossil suid dentition; Harris and Cerling (2002) examined the relationship between third molar crown height and stable carbon and oxygen isotopes from tooth enamel. Most recently, Kingston and Harrison (2007) completed a comprehensive evaluation of suid dental enamel stable isotopic patterns. These studies have improved our understanding of dental adaptation, foraging ecology, and evolutionary changes in suid taxa. Yet, despite these significant contributions and insights into African suid paleoecology and evolution, integration of these methods (i.e., dental morphology, dental wear, isotopic data, limb morphology, etc.) is still in its infancy. Behrensmeyer et al. (2007) point out that habitat and diet reconstructions based on molar crown morphology, carbon and oxygen stable isotope analysis, and evidence from postcranial skeletal material are not always in agreement.

Two studies have addressed this topic. For example, Bishop et al. (1999) used two ecological proxies, namely limb morphology and dental enamel stable carbon isotope analyses, to investigate dietary and habitat preferences in fossil suids. They demonstrated the postcranial morphology depicted relatively closed to intermediate habitats, while the stable carbon isotopes suggested a mixture of open to relatively closed landscapes. The authors interpreted their result to suggest that some closed adapted animals foraged on grass (in open areas) and that the differing signals are not mutually exclusive, nor contradictory, but rather the presence of grass indicates “either seasonality, some aridity, low moisture, or a combination of these conditions”. More recently, Bishop et al. (2006) used a “multiproxy approach” (proxies include dental microwear, stable carbon isotope, and limb morphology) to investigate the paleoecology of an extinct suid taxon. They found the various methods used to determine diet and habitat preference indicate both complementary and contrasting results (i.e., limb morphology suggested a closed environment; isotopic signal revealed partial to complete grass consumption; dental microwear analysis showed no clear modern analog). Based on the results of their multiproxy approach, Bishop et al. (2006) suggest the distribution of habitats and vegetation are different from today, and therefore concluded “a single analysis would produce a flawed or incomplete picture...”; furthermore, they interpret their results to suggest that together the combined methods reveal ecological adaptations for which there is no modern analog. Our current understanding of suid paleoecology, however, is hindered by a lack of more complete fossil skeletons; future discoveries, following a multiproxy approach, will allow further exploration into patterns of morphological and ecological relationships.





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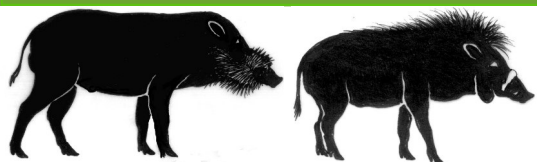
As previously mentioned, an aim of this study is to integrate the mandibular data with findings from previous studies of suid paleoecology and functional morphology (e.g., Bishop 1994; Bishop et al., 2006), in an attempt to more completely understand African suid evolutionary history, and address why habitat/dietary signals may differ. By combining mandibular and dental variables with other ecological indicators, such as isotopic signals and limb morphology, additional insights into suid paleoecology may be gained. In this study, I approach these topics with two questions. First, are fossil suid mandibular and dental morphologies consistent with dietary and habitat preferences derived from dental enamel isotope data? Second, are suid dietary and habitat preferences, inferred from the mandibular and dental morphologies for a particular site, consistent with evidence from other paleoenvironmental reconstructions (e.g. fossil pollen, isotopes from paleosols, and faunal ecomorphology)? These topics are addressed in Chapter 6, Conclusions.

This study has paleontological importance at multiple levels. First, because of the common association of pigs (suids) and people (hominids) in the fossil record, this research contributes to a broader understanding of the paleoecology of both families, Suidae and Hominidae. Second, functional mandibular anatomy most strongly correlated with diet and habitat is identified and morphologic change in suids can be assessed against documented changes in both paleoclimate and paleoenvironment. Third, potential examples of parallel evolution in two African mammal families, Suidae and Hominidae, can be assessed, such as the development of hypsodonty in suids, and hominid hypermasticatory modifications, seen in *Paranthropus*. The question of mosaic evolution can be addressed, as well as how suids and hominins were adapting to changes in their environment. And finally, why study pigs? Because as previous authors have noted, “Of all nonprimate mammals the pig is perhaps most convergent on the human in diet, molar dentition, and oral anatomy” (Scheman, 1967 as cited by Herring, 1971: 209).

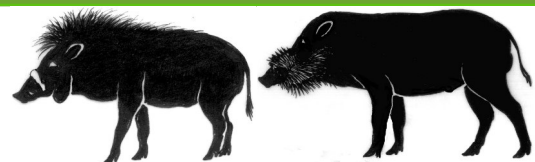
Fossil suid specimens examined in this study come from three East African localities in the Turkana Basin, Kenya namely Lothagam (late Miocene), Kanapoi (early Pliocene), and Koobi Fora (Plio-Pleistocene); for completeness, Nachukui at West Turkana (Pliocene) is also discussed. The localities of Lothagam and Kanapoi are located along the south western border of Lake Turkana, and Koobi Fora is situated on the east side of the lake, all of which are discussed separately in the following sections. Specimens from Nachukui (West Turkana) are mentioned and included in this study, but were not examined directly.

Several authors have noted the similarity between premolars of tetraconodonts and *Crocota* (e.g. Herring, 1971; Cooke and Wilkinson, 1978; McCrossin, 1987; Fortelius et al., 1996) and it is suggested that tetraconodont (e.g. *Ny. syrticus*) premolars were adapted to crush hard objects that include nuts, cones, and bamboo (Cooke and Wilkinson, 1978; van der Made, 1996), and most likely bone. Ewer (1967) pointed out bone crushing in *Crocota* is done by the anterior premolars; it seems the tetraconodonts, with their similar premolar morphology to *Crocota*, at least had the ability to crush bone. Harris and Cerling (2002) found the tetraconodont *Ny. syrticus* had a strong C4 signal, and inferred grass consumption. However, based on the morphology of their premolars converging on *Crocota*, it is very likely they were engaging in behaviors such as scavenging the carcasses of C4 plant eating animals, like the hyena, rather than eating grass. Microwear analyses of anterior cheek teeth of modern *Crocota* and *Ny. syrticus* may aid in identifying the primary source of the dietary signal.





Taxonomy and Evolution



Nyanzachoerus (Leakey, 1958)

Nyanzachoerus is a later Miocene to Pliocene African genus. Pickford (1986) attributed teeth from Ngeringerowa, Baringo District, Kenya to the genus *Nyanzachoerus*. The origin of this group is currently unresolved, and may be either endemic to Africa (Harris and White, 1979) or migrated into Africa during the late Miocene (Harris, 1983b). As previously mentioned, the tetraconodonts have extremely large third and fourth premolars. The trend, however, in *Nyanzachoerus* is a reduction of the premolars through time with later members evolving more complicated molars. Harris and White (1979) regard “the most important distinguishing feature of each species is the relative size and development of the premolars versus the third molar” (119). Six *Nyanzachoerus* species are generally recognized: *Ny. syrticus*, *Ny. devauxi*, *Ny. pattersoni*, *Ny. kanamensis*, *Ny. australis*, and *Ny. jaegeri*; although *Ny. jaegeri* is variably placed in the genus *Notochoerus*.

Leakey (1958) established the genus *Nyanzachoerus* and diagnosed it as:

“A genus of Suidae with enlarged third and fourth lower premolars resembling those of *Tetraconodon Falc.*, but more laterally compressed. Upper and lower molars closer to *Sus* than of *Potamochoerus*. Lower canines verrucose type” .

Cooke and Ewer (1972) revised Leakey’s original diagnosis and regarded *Nyanzachoerus* as:

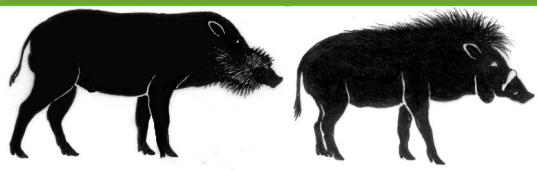
“A genus of Suidae with cheek teeth similar to *Potamochoerus* in basic structure but tending to be more hypsodont and with main cusps of molars more distinctly columnar; third and fourth premolars relatively enlarged and more hypsodont than in *Potamochoerus* ... Corpus of mandible heavy and contrasting markedly with unusually thin bone forming the angle”.

Nyanzachoerus syrticus (Leonardi, 1952)

Nyanzachoerus syrticus (*tulotus*) is a late Miocene suid known from Sahabi, in Libya (Cooke, 1987), and several east African localities including Lukeino and Lothagam (Harris, 1983b), as well as the more recent discovery of specimens attributed to *Ny. syrticus* from Lemundong'o in southern Kenya, which there are dated to about ca. 6 Ma (Hlusko and Haile-Selassie, 2007). *Nyanzachoerus syrticus* is a small member of the genus, but is comparable in size to the largest living suid, *Hylochoerus* (Harris and White, 1979). Members of this species have the largest premolars of the genus. At Lothagam, *Ny. syrticus* is restricted to the Nawata Formation, except for a single specimen recovered from the overlaying Apak member of the Nachukui Formation (Harris and Leakey, 2003b). In addition to the thin bone forming the angle and ascending ramus, *Ny. syrticus* has a short and narrow mandibular symphysis.

Dentally, this species is similar to *Ny. devauxi*, but the former has larger teeth (Harris and Leakey, 2003b). They also note limb bones of a suid recovered from the Upper Nawata, assigned to *Ny. cf. syrticus* with no associated cranial material, reflect a cursorial mode of locomotion, which suggests the animal inhabited an intermediate or more open environment. However, Harris and Leakey question the validity of the taxonomic placement and point out the specimen may not belong to *Ny. syrticus*. McCrossin (1987) interpreted the appendicular remains of *Ny. cf. syrticus* from the Sahabi Formation, Libya, to reflect adaptations for fast running in an open environment. Bishop (1999) determined that postcrania of *Ny. devauxi* (similar to *Ny. syrticus*) displays morphology indicative of an intermediate type landscape. Cursorial adaptations would not be inconsistent with a scavenging mode of foraging or a C4 dietary signal.





Taxonomy and Evolution

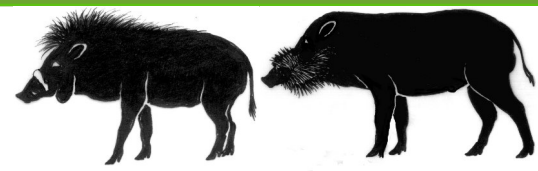
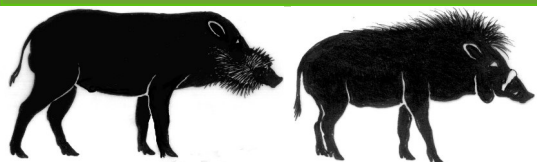


Fig. 1: *Ny. syrticus* lower jaw. Third and fourth premolars are highlighted in upper window.



Fig. 2: *Crocuta* lower jaw.





Taxonomy and Evolution

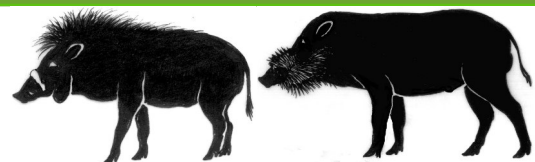


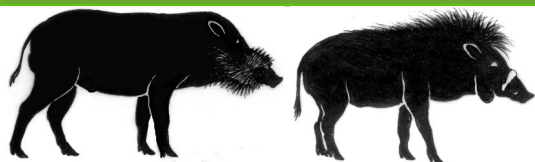
Fig. 3: *Ny. syrticus* partial mandible. Note the extreme depth of the corpus. There is no modern suid analog that exhibits a similar depth and robusticity of the mandibular corpus.

Figures illustrate the similarity in cusp morphology between *Crocuta* and the tetraconodont *Ny. syrticus* (Cuddahee, 2008).

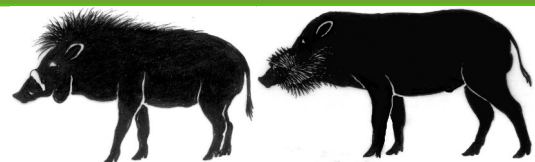
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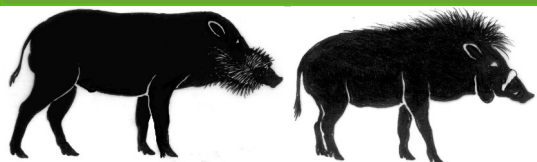


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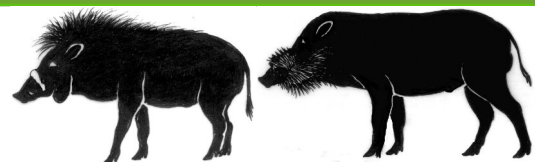


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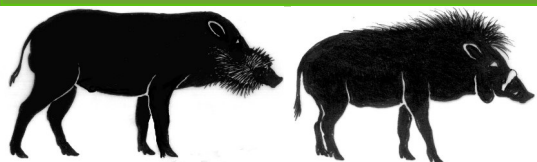


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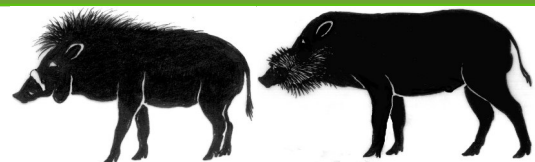


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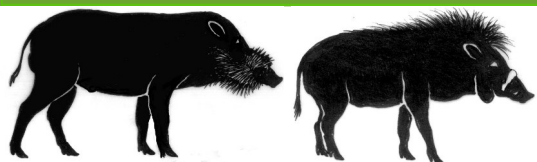


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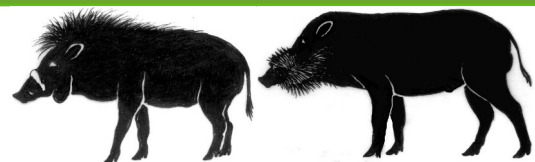


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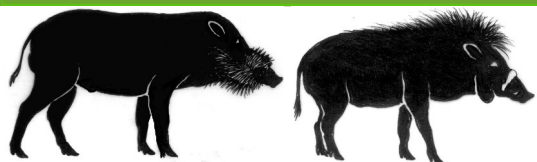


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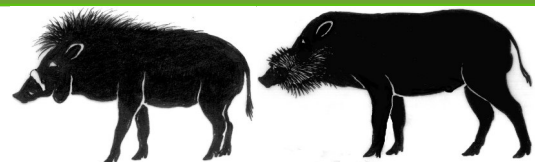


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New literature on Suiformes



Veterinary, Genetic and Physiological Studies

The complete mitochondrial genome sequence of the indigenous I pig (*Sus scrofa*) in Vietnam

Nguyen, HD; Bui, TA; Nguyen, PT; Kim, OTP; Vo, TTB (2017)

ASIAN-AUSTRALASIAN JOURNAL OF ANIMAL SCIENCES 30(7): 930-937

Objective: The I pig is a long nurtured longstanding breed in Vietnam, and contains excellent indigenous genetic resources. However, after 1970s, I pig breeds have become a small population because of decreasing farming areas and increasing pressure from foreign breeds with a high growth rate. Thus, there is now the risk of the disappearance of the I pigs breed. The aim of this study was to focus on classifying and identifying the I pig genetic origin and supplying molecular makers for conservation activities.

Methods: This study sequenced the complete mitochondrial genome and used the sequencing result to analyze the phylogenetic relationship of I pig with Asian and European domestic pigs and wild boars. The full sequence was annotated and predicted the secondary tRNA.

Results: The total length of I pig mitochondrial genome (accession number KX094894) was 16,731 base pairs, comprised two rRNA (12S and 16S), 22 tRNA and 13 mRNA genes. The annotation structures were not different from other pig breeds. Some component indexes as AT content, GC, and AT skew were counted, in which AT content (60.09%) was smaller than other pigs. We built the phylogenetic trees from full sequence and D loop sequence using Bayesian method. The result showed that I pig, Banna mini, wild boar (WB) Vietnam and WB Hainan or WB Korea, WB Japan were a cluster. They were a group within the Asian clade distinct from Chinese pigs and other Asian breeds in both phylogenetic trees (0.0004 and 0.0057, respectively).

Conclusion: These results were similar to previous phylogenic study in Vietnamese pig and showed the genetic distinctness of I pig with other Asian domestic pigs.

Assessment of microbial carcass contamination of hunted wild boars

Mirceta, J; Petrovic, J; Malesevic, M; Blagojevic, B; Antic, D (2017)

EUROPEAN JOURNAL OF WILDLIFE RESEARCH 63 (2)

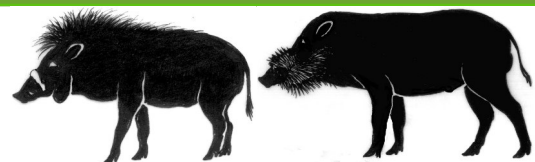
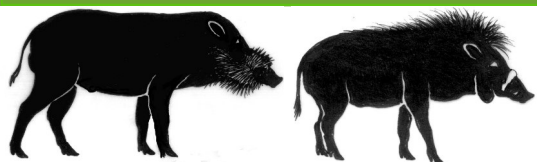
To investigate the microbiological conditions of hunted wild boar carcasses and factors that contribute to the microbial carcass contamination, skin and carcass meat swab samples from 210 hunted wild boars were collected from freshly shot animals. The mean aerobic colony counts (ACCs) and Enterobacteriaceae counts on the skin were 5.2 and 3.6 log(10) CFU/cm(2), with 1.4% of animals' skin tested

positive for *Salmonella* spp. Slightly higher mean ACC and Enterobacteriaceae counts of 5.4 and 3.8 log(10) CFU/cm(2) were obtained from carcass meat with *Salmonella* spp. prevalence of 1.9%. Inadequate hygiene practices in handling and dressing wild boar carcasses, such as evisceration in the laying position on the ground and practice of skin and interior carcass surface washing after evisceration, were found to have the most significant influence on the microbiological conditions of final carcasses. Therefore, these findings indicate the need for the implementation and strict adherence to good hygiene practice in hunting estates and game handling establishments.

The 'heritability' of domestication and its functional partitioning in the pig

Perez-Enciso, M; de los Campos, G; Hudson, N; Kijas, J; Reverter, A (2017)





HEREDITY 118(2): 160-168

We propose to estimate the proportion of variance explained by regression on genome-wide markers (or genomic heritability) when wild/domestic status is considered the phenotype of interest. This approach differs from the standard F_{st} in that it can accommodate genetic similarity between individuals in a general form. We apply this strategy to complete genome data from 47 wild and domestic pigs from Asia and Europe. When we partitioned the total genomic variance into components associated to subsets of single nucleotide polymorphisms (SNPs) defined in terms of their annotation, we found that potentially deleterious non-synonymous mutations (9566 SNPs) explained as much genetic variance as the whole set of 25 million SNPs. This suggests that domestication may have affected protein sequence to a larger extent than regulatory or other kinds of mutations. A pathway-guided analysis revealed ovarian steroidogenesis and leptin signaling as highly relevant in domestication. The genomic regression approach proposed in this study revealed molecular processes not apparent through typical differentiation statistics. We propose that at least some of these processes are likely new discoveries because domestication is a dynamic process of genetic selection, which may not be completely characterized by a static metric like F_{st} . Nevertheless, and despite some particularly influential mutation types or pathways, our analyses tend to rule out a simplistic genetic basis for the domestication process: neither a single pathway nor a unique set of SNPs can explain the process as a whole.

Comparison of three methods to evaluate wild boar diet

Zeman, J; Hrbek, J; Drimaj, J; Kudlacek, T; Kamler, J; Plhal, R; Heroldova, M (2016)

FOLIA ZOOLOGICA 65(3): 221-224

Wild boar diet composition highly reflects the management of the species as well as the level of its damaging effect. For this reason we tried to prove similarity and reliability of three methods of wild boar diet analysis to find out their suitability in practical use. Gastrointestinal tracts of 27 wild boar specimens were sampled, with the stomach and faecal contents of each individual being analysed and compared. Stomach and faeces analyses were done by identification of food items under microscope and measuring their quantity volumetrically. The third method, so called "veterinary", was the simplest one lying in the visual estimation of diet items percentage content diluted and spread in water on a tray. The similarity evaluation by qualitative and quantitative indices and additionally the generalised additive model confirmed that it is possible to identify all major food items which indicate the main diet strategy using all three analysis methods. All three tested methods were relevant in terms of basic features of quantitative and qualitative dietary assessment. The simple "veterinary" method, based on pure estimation, was proved to be suitable for field studies.

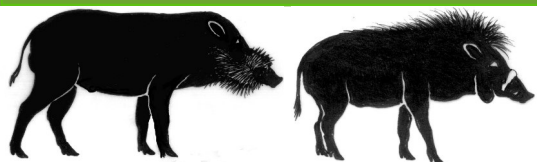
Erosion of canine teeth in babirusa (genus *Babyrusa*).

Macdonald AA (2017)

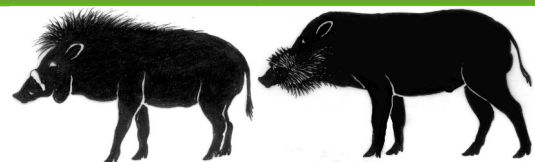
C R Biol.340(5): 271-278

Patterns of wear on the canine teeth were examined in 260 adult male babirusa skulls. Video recordings of 161 adult male babirusas at salt licks in North Sulawesi were viewed for behaviour related to erosion of the canine teeth. Corresponding observations were made of the behaviour of male babirusa in Antwerp and Surabaya Zoos. Most loss of maxillary canine dental tissue was from the ventro-lateral or lateral surface of the tooth, towards its distal end. The teeth were smoothly flattened on a plane approximating to the plane formed on the side of the face by the





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snout, the zygion and the zygomatic process. Mandibular canine dental erosion was on the medial side of that tooth. Rounded smoothness of both teeth was evident rostrally. Ploughing into mud and face rubbing against young trees accounted for the wear of the teeth.

Magnetic alignment in warthogs *Phacochoerus africanus* and wild boars *Sus scrofa*

Cervený, Jaroslav; Burda, Hynek; Jezek, Milos; et ál.. (2017)

MAMMAL REVIEW 47(1): 1-5

Magnetic alignment (MA) results from the preference of animals to align themselves along the field lines of the geomagnetic field, a behavioural expression of a magnetic sense. MA is well documented for ruminants and might demonstrate a general magnetic sensory ability among artiodactyls. We measured body-axis alignment in 1614 foraging or resting wild boars *Sus scrofa*, 1849 wild boar beds, and 1347 warthogs *Phacochoerus africanus*, and found a highly significant north-south preference. The magnetic field was the only common denominator of all observations. Thus, we provide the first data suggesting a magnetic sense in the Suidae.

Test performance of three serological assays for the detection of *Mycobacterium bovis* infection in common warthogs (*Phacochoerus africanus*)

Roos, Eduard O.; Buss, Peter; De Klerk-Lorist, Lin-Mari; et ál.. (2016)

VETERINARY IMMUNOLOGY AND IMMUNOPATHOLOGY 182: 79-84

Sporadic cases of bovine tuberculosis (bTB) have been reported in warthogs in Southern Africa and confirmed through mycobacterial culture. However, there are no validated ante-mortem tests currently available for bTB in warthogs. In this study, we evaluated the use of three serological assays for the detection of *Mycobacterium bovis* infection in warthogs; an indirect enzyme-linked immunosorbent assay (ELISA) using bovine purified protein derivative (PPDb) as a capture antigen (indirect PPD ELISA), as well as two commercial assays, the TB ELISA-VK (R) and DPP (R) VetTB Assay. Test performance of these assays was compared using sera from 35 warthogs of known *Mycobacterium bovis* infection status. All three assays were able to distinguish *M. bovis*-infected from uninfected individuals with high sensitivity (Se) and specificity (Sp) (indirect PPD ELISA Se: 88%, Sp: 89%; TB ELISA-VK (R) 88%, 79%; DPP (R) VetTB Assay 75%, 89%, respectively). The assays performed very similarly and the ELISA assays showed the greatest agreement ($K = 0.89$). These results indicate that *M. bovis*-infected warthogs develop measurable pathogen-specific humoral responses which can be used to distinguish them from uninfected animals. Therefore, serological assays have value as ante-mortem bTB diagnostic tests in warthogs.

Regional level risk factors associated with the occurrence of African swine fever in West and East Africa

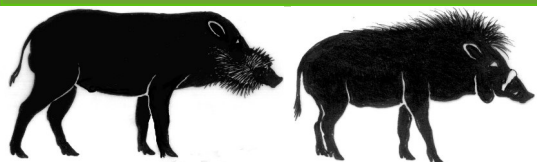
Huang, Zheng Y. X.; van Langevelde, Frank; Honer, Karanina J.; et ál.. (2017)

PARASITES & VECTORS 10

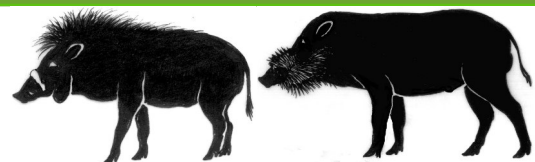
Background: African swine fever (ASF) causes severe socio-economic impacts due to high mortality and trade restrictions. Many risk factors of ASF have been identified at farm level. However, understanding the risk factors, especially wild suid hosts, determining ASF transmission at regional level remains limited.

Methods: Based on ASF outbreak data in domestic pigs during 2006-2014, we here tested, separately for West and East Africa, which risk factors were linked to ASF presence at a regional





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level, using generalized linear mixed models.

Results: Our results show that ASF infections in the preceding year was an important predictor for ASF presence in both West and East Africa. Both pig density and human density were positively associated with ASF presence in West Africa. In East Africa, ASF outbreaks in domestic pigs were also correlated with higher percentages of areas occupied by giant forest hogs and by high-tick-risk areas.

Conclusions: Our results suggest that regional ASF risk in East Africa and in West Africa were associated with different sets of risk factors. Regional ASF risk in West Africa mainly followed the domestic cycle, whereas the sylvatic cycle may influence regional ASF risk in East Africa. With these findings, we contribute to the better understanding of the risk factors of ASF occurrence at regional scales that may aid the implementation of effective control measures.

Conservation of somatic tissue derived from collared peccaries (*Pecari tajacu* Linnaeus, 1758) using direct or solid-surface vitrification techniques

Borges, Alana Azevedo; Lima, Gabriela Liberalino; de Queiroz Neta, Luiza Bento; et ál.. (2017) CYTOTECHNOLOGY 69(4): 643-654

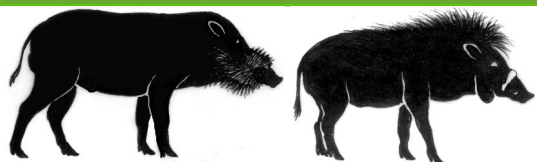
Cryopreservation of somatic tissue can be applied in biodiversity conservation, especially for wild species as collared peccary. We aimed to evaluate the effect of vitrification techniques of ear tissue of collared peccary [direct vitrification in cryovials (DVC) or solid-surface vitrification (SSV)] on the layers of epidermis and dermis by conventional histology and cell ability during the in vitro culture. Thus, both the vitrification methods were able to maintain normal patterns of the epidermis as the cornea and granular layers, furthermore the intercellular space and dermal-epidermal junction of the spinous layer when compared to fresh control. Nevertheless, DVC and SSV percentage of normality decreased in the morphological integrity of cytoplasm (37.5 and 25.0%) of spinous layer, respectively, as compared to the fresh fragments (100%, $p < 0.05$). Moreover, other differences between the fresh control (100%) and DVC tissues were verified in the intraepidermal cleavage of the spinous (37.5%) and basal (37.5%) layers. In general, DVC and SSV techniques were efficient for the recovery of the somatic cells according to most of the evaluated parameters for the in vitro culture ($p[0.05]$). In addition, only at time of 72 h (D3), in the growth curve, DVC fragments showed a reduced cell concentration than fresh control. In conclusion, SSV was found to be a more efficient method for vitrifying collared peccary skin tissue when compared to DVC. These results are relevant for the tissue cryopreservation from collared peccary and could also be useful for mammals with phylogenetic relationships.

In vitro culture of somatic cells derived from ear tissue of collared peccary (*Pecari tajacu* Linnaeus, 1758) in medium with different requirements

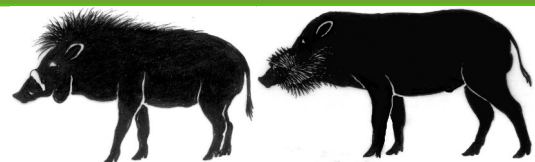
Santos, Magda L. T.; Borges, Alana A.; Queiroz Neta, Luiza B.; et ál.. (2016) PESQUISA VETERINARIA BRASILEIRA 36(12): 1194-1202

The maintenance of metabolic activities during the in vitro culture of somatic cells of wild animals, especially collared peccary (*Pecari tajacu*), is an interesting step in conservation of these cells for the use in nuclear transfer. In this context, it is necessary to optimize the culture conditions of somatic cells by the establishment of appropriate supplementation to the media. Therefore, this study aimed to analyze the composition of the culture means of somatic cell derived from ear tissue of collared peccaries, evaluating concentrations of fetal bovine serum (FBS; 10% vs. 20%) and epidermal growth factor (EGF; 5ng/mL vs. 10ng/mL). Tissues were submitted to primary





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culture and subcultures for 40 days and cells were analyzed for morphology, adhesion, subconfluence, and proliferative activity to develop the growth curve and to determine the population doubling time (PDT), viability, and functional/metabolic activity. No difference was observed between the concentrations of FBS for several parameters, except for viability [FBS10: 85.6% vs. FBS20: 98.2%], PDT [FBS10: 155.4h vs. 77.2h], and functional/ metabolic assay [FBS10: 0.57-0.55 vs. FBS20: 0.82-0.99 (D5-D7)]. For the EGF in culture, no difference was observed in the evaluated parameters. In all experiments, the growth curves were typical S-shape and the cells passed through a lag, logarithmic, and plateau phase. In conclusion, 20% FBS is suitable for the recovery of somatic cells; nevertheless, EGF does not improve the quality of growing these cells. To our knowledge, this is the first study culturing somatic cells of collared peccaries.

Progesterone and estradiol profiles in different reproductive stages of captive collared peccary (*Pecari tajacu*) females assessed by fecal metabolites

Ahuja-Aguirre, Concepcion; Lopez-deBuen, Lorena; Rojas-Maya, Susana; et ál.. (2017)
ANIMAL REPRODUCTION SCIENCE 180: 121-126

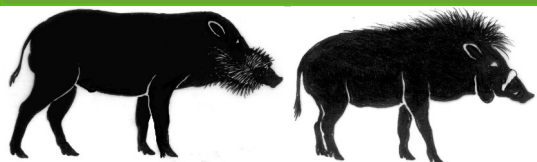
The study determined the fecal progesterone and estradiol profiles in different reproductive stages of captive collared peccary (*Pecari tajacu*) females from eastern Mexico. Fifteen adult females were included. At the start of the study the females were either pregnant (early, mid, or late pregnancy), lactating, or non-lactating of unknown pregnancy status. Feces from each female were collected once a week during nine consecutive months to determine concentrations of fecal progesterone and estradiol metabolites using ELISA. Progesterone was similar in early (2048 +/- 285 ng/g), mid (2254 +/- 1274 ng/g), and late pregnancy (2491 +/- 1374 ng/g), and in early-pregnant and non-lactating females (1154 +/- 274 ng/g). Progesterone in lactating females (442 +/- 255 ng/g) was lower than in females at any stage of pregnancy, but was similar to non-lactating females. Overall progesterone in pregnant females (2229 +/- 1173 ng/g) was higher than in lactating and non-lactating females together (772 +/- 189 ng/g). Estradiol was similar in early (66 +/- 8 ng/g), mid (83 +/- 9 ng/g), late pregnant (109 +/- 15 ng/g), and non-lactating females (64 +/- 9 ng/g). Estradiol in lactating females (34 +/- 8 ng/g) was similar to estradiol in early-pregnant and non-lactating females, but was lower than in females in late and mid pregnancy. Overall estradiol in pregnant females (79 +/- 6 ng/g) was similar to non-lactating females, but higher than in lactating females. The progesterone and estradiol profiles of captive collared peccary females at different reproductive stages were determined by assessing concentrations of fecal hormone metabolites.

Estimating the binding ability of collared peccary (*Pecari tajacu* Linnaeus, 1758) sperm using heterologous substrates

Campos, Livia Batista; Xavier Peixoto, Gislayne Christianne; da Silva, Andreia Maria; et ál..(2017)
THERIOGENOLOGY 92: 57-62

In collared peccaries, the development of artificial insemination (AI) is scarce, requiring search for alternative methods for the evaluation of sperm fertilizing ability. Thus, the aims of this study were to estimate the binding capability of collared peccaries sperm, using swine oocytes and the egg perivitelline membrane, and to evaluate the prognostic value of sperm parameters on the in vitro interactions among sperm and heterologous substrates. Eleven ejaculates were collected by electroejaculation and evaluated for viability and morphology by light microscopy, for functionality





New literature on Suiformes



by hypo-osmotic swelling test, for plasma membrane integrity by epifluorescence microscopy, and for sperm motility by computerized analysis. Subsequently, for analysis of the in vitro interactions, sperm samples were cultured in an incubation medium with swine oocytes and egg perivitelline membrane for 18 h and 20 min, respectively, at 38.5 degrees C and humidified atmosphere. The sperm-oocyte interaction rate was 100% with sperm penetrating 19.8+ 5.5% of oocytes. The average values of bound sperm and penetrated sperm per oocyte were 39.4 + 4.6 and 2.5 + 0.7, respectively. Already for perivitelline membrane binding assay, all samples presented sperm bound (100%) with average of 140.6 +/- 19.4 bound sperm (range 33.9-308.7). Moreover, positive correlations were observed for the number of sperm bound to swine oocytes and osmotic response ($r = 68.5\%$; $P = 0.02$), membrane integrity ($r = 65.1\%$; $P = 0.03$), and straightness ($r = 66.5\%$; $P = 0.03$), as well as for the number of sperm bound to egg perivitelline membrane and sperm viability ($r = 74.0\%$; $P = 0.01$), total motility ($r = 63.6\%$; $P = 0.04$), and linearity ($r = 70.5\%$; $P = 0.02$). Finally, a negative correlation among slow ($r = 80.5\%$; $P = 0.01$) and static ($r = 84.3\%$; $P = 0.01$) sperm with the egg perivitelline membrane was observed. In conclusion, swine oocytes and perivitelline membrane can be used as indicators for the functional evaluation of the binding capability of sperm derived from collared peccaries. These tests could be incorporated into the routine of semen technologies.

Serosurvey of anti-*Leptospira* sp and anti-*Toxoplasma gondii* antibodies in capybaras and collared and white-lipped peccaries

Ullmann, Leila Sabrina; Gravinatti, Mara Lucia; Yamatogi, Ricardo Seiti; et ál.. (2017)

REVISTA DA SOCIEDADE BRASILEIRA DE MEDICINA TROPICAL 50(2) 248-250

Introduction: Brazilian native species are reemerging as increasingly free-ranging populations. Methods: Sera from 31 capybaras (*Hydrochoerus hydrochaeris*) and 28 peccaries (*Pecari tajacu* and *Tayassu pecari*) were tested for anti-*Leptospira* and anti-*Toxoplasma gondii* antibodies using microscopic seroagglutination test. Results: Nineteen percent of free-ranging and 10.0% of captive capybaras, along with 31.8% of collared peccaries, were seropositive for *T. gondii*. None was seropositive for *Leptospira* sp. Conclusions: The present findings indicated low risk of disease, particularly among capybaras and white-lipped peccaries; however, active surveillance programs are important for monitoring wildlife health and public health once they are in public parks around cities.

Awareness and attitudes towards anthrax and meat consumption practices among affected communities in Zambia: A mixed methods approach

Sitali, DC; Mumba, C; Skjerve, E; Mweemba, O; Kabonesa, C; Mwinyi, MO; Nyakarahuka, L; Muma, JB (2017)

PLOS NEGLECTED TROPICAL DISEASES 11 (5)

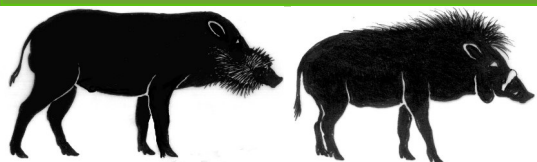
Background

In Zambia, human anthrax cases often occur following cases of animal anthrax. Human behaviour has been implicated in this transmission. The objective of the study was to explore human behavioural patterns that may contribute to outbreaks of anthrax among affected communities.

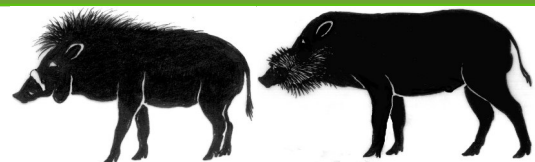
Methods

A mixed methods study was conducted in four districts of Zambia from November 2015 to February 2016. A cross sectional survey involving 1,127 respondents, six focus group discussions and seven key informant interviews with professional staff were conducted. Descriptive statistics





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on socio-demographic characteristics, awareness of anthrax, attitudes towards cattle vaccination and risk factors for anthrax and vaccination practices were run using STATA 12 for analysis.

Results

Overall, 88% of respondents heard about anthrax, 85.1% were aware that anthrax is transmitted by eating infected meat and 64.2% knew that animals and humans can be infected with anthrax. However, qualitative data suggested that awareness of anthrax varied across communities. Qualitative findings also indicated that, in Western and Muchinga provinces, human anthrax was transmitted by eating infected beef and hippo (*Hippopotamus amphibious*) meat, respectively. Although survey data indicated that 62.2% of respondents vaccinated their animals, qualitative interviews and annual vaccination reports indicated low vaccination rates, which were attributed to inadequate veterinary service provision and logistical challenges. While 82% of respondents indicated that they reported animal deaths to veterinary officers, only 13.5% of respondents buried infected carcasses. Majority (78.1%) of respondents either ate, sold or shared meat from dead animals with other community members. Poverty, lack of access to meat protein and economic reasons were cited as drivers for consuming infected meat.

Conclusions

Health education campaigns must be intensified to reduce the risk of human exposure. Veterinary extension services should be strengthened and cold chain facilities decentralized in order to improve accessibility to anthrax vaccine. It is also important to involve the affected communities and collaborate with other disciplines in order to effectively tackle poverty, improve veterinary services and address inherent meat consumption practices within the communities.

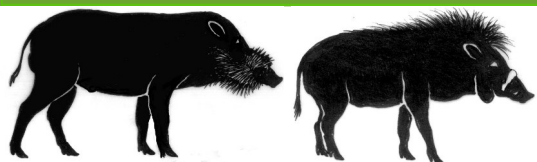
A Retrospective Analysis of Mortality in Captive Pygmy Hippopotamus (*Choeropsis liberiensis*) From 1912 to 2014

Author(s): Flacke, GL; Tkalcic, S; Steck, B; Warren, K; Martin, GB (2016)

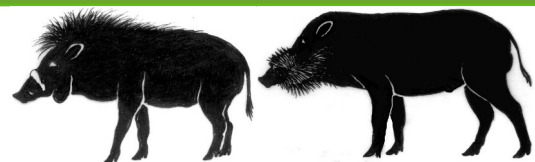
ZOO BIOLOGY 35(6): 556-

The pygmy hippopotamus (*Choeropsis liberiensis*) is an IUCN Red List Endangered species (CITES Appendix II) that has been housed in zoological collections since 1912. As wild populations continue to decline throughout the species' range, successful ex situ breeding and management, including an understanding of morbidity and mortality, are of utmost importance. This study is the first comprehensive review of mortality data from the captive population since 1982 and significantly expands on previous analyses. We solicited necropsy reports from 129/187 zoological institutions worldwide that currently or previously held pygmy hippos and received data for 404 animals (177 male, 220 female, 7 undermined sex), representing 43% of pygmy hippos that have died in captivity. Mortality in neonates was primarily due to perinatal causes (51.8%-stillbirth, failure to thrive, weakness, poor suckling reflex, maternal neglect) or parent-inflicted trauma (28%). Common causes of mortality in adult and geriatric animals included cardiovascular disease (16%), degenerative musculoskeletal conditions (10%), obstructive gastrointestinal disease (9%), and renal insufficiency (13%), sometimes associated with advanced polycystic kidney disease (PKD). Although not the direct cause of mortality, a number of adult and geriatric pygmy hippos were also overweight to obese. Infectious causes of mortality included leptospirosis and encephalomyocarditis virus, the latter usually presenting as acute death due to cardiovascular demise. This comprehensive overview presents a useful guide for recommendations in preventative veterinary care and for improved husbandry and management of pygmy hippos in captivity.





New literature on Suiformes



Eco-epidemiological and pathological features of wildlife mortality events related to cyanobacterial biointoxication in the Kruger National Park, South Africa

Bengis, R; Govender, D; Lane, E; Myburgh, J; Oberholster, P; Buss, P; Prozesky, L; Keet, D (2016)

JOURNAL OF THE SOUTH AFRICAN VETERINARY ASSOCIATION 87 (1)

Over the past decade, several clustered, multispecies, wildlife mortality events occurred in the vicinity of two man-made earthen dams in the southern and south central regions of the Kruger National Park, South Africa. On field investigation, heavy cyanobacterial blooms were visible in these impoundments and analysis of water samples showed the dominance of *Microcystis* spp. (probably *Microcystis aeruginosa*). Macroscopic lesions seen at necropsy and histopathological lesions were compatible with a diagnosis of cyanobacterial intoxication. Laboratory toxicity tests and assays also confirmed the presence of significant levels of microcystins in water from the two dams. These outbreaks occurred during the dry autumn and early winter seasons when water levels in these dams were dropping, and a common feature was that all the affected dams were supporting a large number of hippopotamuses (*Hippopotamus amphibius*). It is hypothesised that hippopotamus' urine and faeces, together with agitation of the sediments, significantly contributed to internal loading of

phosphates and nitrogen - leading to eutrophication of the water in these impoundments and subsequent cyanobacterial blooms. A major cause for concern was that a number of white rhinoceros (*Ceratotherium simum*) were amongst the victims of these bio-intoxication events. This publication discusses the eco-epidemiology and pathology of these clustered mortalities, as well as the management options considered and eventually used to address the problem.

Taxonomic, Biogeographic and Evolutionary Studies

Fossil peccaries of Late Pleistocene/Holocene (Cetartiodactyla, Tayassuidae) from underwater caves of Serra da Bodoquena (Mato Grosso do Sul State, Brazil)

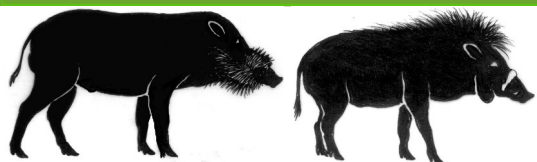
Dutra, Rodrigo Parisi; Missaglia, Rafaela Velloso; Perini, Fernando Araujo; et ál.. (2017)
HISTORICAL BIOLOGY 29(1): 85-92

New records of *Catagonus stenocephalus* and *Tayassu pecari* are reported from the karst of Serra da Bodoquena, located at a south-western portion of Brazil near the border with Paraguay. Skull and lower jaw fragments at different stages of mineralisation were retrieved from two limestone underwater caves, Japones and Nascente do Formoso, associated with clay and sand deposits with no retrievable stratigraphy. C14 dating of fossil mammals from these caves was attempted, but so far no success was achieved, but the inferred age for the associated paleofauna of these caves is Late Pleistocene and Holocene. The morphology of these fossil peccaries, from the most south-western known population in Brazil, is detailed and paleoecological implications are considered.

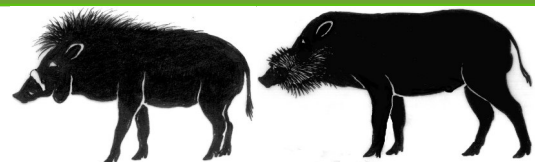
Environment and space as drivers of variation in skull shape in two widely distributed South-American Tayassuidae, *Pecari tajacu* and *Tayassu pecari* (Mammalia: Cetartiodactyla)

Hedges, Carla D.; Bubadue, Jamile M.; Caceres, Nilton C. (2016)
BIOLOGICAL JOURNAL OF THE LINNEAN SOCIETY 119(4): 785-798





New literature on Suiformes



The influence of the environment on the geographical variation of morphological traits has been recognized in a number of taxa. *Pecari tajacu* and *Tayassu pecari* are ideal models to investigate intraspecific geographic variation in skull because of their wide and heterogeneous geographical distribution in South America. We used geometric morphometric procedures to examine the geographical variation in skull shape of 294 adult specimens of these species from 134 localities. We quantified to what extent skull shape variation was explained by environment, skull size and geographical space using variation partitioning analysis. We detected a strong pattern of geographic variation for *P. tajacu* skull shape, but not for *T. pecari*. The environment seems to be the major selective force that drives skull shape variation in both species. Nevertheless, other spatially structured processes (e.g. genetic drift, gene flow) might also have affected variation in the skull shape of the more widespread species *P. tajacu*. Allometric relationships might reflect the biomechanical constraints that are thought to be strong enough to limit size-related changes in *T. pecari* skull shape.

Ecological, Behavioural and Conservation Studies

Tropical-forest mammals as detected by environmental DNA at natural saltlicks in Borneo

Ishige, T; Miya, M; Ushio, M; Sado, T; Ushioda, M; Maebashi, K; Yonechi, R; Lagan, P; Matsubayashi, H (2017)

BIOLOGICAL CONSERVATION 210: 281-285

Although tropical forests are among the most species-rich ecosystems on earth, 42% of mammal species in tropical forests are endangered because of overhunting and/or unsustainable exploitation. Camera-trap surveys have shown that natural saltlicks can be used to determine mammalian fauna, especially medium to large endangered species in tropical forests; establishment of camera traps, however, is time and effort intensive. Furthermore, the photographic range and detectable size of species are often restricted. Environmental DNA (eDNA) metabarcoding is a powerful approach that might provide a better way to study terrestrial animals in tropical forests. In this study, we examined whether eDNA from natural saltlicks comprehensively represented species composition in a Bornean tropical forest. We collected 100-150-mL water samples from natural saltlicks in Sabah, Malaysian Borneo. We constructed amplicon libraries for MiSeq sequencing using eDNA extracted from the water samples. Six endangered species were detected using this method, including Bornean orangutan (*Pongo pygmaeus*), Bornean banteng (*Bos javanicus lowi*), Asian elephant (*Elephas maximus*), Sunda pangolin (*Manis javanica*), sambar deer (*Rusa unicolor*) and bearded pig (*Sus barbatus*). However, most small and minor species were not detected, with low sequence identity (80-96%). Therefore, we propose that more species of tropical forest mammals should have their sequences deposited in DNA databases. This study is the first to report the endangered mammals of a tropical forest detected using eDNA from natural saltlicks.

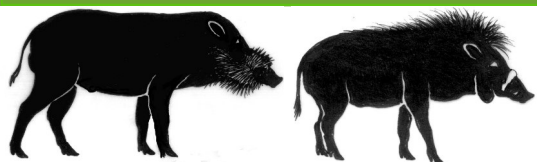
Diversity and activity patterns of sympatric animals among four types of forest habitat in Guanyinshan Nature Reserve in the Qinling Mountains, China

Liu, XH; Wu, PF; Shao, XM; Songer, M ; Cai, Q; He, XB; Zhu, Y (2017)

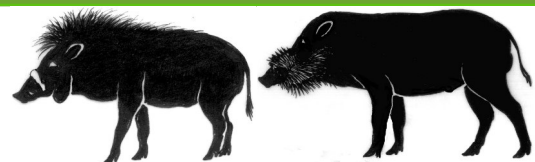
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 24(19; Special Issue): 16465-16477

Environmental heterogeneity contributes to various habitats and may influence the diversity and





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activity patterns of wildlife among habitats. We used camera traps to assess wildlife habitat use in Guanyinshan Nature Reserve from 2009 to 2012. We focused on four types of habitat including open areas with gentle slope (< 15A degrees) (Type1), low elevation areas (about 1500-1700 m) with high bamboo coverage (Type2), high elevation areas (about 2100-2300 m) with high canopy coverage (Type3), and wildlife migration passages (Type4). We analyzed the differences in species richness, relative abundance index (RAI), species diversity, and animals' activity pattern among habitats. Total six species were analyzed on activity pattern, which are Takin (*Budorcas taxicolor*), tufted deer (*Elaphodus cephalophus*), Himalayan goral (*Naemorhedus goral*), wild boar (*Sus scrofa*), golden pheasant (*Chrysolophus pictus*), and porcupine (*Hystrix hodgsoni*). The results are (1) that there were significant differences in richness and RAI(t) among habitats; (2) Type4 habitat had the highest richness and RAI(t) while Type2 had the highest species diversity; giant pandas were found in these two habitats; (3) there were significant differences in species' activity during daytime and nighttime; and (4) differences appeared in habitat preference of the most abundant species. Takin and tufted deer preferred Type1, Himalayan goral preferred Type2, and golden pheasant preferred Type3. Type4 habitat was used by most animals. All these revealed that habitat heterogeneity plays an important role in species diversity and their importance for conservation.

Non-invasive genetics outperforms morphological methods in faecal dietary analysis, revealing wild boar as a considerable conservation concern for ground-nesting birds

Oja, R; Soe, E; Valdmann, H; Saarma, U (2017)

PLOS ONE 12(6)

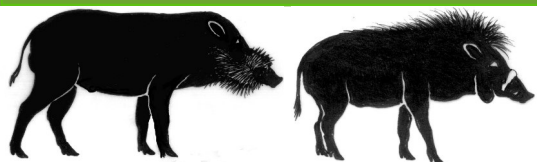
Capercaillie (*Tetrao urogallus*) and other grouse species represent conservation concerns across Europe due to their negative abundance trends. In addition to habitat deterioration, predation is considered a major factor contributing to population declines. While the role of generalist predators on grouse predation is relatively well known, the impact of the omnivorous wild boar has remained elusive. We hypothesize that wild boar is an important predator of ground-nesting birds, but has been neglected as a bird predator because traditional morphological methods underestimate the proportion of birds in wild boar diet. To distinguish between different mammalian predator species, as well as different grouse prey species, we developed a molecular method based on the analysis of mitochondrial DNA that allows accurate species identification. We collected 109 wild boar faeces at protected capercaillie leks and surrounding areas and analysed bird consumption using genetic methods and classical morphological examination. Genetic analysis revealed that the proportion of birds in wild boar faeces was significantly higher (17.3%; 4.5x) than indicated by morphological examination (3.8%). Moreover, the genetic method allowed considerably more precise taxonomic identification of consumed birds compared to morphological analysis. Our results demonstrate: (i) the value of using genetic approaches in faecal dietary analysis due to their higher sensitivity, and (ii) that wild boar is an important predator of ground-nesting birds, deserving serious consideration in conservation planning for capercaillie and other grouse.

An updated account of mammal species and population status of ungulates in Keoladeo National Park, Bharatpur, Rajasthan

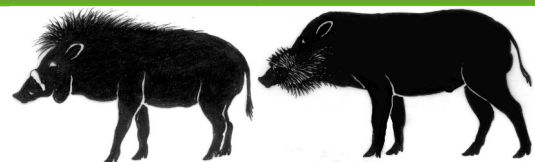
Singh, A ; Mukherjee, A; Dookia, S ; Kumara, HN (2017)

CURRENT SCIENCE 113(1): 103-111





New literature on Suiformes



This study documents the present status of mammals in Keoladeo National Park (KNP) and assesses the population structure of ungulates. It provides a comprehensive account of the mammal diversity of the park and aims to compare the change in mammalian species account ever since the park became a protected area. We employed line transect surveys for density estimation of ungulates. We report local extinction of eight species since 1966, and extant diversity of 34 mammalian species in KNP. The estimated densities of chital, feral cattle, nilgai, wild boar and sambar were 52.37, 33.66, 13.68, 3.21 and 0.32 individuals/km² respectively. Although blackbuck has become locally extinct and sambar density has significantly reduced, chital and nilgai as habitat generalists have increased in density in the last 25 years, which has contributed to an overall increase in ungulate population density in KNP. The mammalian diversity has changed substantially with local extinction of some carnivores and constant change in the habitat condition.

Hunters serving the ecosystem: the contribution of recreational hunting to wild boar population control

Quiros-Fernandez, F; Marcos, J; Acevedo, P; Gortazar, C (2017)
EUROPEAN JOURNAL OF WILDLIFE RESEARCH 63(3)

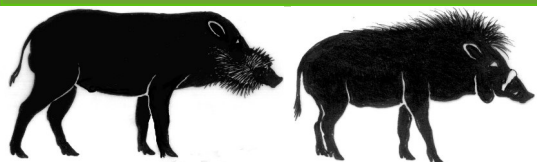
The extractive nature of recreational hunting may provide a service to both the ecosystem and society, namely the control of problem species. We reviewed the annual wild boar hunting bag data from hunting sites in Asturias (Spain) from 2000/01 to 2013/14, paying particular attention to the evolution on hunting estates after ban periods. We hypothesized that the annual hunting bag after a hunting ban would be larger than that of the pre-ban period, and that this difference could provide an indication of hunters' relative contribution to wild boar population regulation. The total hunting bag grew during the study period, from 3723 wild boar (0.39 ind/km²) in the 2000/01 hunting year to 7593 in that of 2013/14 (0.79 ind/km²)-a mean annual increase of 5.63%. Low hunting quotas cannot be blamed for these growing trends, since no more than 50% of the authorized animals are hunted. The growth of the mean annual pre-ban hunting bag on the estates on which hunting bans took place was 8.46%. The hunting bag grew by 40.33% immediately after the hunting ban ended-a growth rate seven times higher than that of the background hunting bag. This constitutes a proxy of the regulatory effect of hunters on wild boar population growth. Following the remarkable increase after the ban, the wild boar hunting bag attained values that were slightly lower than those of the preban period, which indicates that hunters are able to reduce wild boar abundance. Hunting, therefore, provides an important service to both the ecosystem and society by contributing to regulating the growth of problem species such as the wild boar.

Development of known-fate survival monitoring techniques for juvenile wild pigs (*Sus scrofa*)

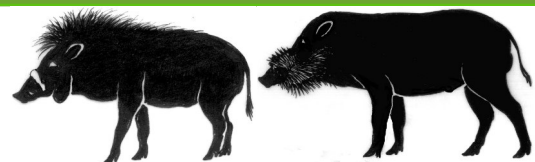
Keiter, DA; Kilgo, JC; Vukovich, MA; Cunningham, FL; Beasley, JC (2017)
WILDLIFE RESEARCH 44(2): 165-173

Context. Wild pigs are an invasive species linked to numerous negative impacts on natural and anthropogenic ecosystems in many regions of the world. Robust estimates of juvenile wild pig survival are needed to improve population dynamics models to facilitate management of this economically and ecologically important invasive species. Despite this critical knowledge gap, to date no successful known-fate study of wild piglet survival (< 5 months of age) has been





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conducted, due to a lack of appropriate method for this species. Aims. To aid in locating and tagging neonates, we piloted the use of vaginal implant transmitters (VITs) in adult wild pigs and evaluated average retention times of stud ear-tag transmitters, clip ear-tag transmitters, sutured and epoxied transmitters, harness transmitters, and surgically implanted transmitters to monitor known-fate survival of piglets.

Methods. We captured pregnant female pigs and implanted them with VITs. We tagged subsequently located neonates and piglets captured in traps with the aforementioned transmitters and monitored them to determine retention times and feasibility of each method. Key results. VITs were effectively used to determine the location and time of wild pig parturition, allowing counting and tagging of neonate wild pigs. Stud ear-tag and abdominal implant transmitters were well retained by piglets weighing ≥ 3 kg, in contrast to the other tested transmitters.

Conclusions. Stud ear-tag and abdominal implant transmitters allowed known-fate monitoring of juvenile wild pigs, although, of these, stud ear-tag transmitters may be more practical as they do not require field surgery on piglets. Due to their relatively large size, the stud ear tag transmitters were infeasible for monitoring of true neonates (similar to 1 kg); however, this application method may be suitable for neonates upon development of lighter-weight transmitters. The other transmitter attachment methods we tested were ineffective for monitoring of piglet survival, due to poor retention of transmitters.

Implications. The techniques piloted in this study will facilitate research into the reproductive ecology of wild pigs and known-fate studies of piglet mortality to aid in population modelling and evaluation of cause-specific mortality and factors affecting survival of these often-invasive animals.

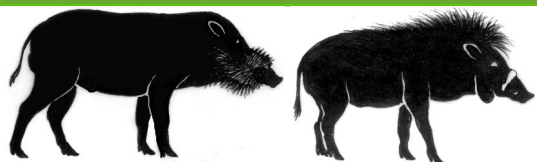
Dietary preference of European wild boar (*Sus scrofa* L.) grazing grass and legume at two contrasting plant heights: A pilot Study

Rivero, MJ; Gallardo, MA; Marnet, PG; Velasquez, A (2017)

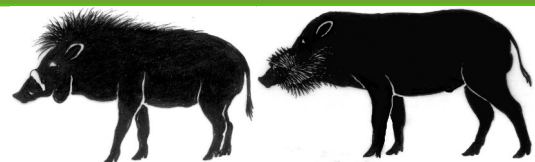
LIVESTOCK SCIENCE 200: 64-70

There were two objectives: checking a methodology to test diet preferences in a natural environment and secondly to assess diet preferences of European wild boar in terms of species and plant characteristics when offered in a situation with minimal physical constraints. Five hundred pots (100 mm upper diameter, 450 cc volume) were completely filled with soil. Half of the pots were sown with red clover (*Trifolium pretense*) and half with hybrid ryegrass (*Lolium hybridum* Hausskin). All pots were irrigated, periodically cut, and maintained outdoors. Then 220 leaves of ryegrass, 201 leaflets of clover and 188 petioles of clover were used to establish a relationship between plant structure dimensions and their dry matter mass. The preference study was conducted in a fenced area (18 m length and 11,1 m width) with a pasture cut to a height of 3 cm (lowest height possible to cover the soil). Four transects were marked separated 2 m from each other, and 16 holes within each transect were made 1 m apart, in which the pots were buried and anchored. Treatments consisted of the factorial combination of two plant species (red clover and hybrid ryegrass) and two plant heights (12 and 18 cm, tall and short, respectively), randomized within each transect (block). During three days, four nose-ringed wild boars grazed the experimental area for one hour and the treatments which they were grazing were recorded every two minutes. Plants structures were measured pre -and post-grazing from marked plants (green thread tied at the base) in each pot to detect consumption and to estimate the amount consumed. Strong correlations were found between plant structures and their dry mass (R² between 0,83 and 0,89). The methodology was able to show that more dry matter was apparently





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consumed from clover than ryegrass ($P < 0.001$) and clover had a greater probability of being grazed than ryegrass ($P < 0.05$). Also, the tall plants were consumed more than the short plants ($P < 0.001$) with individual tall plants having a higher probability of being grazed ($P < 0.05$). It is concluded that the novel method proposed was able to detect the diet preferences of wild boar during grazing. Additionally, in this study European wild boar discriminated between plant species and between plant heights, preferring legume over ryegrass and taller over shorter plants. However, more studies with a greater number of animals are necessary to validate these results.

An analysis of intrinsic and extrinsic factors affecting the activity of a nocturnal species:

The wild boar

Brivio, F; Grignolio, S; Brogi, R; Benazzi, M; Bertolucci, C; Apollonio, M (2017)

MAMMALIAN BIOLOGY 84: 73-81

Over the last century, the wild boar (*Sus scrofa*) has become an important wildlife species in both economic and ecological terms. Considered a pest by some and a resource by others, its rapid increase in population and distribution has raised management concerns. Studies on activity rhythms may provide useful insights into its overall ecology and help develop effective management strategies. By examining highly detailed activity data collected by means of accelerometers fitted on GPS-collars, we studied wild boar daily activity rhythms and the effect of environmental conditions on their diurnal and nocturnal activity. We thus provided evidence of the predominantly nocturnal and monophasic activity of wild boars. All year round, we reported low activity levels during the day, which opportunistically increased under the most favourable environmental conditions. Activity was found to be significantly affected by such weather conditions as temperature, precipitation and air relative humidity. Moreover, we found that nocturnal activity slightly increased as moonlight increased. Part of our analysis was focused on the hunting period in order to investigate whether wild boars modify their activity levels in response to hunting disturbance. Our results suggested that wild boar nocturnal habits are not directly influenced by the current hunting disturbance, though we hypothesised that they may have evolved over several decades of hunting harassment. Alternatively, but not exclusively, nocturnal habits may have evolved as a low-cost strategy to achieve an optimum thermal balance (i.e., behavioural thermoregulation).

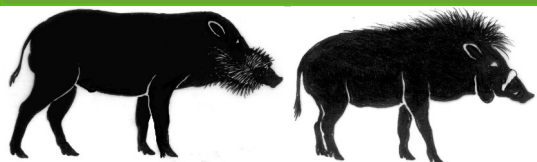
Behaviour of free ranging wild boar towards their dead fellows: potential implications for the transmission of African swine fever

Probst, C; Globig, A; Knoll, B; Conraths, FJ; Depner, K (2017)

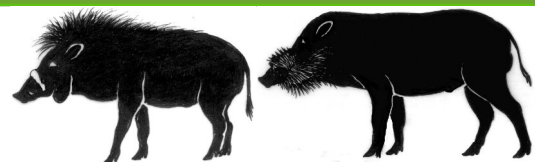
ROYAL SOCIETY OPEN SCIENCE 4(5)

The behaviour of free ranging wild boar (*Sus scrofa*) towards carcasses of their conspecifics potentially infected with African swine fever (ASF) may significantly influence the course of an ASF epidemic. This study aims to better understand the behaviour of wild boar towards their dead fellows. Thirty-two wild boar carcasses on nine study sites in northeast Germany were monitored under field conditions by photo-trapping from October 2015 until October 2016. During this period, a total of 122 160 pictures were taken, thereof 16 111 pictures of wild boar. In both winter and summer, wild boar seemed to be particularly interested in the soil next to and underneath the carcasses. About one third of the visits of wild boar led to direct contact with dead conspecifics. The contacts consisted mostly in sniffing and poking on the carcass. Under the given ecological and climatic conditions, there was no evidence for intra-species scavenging.





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However, piglets were observed several times chewing bare bones once skeletonization of the carcasses was complete. It must be assumed that all these types of contact may represent a risk of transmission. Both the high tenacity of ASF virus and the long time wild boar carcasses can remain in the environment, allow the persistence of the virus for several months or even years. We therefore consider the rapid detection and removal (or destruction on the spot) of contaminated carcasses as an important control measure against ASF in wild boar.

Wild boar impact on forest regeneration in the northern Apennines (Italy)

Bongi, P; Tomaselli, M; Petraglia, A; Tintori, D; Carbognani, M (2017)

Source: FOREST ECOLOGY AND MANAGEMENT 391: 230-238

The foraging activities of wild boar (*Sus scrofa* L.) have been suggested to impact biodiversity and ecological processes in a wide array of ecosystems. Data indicate that wild boar affects forest vegetation by feeding on above- and belowground plant parts, as well as by soil disturbance causing plant mortality and influencing seedling recruitment. In this paper, we investigated wild boar impacts on forest regeneration within three different types of mixed deciduous woodlands, respectively dominated by chestnut (*Castanea sativa*), Turkey oak (*Quercus cerris*) and beech (*Fagus sylvatica*) occurring in the northern Apennines (Italy), a mountain area where wild boar numbers have increased rapidly in recent decades. The goal of our study was to present a robust procedure targeted towards estimating wild boar impact on fruits predation and seedling survival of tree species. We evaluated the impact comparing wild boar excluding plots with completely access free ones. Differently from the majority of other experiments, we used replicated enclosure plots (by means of an electro-welded iron grid) excluding wild boars without excluding all other large ungulates such as deer and native small vertebrates. This method, tested with camera trapping surveys, was effective in reducing time spent by wild boar on experimental plots in comparison with other animals. Nevertheless, the number of fruit was similar in the enclosure plots and completely access free plots. Our study demonstrated, however, that wild boar feeds preferentially with the bigger fruits that are visually more attractive and have higher energetic potentialities too. The proportion of seedlings survived at the end of the period studied was significantly higher in wild boar excluding plots compared to those completely access free. Moreover, the dominant species were not equally influenced by the enclosure method, with chestnut and beech more markedly affected with respect to Turkey oak. Finally, the seedling survival of subordinate tree species, compared to the one of dominant plants, was reduced by the activity of wild boars in all the woodlands studied. This impact could lead to reduced tree species richness of the woodlands under study with negative effects on the biodiversity of plants and animals within these ecosystems.

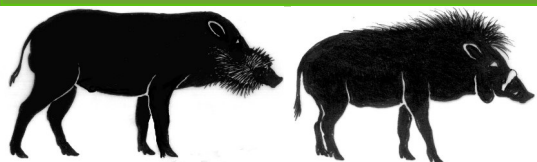
Wild inside: Urban wild boar select natural, not anthropogenic food resources

Stillfried, M; Gras, P; Busch, M; Borner, K; Kramer-Schadt, S; Ortmann, S (2017)

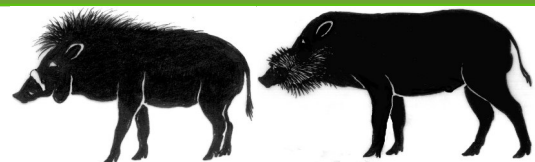
PLOS ONE 12 (4)

Most wildlife species are urban avoiders, but some became urban utilizers and dwellers successfully living in cities. Often, they are assumed to be attracted into urban areas by easily accessible and highly energetic anthropogenic food sources. We macroscopically analysed stomachs of 247 wild boar (*Sus scrofa*, hereafter WB) from urban areas of Berlin and from the surrounding rural areas. From the stomach contents we determined as predictors of food quality modulus of fineness (MOF), percentage of acid insoluble ash (AIA) and macronutrients such as





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amount of energy and percentage of protein, fat, fibre and starch. We run linear mixed models to test: (1) differences in the proportion of landscape variables, (2) differences of nutrients consumed in urban vs. rural WB and (3) the impact of landscape variables on gathered nutrients. We found only few cases of anthropogenic food in the qualitative macroscopic analysis. We categorized the WB into five stomach content categories but found no significant difference in the frequency of those categories between urban and rural WB. The amount of energy was higher in stomachs of urban WB than in rural WB. The analysis of landscape variables revealed that the energy of urban WB increased with increasing percentage of sealing, while an increased human density resulted in poor food quality for urban and rural WB. Although the percentage of protein decreased in areas with a high percentage of coniferous forests, the food quality increased. High percentage of grassland decreased the percentage of consumed fat and starch and increased the percentage of fibre, while a high percentage of agricultural areas increased the percentage of consumed starch. Anthropogenic food such as garbage might serve as fallback food when access to natural resources is limited. We infer that urban WB forage abundant, natural resources in urban areas. Urban WB might use anthropogenic resources (e.g. garbage) if those are easier to exploit and more abundant than natural resources. This study shows that access to natural resources still is mandatory and drives the amount of protein, starch, fat or fibre in wild boar stomachs in urban as well as rural environments.

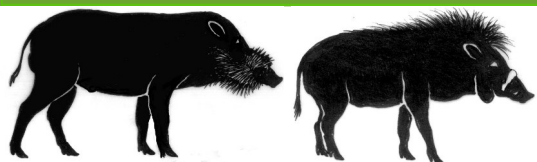
Insular East Asia pig dispersal and vicariance inferred from Asian wild boar genetic evidence

Li, KY ; Li, KT; Yang, CH; Hwang, MH; Chang, SW; Lin, SM; Wu, HJ; Basilio, EB; Vega, RSA; Laude, RP; Ju, YT (2017)

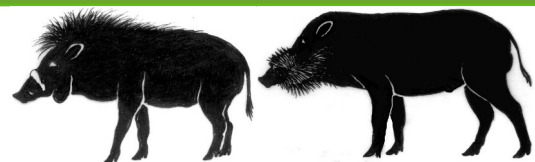
JOURNAL OF ANIMAL SCIENCE 95(4): 1451-1466

The Formosan wild boar (*Sus scrofa taiwanus*) is an endemic subspecies in Taiwan. Understanding the origins and spread of the Formosan wild boar could help clarify East Asian wild boar dispersion. Although in situ domestication of the wild boar occurred at a number of domestication centers across East Asia, corroborating archaeological and genetic evidence of pig domestication on Taiwan is lacking, leading to domestication being described as cryptic. This characterization applies to the Lanyu pig—a domestic pig breed found on Taiwan. To better understand pig domestication, this study examines the sympatric Formosan wild boar and domestic Lanyu pig to build a model of potential wild boar domestication on Taiwan and elucidate wild boar domestication patterns in the region. To this end, a comprehensive phylogenetic study of the Formosan wild boar and the Lanyu pig was conducted on animals sourced from Taiwan, Lanyu, and the Philippines. Phylogenetic analyses were conducted using full mitochondrial control-region sequences from 345 wild boars and domestic pigs. These were studied in concert with existing reports on 206 Asian wild boars. Genetic characteristics and Bayesian phylogenetic tree results identified 2 wild boar lineages of remote phylogenetic relationship. These were Formosan wild boar lineage (FWBL) and Formosan wild boar with Lanyu sign lineage (FWBLYL). Molecular clock analyses indicate that FWBLYL diverged earlier than other insular East Asia wild boars and show that FWBLYL and FWBL diverged approximately 0.60 million years ago. This result supports boars of FWBLYL being the earliest wild boars to have spread and become isolated in insular East Asia. In addition, the study proposes 6 Asian wild boar dispersion routes during glacial periods. At least 3 of these events occurred in insular East Asia with subsequent





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geographical isolation after glacial recession. This isolation potentially led to allopatric differentiation of wild boar subspecies. Also, the similar genetic signature and phylogenetic uniqueness of Lanyu pigs to wild boars of FWBLYL suggests such wild boars were the wild ancestor of domestic Lanyu pigs. This result indicates potential in situ domestication occurring on Taiwan. Finally, pigs possessing FWBLYL's genetic signatures were continuously distributed among Taiwan, Lanyu, and the Philippines. This pattern may signify human-mediated pig dispersal routes.

Landscape effects on wild boar home range size under contrasting harvest regimes in a human-dominated agro-ecosystem

Fattebert, J; Baubet, E; Slotow, R; Fischer, C (2017)

EUROPEAN JOURNAL OF WILDLIFE RESEARCH 63(2)

Agro-ecosystems can experience elevated human-wildlife conflicts, especially crop damage. While game management often aims at reducing number to mitigate conflicts, there is on-going debate about the role of hunting disturbance in promoting game to range over wider areas, thereby potentially exacerbating conflicts. Herein, we hypothesised that landscape configuration and non-lethal disturbance modulate the response to harvest disturbance. We used an information theoretic approach to test the effects of landscape and anthropogenic variables on wild boar ranging patterns across contrasting harvest regimes. We used 164 seasonal home ranges from 95 wild boar (*Sus scrofa*) radio-tracked over 6 years in the Geneva Basin where two main harvest regimes coexist (day hunt and night cull). Mean 95% kernel home range size was $4.01 \pm 0.20 \text{ km}^2$ (SE) and 50% core range size $0.79 \pm 0.04 \text{ km}^2$, among the smallest recorded in Europe. Range sizes were larger in the day hunt area than in the night cull area, with no seasonal effect. However, when accounting for landscape variables, we demonstrate that these patterns were likely confounded by the underlying landscape configuration, and that landscape variables remain the primary drivers of wild boar ranging patterns in this human-dominated agro-ecosystem with range size best explained by a model including landscape variables only. Therefore, we recommend accounting for landscape configuration and sources of non-lethal disturbance in the design of harvest strategies when the aim is to limit wide-ranging behaviour of wild boar in order to mitigate conflicts.

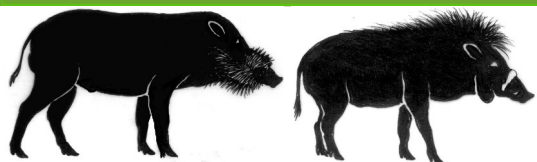
Reproductive allocation in pulsed-resource environments: a comparative study in two populations of wild boar

Gamelon, M; Focardi, S; Baubet, E; Brandt, S; Franzetti, B; Ronchi, F; Venner, S; Sther, BE; Gaillard, JM (2017)

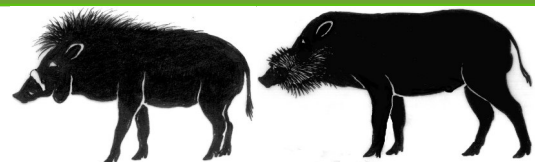
OECOLOGIA 183(4): 1065-1076

Pulsed resources influence the demography and evolution of consumer populations and, by cascading effect, the dynamics of the entire community. Mast seeding provides a case study for exploring the evolution of life history traits of consumers in fluctuating environments. Wild boar (*Sus scrofa*) population dynamics is related to seed availability (acorns/beechnuts). From a long-term monitoring of two populations subjected to markedly different environmental contexts (i.e., both low vs. high frequency of pulsed resources and low vs. high hunting pressure in Italy and in France, respectively), we assessed how pulsed resources shape the reproductive output of females. Using path analyses, we showed that in both populations, abundant seed availability increases body mass and both the absolute and the relative (to body mass) allocation to





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reproduction through higher fertility. In the Italian population, females equally relied on past and current resources for reproduction and ranked at an intermediate position along the capital-income continuum of breeding tactics. In contrast, in the French population, females relied on current more than past resources and ranked closer to the income end of the continuum. In the French population, one-year old females born in acorn-mast years were heavier and had larger litter size than females born in beechnut-mast years. In addition to the quantity, the type of resources (acorns/beechnuts) has to be accounted for to assess reliably how females allocate resources to reproduction. Our findings highlight a high plasticity in breeding tactics in wild boar females and provide new insight on allocation strategies in fluctuating environments.

Patterns of crop raiding by wild ungulates and elephants in Ramnagar Forest Division, Uttarakhand

Kumar, A; Bargali, HS; David, A; Edgaonkar, A (2017)

HUMAN-WILDLIFE INTERACTIONS 11(1): 41-49

Crop raiding is a major form of human-wildlife conflict that not only affects livelihoods of farmers living close to forest areas but also jeopardizes the objective of wildlife conservation. In this study, we report patterns associated with crop raiding based on periodic field inspections of 95 crop fields spread across 16 villages in India. Average raided area of the field was highest in seedling stage (21%). Fields closer to the forest edge incurred higher damage in the seedling (22%) and mature stages (7%) than fields farther from the forest edge, although this was not statistically significant. Guarding was found to be ineffective in decreasing crop raiding, with no statistical difference in the mean area of damage between guarded and unguarded fields. Cheetal (*Axis axis*), sambar (*Rusa unicolor*), nilgai (*Boselaphus tragocamelus*), and wild pig (*Sus scrofa*) were the main raiders in fields close to the forest edge whereas nilgai and wild pig were chief raiders in fields farther from the forest edge. Results of this study suggest that in the study area, wild pig and nilgai are more problematic species than elephants (*Elephas maximus*), which are reported to cause the most damage in other landscapes.

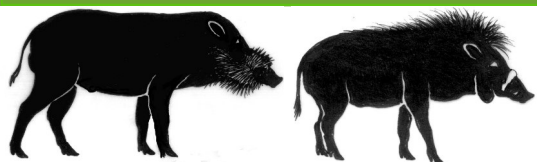
Spatio-temporal characteristics of crop damage caused by wild boar in north-eastern Poland

Bobek, B; Furtek, J; Bobek, J; Merta, D; Wojciuch-Ploskonka, M (2017)

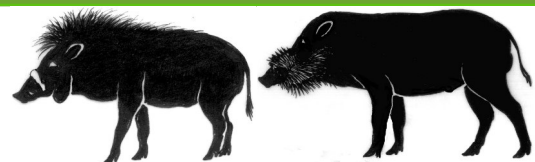
CROP PROTECTION 93: 106-112

Increasing wild boar damage to farmlands has resulted in a growing conflict between farmers and hunters in north-eastern Poland. The objective of this study was to evaluate wild boar crop damage and compensation as well as the fiscal balance of wild boar management over an area of 1867.2 km², with 27.4% fragmented forests. During 2011-2013, the total area of farmland damaged by wild boar (1365 cases) amounted to 1000.4 ha. In this period, farmers received 432,600 EUR as compensation for destruction of crops caused by wild boar. In the area of damaged crops, cereals predominated (50.2%), followed by grasslands (24.0%) and rapeseed (21.2%). The damage by wild boar was correlated with population density ($r = 0.648$), forest cover ($r = -0.514$) and distance to forest-farmland border ($r = 0.918$). The net income per year from wild boar hunting was EUR 163,100 whereas the compensation paid amounted to EUR 144,200. The issue of reducing the conflict between farmers and hunters through lowering the wild boar population density is discussed.





New literature on Suiformes



What does the wild boar mean to the wolf?

Mori, E ; Benatti, L; Lovari, S; Ferretti, F (2017)

EUROPEAN JOURNAL OF WILDLIFE RESEARCH 63(1)

Generalist predators are expected to shape their diets according to the local availability of prey species. In turn, the extent of consumption of a prey would be influenced by the number of alternative prey species. We have tested this prediction by considering the wild boar and the grey wolf: two widespread species whose distribution ranges overlap largely in Southern Europe, e.g. in Italy. We have reviewed 16 studies from a total of 21 study areas, to assess whether the absolute frequency of occurrence of wild boar in the wolf diet was influenced by (i) occurrence of the other ungulate species in diet and (ii) the number of available ungulate species. Wild boar turned out to be the main prey of the wolf (49% occurrence, on average), followed by roe deer (24%) and livestock (18%). Occurrence of wild boar in the wolf diet decreased with increasing usage of roe deer, livestock, and to a lower extent, chamois and red deer. The number of prey species did not influence the occurrence of wild boar in the wolf diet. The wild boar is a gregarious, noisy and often locally abundant ungulate, thus easily detectable, to a predator. In turn, the extent of predation on this ungulate may not be influenced so much by the availability of other potential prey. Heavy artificial reductions of wild boar numbers, e.g. through numerical control, may concentrate predation by wolves on alternative prey (e.g. roe deer) and/or livestock, thus increasing conflicts with human activities.

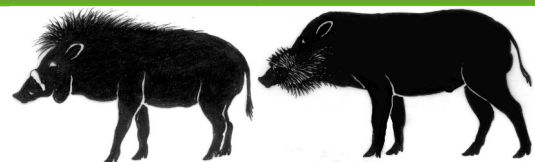
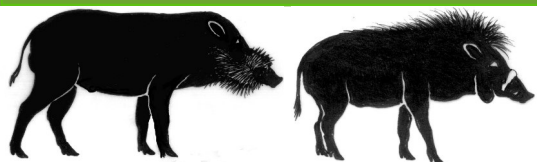
Do cities represent sources, sinks or isolated islands for urban wild boar population structure?

Stillfried, M; Fickel, J; Borner, K; Wittstatt, U; Heddergott, M; Ortmann, S; Kramer-Schadt, S; Frantz, AC (2017)

JOURNAL OF APPLIED ECOLOGY 54(1): 272-281

Urban sprawl has resulted in the permanent presence of large mammal species in urban areas, leading to human-wildlife conflicts. Wild boar *Sus scrofa* are establishing a permanent presence in many cities in Europe, with the largest German urban population occurring in Berlin. Despite their relatively long-term presence, there is little knowledge of colonization processes, dispersal patterns or connectivity of Berlin's populations, hampering the development of effective management plans. We used 13 microsatellite loci to genotype 387 adult and subadult wild boar from four urban forests, adjacent built-up areas and the surrounding rural forests. We applied genetic clustering algorithms to analyse the population genetic structure of the urban boar. We used approximate Bayesian computation to infer the boar's colonization history of the city. Finally, we used assignment tests to determine the origin of wild boar hunted in the urban built-up areas. The animals in three urban forests formed distinct genetic clusters, with the remaining samples all being assigned to one rural population. One urban cluster was founded by individuals from another urban cluster rather than by rural immigrants. The wild boar that had been harvested within urban built-up areas was predominantly assigned to the rural cluster surrounding the urban area, rather than to one of the urban clusters. Synthesis and applications. Our results are likely to have an immediate impact on management strategies for urban wild boar populations in Berlin, because they show that there are not only distinct urban clusters, but also ongoing source-sink dynamics between urban and rural areas. It is therefore essential that the neighbouring Federal States of Berlin and Brandenburg develop common hunting plans to control the wild boar population and reduce conflicts in urban areas.





Substantial Hybridisation Between Wild Boars (*Sus scrofa scrofa*) and East Balkan Pigs (*Sus scrofa f. domestica*) in Natural Environment As a Result of Semi-wild Rearing in Bulgaria

Nikolov, IS ; Stoeckle, BC; Markov, G; Kuehn, R (2017)

CZECH JOURNAL OF ANIMAL SCIENCE 62(1): 1-8

The East Balkan pig (EBP) is a traditional domestic pig breed in Bulgaria managed in semi-wild conditions and well-adapted to the continental climate and rearing on pastures. From the genetical and historical point of view it is important to preserve this ancient breed. However, over the last several years, a dramatic decline of EBP herds has been observed. Moreover, introgression between EBP and wild boar in Bulgaria (WBB) is very likely to have occurred. In this study we used a set of 10 microsatellites and the polymerase chain reaction-restriction fragment length polymorphism method on melanocortin-1 receptor (MC1R) polymorphisms to study the degree of hybridisation between WBB, EBP, and a commercial pig breed (CPB). MC1R results identified WBB-EBP hybrids and the analysis of the microsatellite data with a Bayesian assignment approach and the Discriminant Analysis of Principal Components revealed a low genetic differentiation between WBB and EBP and a high amount of introgression of WBB into EBP. A mentionable introgression of CPB into EBP was also revealed. It is apparent that the traditional rearing system of EBP, which is hundreds of years old, has led to a permanent hybridisation between WBB and EBP. In our opinion, the preservation of the semi-wild rearing system is a prerequisite for the conservation of this old, indigenous pig breed and its genetic composition, as the semi-wild rearing system allows the continuous introgression with WBB. Moreover, the introgression of commercial breeds into EBP or WBB should be prevented. Due to the bidirectional gene flow these hybridisation events would have negative consequences (i.e. loss of viability and adaptation) for the wild boars as well as for the indigenous pig breed.

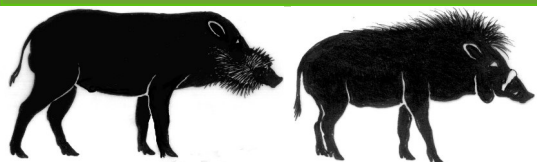
Hog Heaven? Challenges of Managing Introduced Wild Pigs in Natural Areas

Keiter, DA; Beasley, JC (2017)

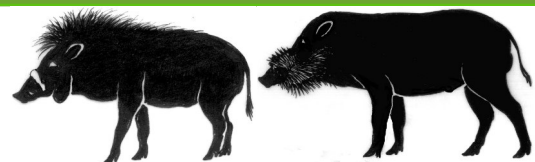
NATURAL AREAS JOURNAL 37(1): 6-16

The geographic distribution and size of wild pig (*Sus scrofa*) populations has rapidly expanded in recent years globally, resulting in increased impacts on natural and anthropogenic environments. In this review, we discuss the impacts of wild pigs on native ecosystems in terms of habitat degradation, competition with and depredation of native species, and disease transmission, and highlight recent developments in population control techniques, including areas where further research is required. We also provide an overview of many of the behavioral and demographic characteristics that make it difficult to control wild pigs and additional factors affecting the success of pig management programs in natural areas. Finally, based upon our review of contemporary research and successfully conducted pig eradication campaigns, we provide recommendations for the development of effective wild pig management programs. Overall, we recommend (1) managers implement strategies to detect wild pigs prior to the establishment of stable, breeding populations, (2) management strategies be tailored to specific regional habitat and climatic characteristics, and (3) control be implemented within an adaptive management framework, when possible, to allow further refinement of management objectives and improved characterization of the effects of wild pigs on natural areas.





New literature on Suiformes



Level and growth rate of wild boar populations in relation to forest cover, crop field size and maize occurrence in Poland in the years 1999-2014

Budny, M; Panek, M (2016)

SYLWAN 160(12): 1020-1026

The number of wild boars considerably increased in Poland at the beginning of the 21st century. We tested hypotheses that both the level of wild boar populations and rate of the increase in their numbers in Poland in the years 1999-2014 were dependent on some landscape factors, i.e. forest cover, crop field size and maize occurrence. Hunting bag was used as an index of wild boar abundance. The mean hunting bag of this species in the initial and final part of the study period was positively related to the forest cover and the mean size of farms (as an index of crop field size). In the final years also the occurrence of maize showed a positive effect (tab.). However, the index of wild boar bag growth rate decreased with the forest cover and the farm size. Higher increase in wild boar abundance occurred in regions characterized by lower forests share and fragmented crop fields, where the density of investigated species were lower than in regions with the mosaic of forests and large crop fields. The occurrence of maize significantly affected the growth rate index only in north-eastern part of the country (fig.). Our analysis showed that some evolution in wild boar landscape relations took place in the recent period. Such changes may lead to an increase in conflicts with agricultural economy caused by this species.

Wild boar battues reduce crop damages in a protected area

Gimenez-Anaya, A; Herrero, J; Garcia-Serrano, A; Garcia-Gonzalez, R; Prada, C (2016)

FOLIA ZOOLOGICA 65(3): 214-220

Agricultural damages caused by wild boar *Sus scrofa* have given farmers a negative impression of protected areas and their management. To mitigate those damages and the social conflicts that they create, hunting battues involving experienced local hunters were used as a lethal population control method in a protected Iberian wetland. In the Ebro Sotos and Galachos Nature Reserve, Spain, between 1994 and 2011, 259 wild boars were culled during 476 battues. On average, battues involved six hunters and ten dogs, and culling efficiency (number of animals killed per animals seen during battues) was 39 %. The number of battues per year and the area of crop damages caused by wild boar were significantly negatively correlated, demonstrating battue efficiency to decrease damages. Moreover, intermittent population control through culling led to a Substantial increase in the wild boar population, with an increase in crop damages. This underlines the importance of constant control. The numbers of hunters and dogs and the number of wild boar seen during battues were strongly correlated. To minimize the conflicts between farmers and the management of protected areas, we suggest that the inexpensive, volunteer-based population control program could be enhanced by incorporating stalking and mobile electric fences.

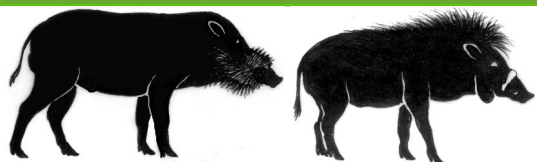
The Demographic Pattern of Wild Boars (*Sus scrofa*) Inhabiting Fragmented Forest in North-Eastern Poland

Albrycht, M; Merta, D; Bobek, J; Ulejczyk, S (2016)

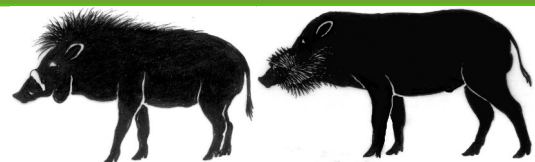
BALTIC FORESTRY 22(2): 251-258

The high density of wild boar populations in the farmland-forest landscape on north-eastern Poland has resulted in crop damage and conflict with farmers. Any effective harvest plan has to





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consider the population demography. Therefore, the objective of the study was to estimate the age-sex structure and reproduction in the population of wild boars inhabiting an area of 1,310 km², where the share of fragmented forest amounted to 26.8 %. The study material consisted of 234 wild boars harvested during drive hunting between October and mid-January from 2012 to 2014. Among the animals harvested there were 63.3 % piglets, 15.8 % of yearlings and 20.9 % older individuals. The differences in carcass mass (CM) and in kidney fat index (KFI) between piglets and yearlings and between yearlings and adults were statistically significant, both of males and females. The sex ratio was male-biased in piglets (1:0.78) but in the cumulated group of yearlings and adult females predominated (1:1.53). In 117 studied females, the percentage share of pregnant individuals was 39.3 % and the mean size of litter was 5.2 +/- 0.29. All pregnant female piglets were aged 9-12 months and had significantly higher CM (37.6 +/- 2.30 kg vs. 29.6 +/- 1.82 kg) and KFI (1.67 +/- 0.06 vs. 1.35 +/- 0.05) than not pregnant ones. The farrowing took place in all months of the year except October. More than half of the piglets (57.4 %) were born in March, April and May. The harvest strategy to reduce the population density of wild boar in the study area is discussed.

Crop raiding by wild mammals in Ethiopia: impacts on the livelihoods of smallholders in an agriculture-forest mosaic landscape

Ango, Tola Gemechu; Borjeson, Lowe; Senbeta, Feyera (2017)

ORYX 51(3): 527-537

We assessed the impacts of crop raiding by wild mammals on the livelihoods of smallholding farmers in south-western Ethiopia. Data were generated through participatory field mapping, interviews and focus groups. The results indicated that wild mammals, mainly olive baboons *Papio anubis* and bush pigs *Potamochoerus larvatus*, were raiding most crops cultivated in villages close to forests. In addition to the loss of crops, farmers incurred indirect costs in having to guard and cultivate plots far from their residences, sometimes at the expense of their children's schooling. Raiding also undermined farmers' willingness to invest in modern agricultural technologies. Various coping strategies, including guarding crops and adapting existing local institutions, were insufficient to reduce raiding and its indirect impacts on household economies to tolerable levels, and were undermined by existing policies and government institutions. It is essential to recognize wild mammal pests as a critical ecosystem disservice to farmers, and to identify ways to mitigate their direct and indirect costs, to facilitate local agricultural development and livelihood security, and integrate wildlife conservation and local development more fully in agriculture-forest mosaic landscapes.

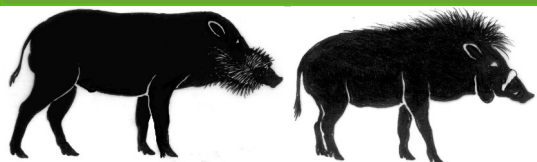
Does variation between dry and wet seasons affect tropical forest mammals' occupancy and detectability by camera traps? Case study from the Udzungwa Mountains, Tanzania

Martin, Emanuel H.; Ndibalema, Vedasto G.; Rovero, Francesco (2017)

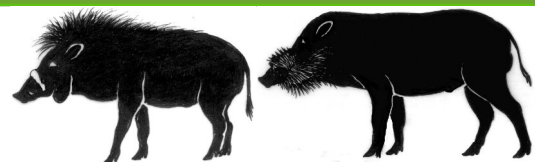
AFRICAN JOURNAL OF ECOLOGY 55(1): 37-46

The increasing use of camera trapping coupled to occupancy analysis to study terrestrial mammals has opened the way to inferential studies that besides estimating the probability of presence explicitly consider detectability. This in turn allows considering factors that can potentially confound the estimation of occupancy and detection probability, including seasonal variations in rainfall. To address this, we conducted a systematic camera trapping survey in the Udzungwa Mountains of Tanzania by deploying twenty camera traps for 30 days in dry and wet





New literature on Suiformes



seasons and used dynamic occupancy modelling to determine the effect of season on estimated occupancy and detection probability for species with >10 capture events. The sampling yielded 7657 and 6015 images in dry and wet seasons, respectively, belonging to 21 mammal species. Models with no season dependency and with season-dependent detectability were best supported, indicating that neither colonization nor extinction varied with seasons and hence occupancy did not vary. Only bush pig (*Potamochoerus larvatus*) showed a significant decrease in detectability from dry to wet seasons. Our study indicates that seasonal variation in rainfall may have limited effect on occupancy and detectability of resident mammals in Udzungwa rainforests; however, it remains a factor to consider when designing future studies.

Occupancy and demographics of red river hog *Potamochoerus porcus* on Tiwai Island, Sierra Leone

McCollum, Kathryn R.; Conway, April L.; Lee, Myung-Bok; et ál.. (2017)

AFRICAN JOURNAL OF ECOLOGY 55(1): 47-55

The red river hog (*Potamochoerus porcus*, Linnaeus) is a species of Suidae with populations ranging from western to central Africa. Little is known about the population status of red river hog, and few studies have investigated habitat characteristics associated with their occupancy which is critical in determining possible reasons behind suspected population declines. We used camera traps and site occupancy models to examine the effects of habitat covariates on occupancy of red river hog on Tiwai Island and in surrounding forests of Sierra Leone during two field seasons, 2008-2011. We also estimated group size and composition and growth patterns of juveniles. In both sampling periods, understory vegetation strongly influenced red river hog occupancy with greatest association with riparian and swamp vegetation types. Red river hogs seemed to avoid habitats of high human impact such as farmbrush and secondary growth forests. Average group size was 2.46 +/- 0.28 (SE) hogs per group. Growth patterns of juveniles suggested the majority of piglets were born during the middle of dry season (January-February). Our research suggests landscape use by red river hog is influenced by presence of riparian habitats with dense vegetation.

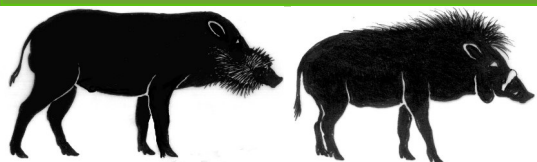
Assessment of mammal reproduction for hunting sustainability through community-based sampling of species in the wild

Mayor, Pedro; El Bizri, Hani; Bodmer, Richard E.; et ál..(2017)

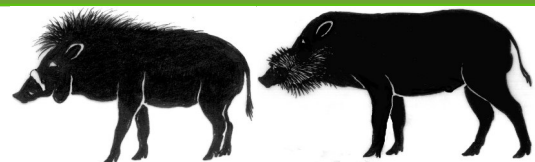
CONSERVATION BIOLOGY 31(4): 912-923

Wildlife subsistence hunting is a major source of protein for tropical rural populations and a prominent conservation issue. The intrinsic rate of natural increase. ($r(\max)$) of populations is a key reproductive parameter in the most used assessments of hunting sustainability. However, researchers face severe difficulties in obtaining reproductive data in the wild, so these assessments often rely on classic reproductive rates calculated mostly from studies of captive animals conducted 30 years ago. The result is a flaw in almost 50% of studies, which hampers management decision making. We conducted a 15-year study in the Amazon in which we used reproductive data from the genitalia of 950 hunted female mammals. Genitalia were collected by local hunters. We examined tissue from these samples to estimate birthrates for wild populations of the 10 most hunted mammals. We compared our estimates with classic measures and considered the utility of the use of $r(\max)$ in sustainability assessments. For woolly monkey (*Lagothrix poeppigii*) and tapir (*Tapirus terrestris*), wild birthrates were similar to those from





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captive populations, whereas birthrates for other ungulates and lowlandpaca (*Cuniculus paca*) were significantly lower than previous estimates. Conversely, for capuchin monkeys (*Sapajus macrocephalus*), agoutis (*Dasyprocta* sp.), and coatis (*Nasua nasua*), our calculated reproductive rates greatly exceeded often-used values. Researchers could keep applying classic measures compatible with our estimates, but for other species previous estimates of $r(\max)$ may not be appropriate. We suggest that data from local studies be used to set hunting quotas. Our maximum rates of population growth in the wild correlated with body weight, which suggests that our method is consistent and reliable. Integration of this method into community-based wildlife management and the training of local hunters to record pregnancies in hunted animals could efficiently generate useful information of life histories of wild species and thus improve management of natural resources.

The defensive behavioral patterns of captive white-lipped and collared peccary (Mammalia, Tayassuidae): an approach for conservation of the species

Nogueira, Selene S. C.; Reis, Aline M.; Marsaro, Stefane G.; et ál.. (2017)

ACTA ETHOLOGICA 20(2): 127-136

Defensive behavioral patterns in response to human-induced rapid environmental change can affect animals' fitness and may play a role in species conservation status. To test this hypothesis, we compared the risk assessment and defensive behavioral responses of captive white-lipped peccary (WLP; *Tayassu pecari*) and collared peccary (CP; *Pecari tajacu*), which retain different conservation status; WLP are considered vulnerable and CP of least concern. We used an adapted paradigm of the mouse defense test battery (MDTB) comprising four consecutive tests. Two of these tests simulated a novel environment, while the other two stimulated the expression of defensive behavioral patterns. Besides differences in risk assessment and defensive threat/attack behavioral patterns between species, we compared flight initiation distance, flight speed, and plasma glucocorticoid concentrations. When facing a novel environment and risk challenges from humans' predator-like cues, the white-lipped peccary showed more exploratory and defensive threat/attack behavioral patterns, shorter flight initiation distances, and lower flight speeds, whereas the collared peccaries showed more cautious and retreat patterns, longer flight initiation distances, and higher flight speeds. There were also correlations between physiological and behavioral parameters. We confirmed our hypothesis that the collared peccary's cautiousness may help to prevent a decrease in its population, while the white-lipped peccary's exploratory and confrontational behavioral patterns in overhunted areas, together with other simultaneous factors as forest fragmentation, might contribute to placing this species in the vulnerable category.

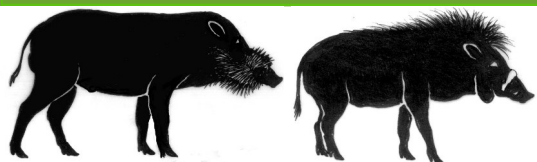
Using indigenous knowledge to link hyper-temporal land cover mapping with land use in the Venezuelan Amazon: "The Forest Pulse"

Olivero, Jesus; Ferri, Francisco; Acevedo, Pelayo; et ál..(2016)

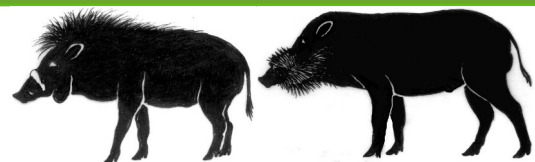
REVISTA DE BIOLOGIA TROPICAL 64(4): 1661-1682

Remote sensing and traditional ecological knowledge (TEK) can be combined to advance conservation of remote tropical regions, e.g. Amazonia, where intensive in situ surveys are often not possible. Integrating TEK into monitoring and management of these areas allows for community participation, as well as for offering novel insights into sustainable resource use. In this study, we developed a 250 m resolution land-cover map of the Western Guyana Shield





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(Venezuela) based on remote sensing, and used TEK to validate its relevance for indigenous livelihoods and land uses. We first employed a hyper-temporal remotely sensed vegetation index to derive a land classification system. During a 1300 km, eight day fluvial expedition in roadless areas in the Amazonas State (Venezuela), we visited six indigenous communities who provided geo-referenced data on hunting, fishing and farming activities. We overlaid these TEK data onto the land classification map, to link land classes with indigenous use. We characterized land classes using patterns of greenness temporal change and topo-hydrological information, and proposed 12 land-cover types, grouped into five main landscapes: 1) water bodies; 2) open lands/forest edges; 3) evergreen forests; 4) submontane semideciduous forests, and 5) cloud forests. Each land cover class was identified with a pulsating profile describing temporal changes in greenness, hence we labelled our map as "The Forest Pulse". These greenness profiles showed a slightly increasing trend, for the period 2000 to 2009, in the land classes representing grassland and scrubland, and a slightly decreasing trend in the classes representing forests. This finding is consistent with a gain in carbon in grassland as a consequence of climate warming, and also with some loss of vegetation in the forests. Thus, our classification shows potential to assess future effects of climate change on landscape. Several classes were significantly connected with agriculture, fishing, overall hunting, and more specifically the hunting of primates, *Mazama americana*, *Dasyprocta fitliginosa*, and *Tayassu pecari*. Our results showed that TEK-based approaches can serve as a basis for validating the livelihood relevance of landscapes in high-value conservation areas, which can form the basis for furthering the management of natural resources in these regions.

New records of the Endangered Chacoan peccary *Catagonus wagneri* suggest a broader distribution than formerly known

Torres, Ricardo; Tamburini, Daniela; Lescano, Julian; et ál.. (2017)
ORYX 51(2): 286-289

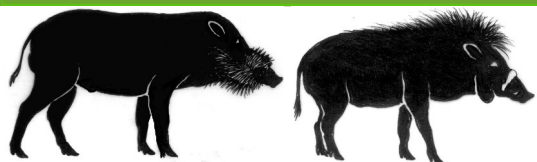
The Chacoan peccary *Catagonus wagneri* is the rarest and most threatened of the three extant species of peccary. Its presence has been recorded in the northern Dry Chaco ecoregion, which spans northern Argentina, western Paraguay and south-eastern Bolivia. However, distribution models based on its occurrence in Argentina have predicted that suitable habitat extends southwards into central Argentina, where the species was not previously recorded. We present several records of the species outside the currently accepted distribution, including the first two records in the west of Cordoba province, > 650 km south of the southern limit of the previously known distribution. The discovery of the Chacoan peccary in central Argentina could serve as a justification for the protection of Chacoan forests in this region, where deforestation rates are among the highest worldwide.

Distributional patterns of living ungulates (Mammalia: Cetartiodactyla and Perissodactyla) of the Neotropical region, the South American transition zone and Andean region

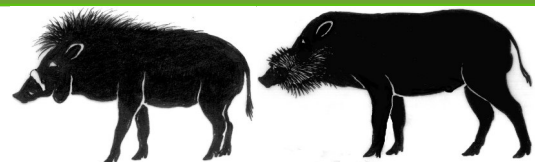
Absolon, Bruno Araujo; Gallo, Valeria; Avilla, Leonardo S. (2016)
JOURNAL OF SOUTH AMERICAN EARTH SCIENCES 71(SI): 63-70

To recognize the distributional patterns of living ungulates in the Neotropical region, the South American transition zone, and Andean region using the panbiogeographical method of track analysis, and to attempt to correlate these patterns with geological history. The distribution of 24 species of living ungulates (in the families Camelidae, Cervidae, Tapiridae and Tayassuidae) was





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studied by the pan biogeographical method of track analysis. It was performed using distributional data acquired from literature and databases of scientific institutions. Individual tracks were obtained for each species by plotting locality records on maps and connecting them by minimum-spanning trees. Generalized tracks were determined from the spatial overlap between individual tracks, indicating a common history. The intersection between generalized tracks defined a biogeographic node, implying that these locations are biogeographic composites resulting from different ancestral biotas coming into spatial contact, possibly at different geologic times. The superposition of the 24 individual tracks resulted in five generalized tracks (GT5): GT1, Mesoamerican/Choco (composed of *Mazama pandora*, *Mazama temama*, *Odocoileus virginianus* and *Tapirus bairdii*); GT2, Northern Andes (*Mazama rufina*, *Pudu mephistophiles* and *Tapirus pinchaque*); GT3, Central Andes (*Hippocamelus antisensis*, *Lama guanicoe*, *Mazama chunyi* and *Vicugna vicugna*); GT4, Chilean Patagonia (*Hippocamelus bisulcus* and *Pudu puda*); and GT5, Chaco/Central west Brazil (*Blastocerus dichotomus*, *Catagonus wagneri* and *Ozotocerus bezoarticus*). The biogeographic node was found in the Northwestern Colombia. The geological events such as tectonism and volcanism that occurred through the Neogene and mainly in the Pleistocene caused fragmentation, diversification and endemism of biota. The biogeographic node in Colombia occurred within a zone of convergence. This node emphasized the complexity of the area and it contains biotic elements with different origins, which represent a special condition for the establishment of priority conservation areas.

Good news from north-central Africa: largest population of Vulnerable common hippopotamus *Hippopotamus amphibius* is stable

Scholte, P; Nguimkeng, F; Iyah, E (2017)

ORYX 51(2) 218-

North-central Africa (i.e. Cameroon, the Central African Republic and Chad) once held important populations of large mammals, including the hippopotamus *Hippopotamus amphibius*. Exports of hippopotamus trophies from Cameroon were suspended in 2012 but the species' status and population trends remain poorly known. Using the same methodology as in 2000 and 2008, we counted hippopotamuses in Faro National Park and bordering hunting zones in 2014. We counted 685 individuals along 97 km of river, compared with 647 and 525 in 2000 and 2008, respectively. The stability of this population contrasts with the declines in populations of large mammals across northcentral Africa. We attribute this conservation success to private efforts (i.e. safari hunting) compensating for a decline in state protection. However, the situation remains fragile, as highlighted by an influx of transhumant cattle and gold diggers. We recommend increasing public-private conservation efforts, including incentives for the safari hunting industry, which is also under pressure.

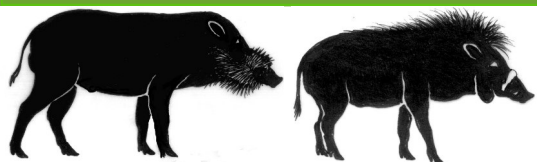
Preventing crop raiding by the Vulnerable common hippopotamus *Hippopotamus amphibius* in Guinea-Bissau

Gonzalez, LM; Montoto, FGD; Mereck, T; Alves, J; Pereira, J; de Larrinoa, PF; Maroto, A; Bolonio, L; El-Kadhir, N (2017)

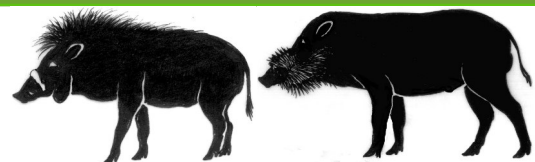
ORYX 51 (2): 222-229

Guinea-Bissau is host to the westernmost subpopulation of the common hippopotamus *Hippopotamus amphibius*, which is one of only two known populations inhabiting coastal waters. The presence of hippopotamuses causes conflict with rice farmers as a result of crop damage





New literature on Suiformes



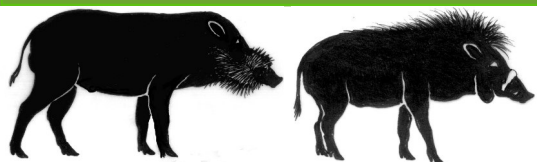
and the absence of effective measures to protect crops. To develop an effective method for protecting rice fields, we studied the patterns of access to flooded and rain-fed rice fields by hippopotamuses and assessed the effect of the installation of electric fences. Hippopotamuses were detected in 54% of the flooded fields (n = 100) and in 31.9% of the rain-fed fields (n = 91). They were detected more frequently in fields on offshore islands than on the mainland, in unfenced than in fenced fields, and in fields closer to running water. Hippopotamuses entered fenced flooded fields less frequently than unfenced, and were detected most frequently at the end of the rainy season and the start of the dry season, and in the period of vegetative stem growth. Electric fences were an effective deterrent and facilitated increased rice production. The maintenance and cost of the electric fencing were acceptable to farmers, and therefore the use of such fencing is recommended to resolve the conflict between hippopotamuses and farmers in Guinea-Bissau and in other areas with similar conditions.

A mix of community-based conservation and protected forests is needed for the survival of the Endangered Pygmy hippopotamus *Choeropsis liberiensis*

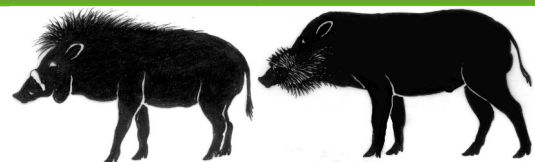
Hillers, A; Buchanan, GM; Garteh, JC; Tommy, SM; Fofana, ML; Lindsell, JA (2017)
ORYX 51(2): 230-239

The contribution of protected areas to biodiversity conservation is well attested but many taxa in many regions remain dependent on the unprotected wider landscape. To develop conservation plans for large mammals such as the Endangered pygmy hippopotamus *Choeropsis liberiensis* of West Africa's Upper Guinea Forests it is critical to understand the importance of unprotected land. Despite being a conservation priority, little is known about the habitat associations of this species, or its distribution across its range. Through a combination of field surveys, species distribution models and community questionnaires we investigated the use of unprotected areas by the pygmy hippopotamus in the Sierra Leone-Liberia border region. We found signs of the species in 128 of 525 1-km² cells surveyed. Our analysis suggested that the species is reasonably widespread in this region and is associated with major rivers. It occurred close to, but rarely within, large areas of intact forest, and 80.4% of pygmy hippopotamus signs were recorded outside protected areas. The expansion of the protected area network in this area is unrealistic in Sierra Leone and to some extent in Liberia, mainly because of anthropogenic pressure and the overlap of proposed protected areas with mining and logging concessions. Thus pygmy hippopotamus conservation activities in the region need to include programmes on community lands while maintaining a robust network of protected forests. Community-based conservation of the pygmy hippopotamus may prove valuable for other threatened and endemic species that are not confined to protected areas in this region.



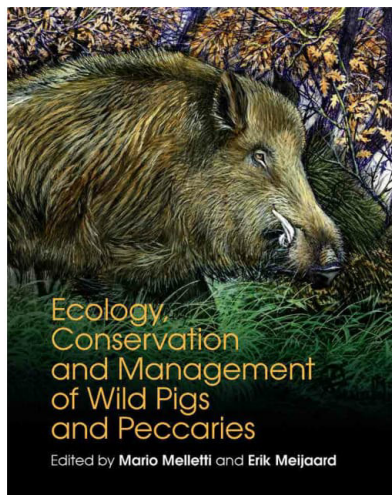


New books about Suiformes



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Ecology, Conservation and Management of Wild Pigs and Peccaries

Edited by:
Mario Melletti and Erik Meijaard

Covering all wild pig and peccary species, this forthcoming volume brings together the contributions of 100 international experts on the ecology, conservation status and management of the Suidae and Tayassuidae families providing:

- A comprehensive review of current knowledge on evolution, taxonomy and domestication of wild pigs and peccaries (chapters 1-5).
- A complete understanding of the ecology and conservation of each species and the gaps in our current knowledge (chapters 6 to 25).
- A number of case studies on conservation activities and management of wild and feral pigs (chapters 26 to 38).

An invaluable resource for students, researchers, and professionals in conservation biology, evolutionary biology, disease ecology and management, this beautifully illustrated reference work reveals the fascinating long history of interactions between wild pigs and humans, the benefits some of these species have brought us, and their role and impact on natural ecosystems.

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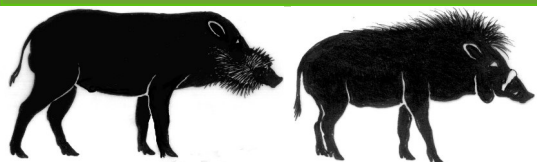
Cambridge University Press, University Printing House, Shaftesbury Road CB2 8BS

Foreword: Don E. Wilson; **Introduction:** Erik Meijaard and Mario Melletti; **Part I. Evolution, Taxonomy and Domestication:** 1. Evolutionary relationships and taxonomy of Suidae and Tayassuidae. Jaime Gongora, Colin Groves, Erik Meijaard; 2. Postcranial skeletal morphology in living and fossil African Suidae. Laura C. Bishop; 3. Diet and ecology of extant and fossil wild pigs. Antoine Souron; 4. A history of pig domestication: New ways of exploring a complex process. Evin Allowen, Keith Dobney, Thomas Cucchi; 5. Space, time and pig. David J. Nemeth. **Part II. Species Accounts:** 6. Sulawesi Babirusa. Alastair A. Macdonald; 7. Moluccan Babirusa. Sheherazade, Eka Hesdianti, Mochamad Indrawan; 8. Togian Babirusa. Ito Masaaki and Mario Melletti; 9. Common Warthog. Thomas M. Butynski and Yvonne A. de Jong; 10. Desert Warthog. Yvonne A. de Jong and Thomas M. Butynski; 11. Forest Hog. Rafael Reyna Hurtado, Jean-Pierre d'Huart, Andrea Turkalo; 12. Bushpig. Armin H. W. Seydack; 13. Red River Hog. Mario Melletti, Thomas Breuer, Brent A. Huffman, Andrea K. Turkalo, Marzia Mirabile, Fiona Maisels; 14. Visayan Warty Pig. Mario Melletti, Erik Meijaard and Lidia Przybylska; 15. Philippine Warty Pig. Erik Meijaard and Mario Melletti; 16. Mindoro Warty Pig. Geoff Tabaranza, Emmanuel Schütz, Juan Carlos T. Gonzalez, Leticia M. Espiritu-Afuang; 17. Palawan Bearded Pig. Peter Widmann; 18. Bearded Pig. Matthew S. Luskin and Alison Ke; 19. Sulawesi Warty Pig. James A. Burton, Abdul Haris Mustari, Ikeu Sri Rejeki; 20. Javan/Bawean Warty Pig. Eva Johanna Rode-Margono, Mark Andreas Rademaker, Gono Semiadi, Stephan Bulk; 21. Eurasian Wild Boar. Oliver Keuling, Tomasz Podgórski, Andrea Monaco, Mario Melletti, Dorota Merta, Marzena Albrycht, Peter V. Genov, Friederike Gethoffer, Ferran Jori, Sebastian Vetter, Riccardo Scalera, Jaime Gongora; 22. Pygmy Hog. Goutam Narayan and Parag Jyoti Deka; 23. Chacoan Peccary. Mariana Altrichter, Harald Beck, Jaime Gongora, Alexine Keuroghlian, Rafael Reyna Hurtado; 24. Collared Peccary. Rafael Reyna Hurtado, Alexine Keuroghlian, Mariana Altrichter, Harald Beck, Jaime Gongora; 25. White-lipped Peccary. Harald Beck, Alexine Keuroghlian, Rafael Reyna Hurtado, Mariana Altrichter, Jaime Gongora; **Part III. Conservation and Management:** 26. Conservation of wild pigs and peccaries. Alexine Keuroghlian, Rafael Reyna Hurtado, Erik Meijaard, Mariana Altrichter, Harald Beck, Jaime Gongora; 27. Modelling pygmy hog habitat to inform habitat management. Janani Pradhan and Erik Meijaard; 28. Introduced wild pigs in North America: history, problems and management. John J. Mayer; 29. Biological invasion of wild boar and feral pigs *Sus scrofa* L. (Suidae) in South America: a review and mapping with implications for conservation of peccaries (Tayassuidae). Carlos Henrique Salvador and Fernando Fernandez; 30. Feral pigs in Australia and New Zealand: range, trend, management and impacts of an invasive species. Andrew Bengsen, Peter West, Cheryl Krull; 31. Wild boar management in Europe: knowledge and practice. Andrés Náhlik, Sean Cahill, Sandra Cellina, János Gál, Ferenc Jánoska, Carme Rosell, Sophie Rossi, Giovanna Massei; 32. Resolving conflict between farmers and wild boar in Europe and in Northern Asia. Bogusław Bobek, Jakub Furtek, Nikolay Markov, Dorota Merta, Marta Wojciuch Płoskonka, Michał Wójcik, Ulf Hohmann; 33. Human dimensions of wild boar: the need to include people in decision making processes. Beatrice Frank; 34. A genomic perspective about wild boar demography and evolution. Marcel Amills Eras, Hendrik-Jan Megens, Arianna Manunza, Sebastián E. Ramos-Onsins, Martien Groenen; 35. Disease transmission at the interface between wild and domestic Suiform species in the Old and New world. Ferran Jori, Arian Payne, Richard Kock, Alessandra Nava, Karl Ståhl, Sophie Rossi; 36. Ecological impact of wild boar in natural ecosystems. Peter V. Genov, Stefano Focardi, Federico Morimando, Laura Scillitani, Atidzhe Ahmed; 37. Ex situ conservation of wild pigs and peccaries: roles, status, management successes and challenges. Kristin Leus. 38. Antimicrobial resistance in wild boar in Europe: present knowledge and future challenges. Rita Tinoco Torres, Mónica V. Cunha, Tânia Caetano, Sónia Mendo, Emmanuel Serrano, Carlos Fonseca **Illustrators:** Francesco Rinaldi and Luciano Toma. **IUCN distribution maps:** Daniele Baisero

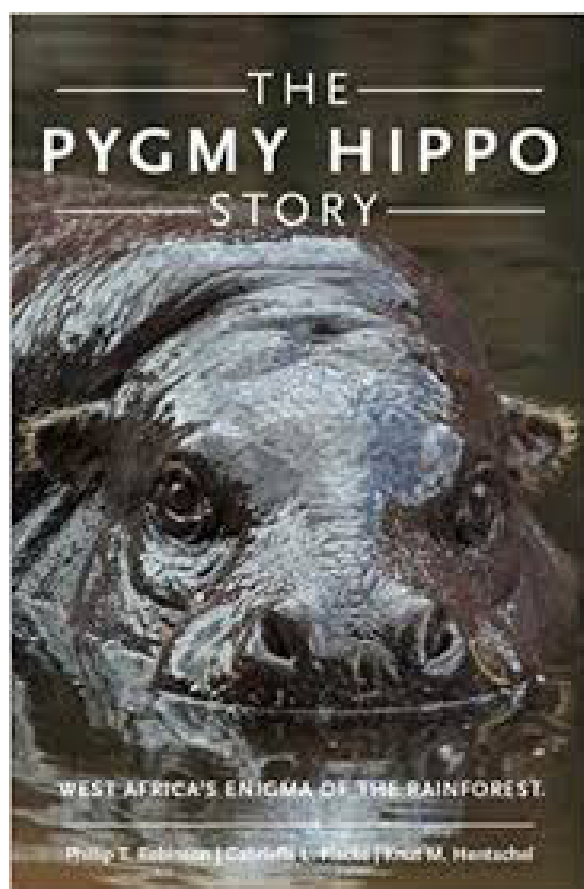
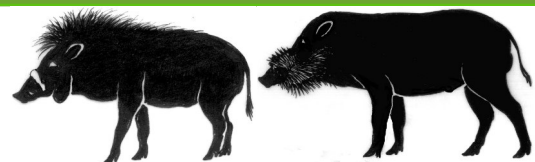


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New books about Suiformes



The Pygmy hippo is one of the large mammals we have the biggest lack of knowledge about. After its scientific description in 1844 only few scientists were able to observe it in its natural habitat in the Upper Guinean forests. This book, written by Phillip T. Robinson, Gabriella L. Flacke and Knut M. Hentschel is the first monograph of “West Africa’s enigma of the rainforest”. It presents the most comprehensive description of this species.

It is separated into five parts:

Part 1 deals with the discovery of the species, the history of the research about it and the first captures of Pygmy hippos. This part comprises descriptions of the hippo’s morphology, physiology and behaviour and hippos in popular culture and folklore. Early observations are cited. One chapter deals with all what is known about the extinct subspecies *heslopi*, which once lived in the Niger Delta in Nigeria. Further chapters deal with the activities of Hans Schomburgk, a famous game hunter and trapper and with Frans Van den Brink, the most successful trapper of Pygmy hippos.

The second part deals with the challenges, scientists and conservationists. The authors write about their experiences working in Sierra Leone, Liberia and in the Ivory Coast. They tell about their adventures, the conflicts and problems they faced and had to solve in these countries. This part is the greatest and most impressive part of the book. The author’s personal impressions and experiences make this book more than an exclusively scientific book. It is interesting to read about all the problems they had to endure. They take us to remote rainforests and show the difficulties of scientific field work but also share the magical moments after all the troubles.

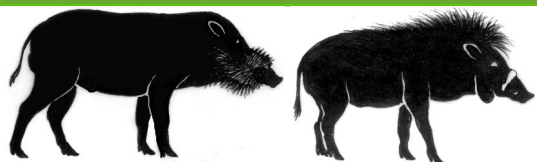
The third part is about the Upper Guinean Rainforests, the flora and fauna of the hippo forests, details of pygmy hippos feeding biology, about local hunters as guides, a comparison of pygmy hippos with their bigger relative the Common hippopotamus and about the scientific knowledge derived from observations and experiences with pygmy hippos in captivity.

Sierra Leone and Liberia had to suffer some of the most barbarous civil wars in the last decades. The fourth part of the book tells about the authors’ experiences in conservation work made during these potentially dangerous times. Again, this book is much more than just a scientific monograph but also a remarkable report about the civil wars.

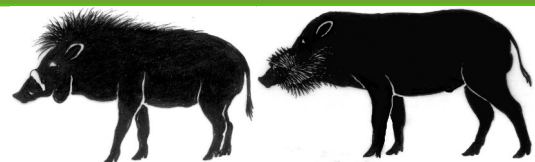
The last part of the book is about conservation of pygmy hippos, long lasting and new problems for the survival of this species. The Ebola crisis in Guinea, Sierra Leone and Liberia from 2014 to 2016 has taken a huge toll not only on the people of these countries but also on their economy. These countries will need several years to overcome the poverty problems which became even more severe during the Ebola crisis.

Overall, this book is the most up-to-date scientific and most comprehensive book about pygmy hippos. The combination with the personal experiences and challenges of scientific and





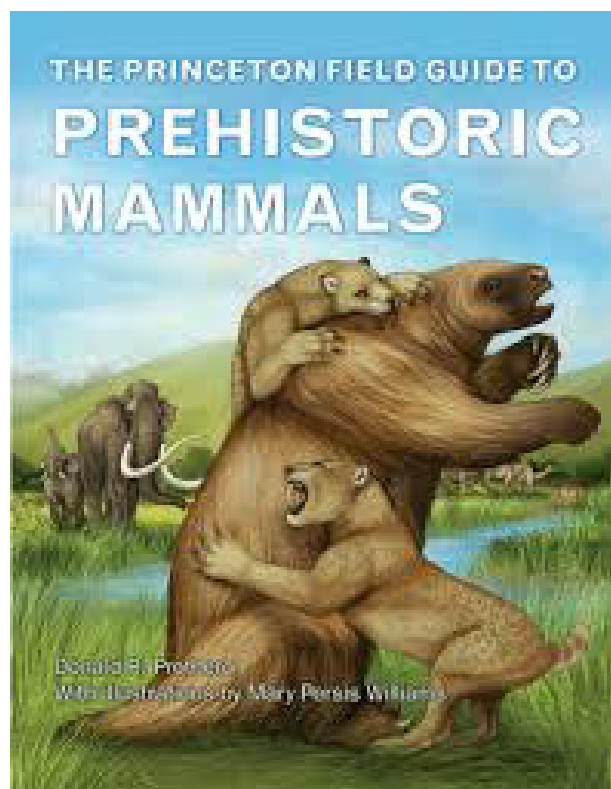
New books about Suiformes



conservation work is quite unique. Therefore, not only people who are interested in hippos should read it but also those who are generally interested in the Upper Guinean forests, their social troubles, armed conflicts and in vivid descriptions and adventures of scientists. Hopefully the book will help to raise interest in these forests and the enigmatic and cute but endangered pygmy hippos living in them!

The Pygmy Hippo Story: West Africa's enigma of the forest
Phillip T. Robinson, Gabriella L. Flake and Knut M. Hentschel
421 pages
2017, Oxford University Press, New York

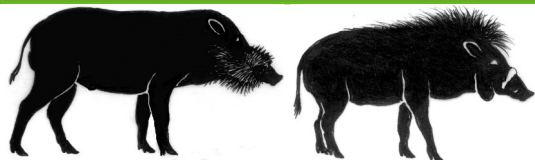
Reviewed by Thiemo Braasch



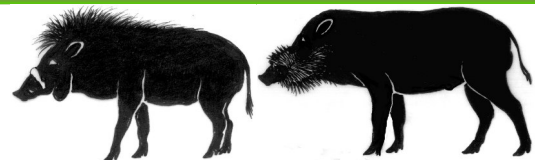
There are over 5,000 extant mammal species, but many more thousands of species from the fossil record. Therefore, it is difficult to keep the overview about all the taxa, their relations among different time scales and the ongoing debate about taxonomy. Donald R. Prothero is professor emeritus of geology. He has studied prehistoric mammals for decades, knows the scientific debates about them and how to classify recently found mammal fossils in the taxonomical context. The first chapter deals with the general rise of mammals, how to date rocks, clocks derived from rocks, a short introduction in the system of naming and classifying species and most importantly the methods of analysing bones and recognizing teeth of prehistoric mammals. This seems to be a dry and difficult subject with a cornucopia of technical dental terms, but Prothero keeps these descriptions as simple as possible throughout the whole book using them only when really necessary.

In the following chapters all mammalian orders and most of the families within them, whether extinct or extant, are presented - first their taxonomic relations to other families, then with the features that make them unique. Most interesting for people interested in Suiformes is the chapter about artiodactyla, the “even-toed” hoofed mammals including pigs, hippos, whales, ruminants and their extinct relatives (chapter 14). The suoid artiodactyls include two families, the true pigs (family Suidae) and the peccaries (family Tayassuidae). For both families detailed taxonomic facts are shown and also important anatomical differences between true pigs and peccaries. Some important prehistoric pig species like *Kubanochoerus* and *Nyanzachoerus* are mentioned and for peccaries *Perchoerus* and *Platygonus* (for prehistoric true pig species see also the article on page 56 in this issue). The extinct family Anracotheriidae is presented with some details and also





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the family Entelodontidae with a reconstruction of the rhino-size entelodont *Daedon* although the latest analysis places them closer to the Whippomorpha. Species of this family have become media stars due to TV series like “Walking with beasts” and acquired nicknames such as “killer pigs” or “terminator pigs”. Prothero uses the latest molecular evidences to cluster whales and hippos within a group, the Whippomorpha. These combinations of molecular data and anatomical studies of fossils show that “hippos are descendents from anthracotheres and whales from a different kind of anthracothere relative.” Therefore, the two extant hippo species are more closely related to whales than to the other Suiformes. Similar to the section about the Suiform families, important prehistoric hippo species such as *Morotochoerus* and *Kenyapotamus* are mentioned. The illustrations show a diversity of strange looking Suiform creatures.

As this book is a “field guide”, there are many photos of skeletons and skulls along with Mary Persis Williams’ illustrations of prehistoric mammal species in each chapter of the book (including many family trees). Along with drawings of typical and famous species in relation to human body size the book offers a well written and comprehensible overview about prehistoric mammals. The last chapter deals with the questions why prehistoric mammals were so big, where they all have gone (with a consideration of which hypothesis - the “overkill” hypothesis, the climate-change hypothesis and the impact hypothesis – is the best explanation) how mammals diversified after the dinosaurs vanished and the role of mass extinctions. At the end of the book the section about the future of mammals in the era of the “Sixth Extinction”, the human made extinction crisis, gives a bleak outlook for the future of mammal life on earth.

Due to Prothero’s work with his vivid style of writing mentioning popular prehistoric mammal species (like the giant ground sloth *Megatherium*, the saber-toothed marsupial *Thylacosmilus*, or Steller’s sea cow) and Williams’ illustrations this prehistoric world is revived and reminds us how evolution has formed a breathtaking biodiversity of mammals with all their different forms and weird looking species and that we have to protect the living descendants of these ancestors.

The Princeton Field Guide to Prehistoric Mammals
Donald R. Prothero with illustrations by Mary Persis Williams
240 pages
2016, Princeton University Press, Princeton

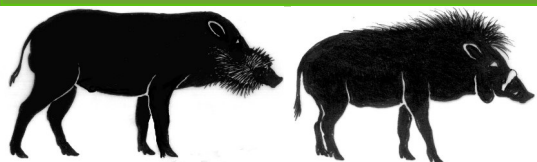
Reviewed by Thiemo Braasch

Pull the other one! Piglet with six legs and two tails is born in China

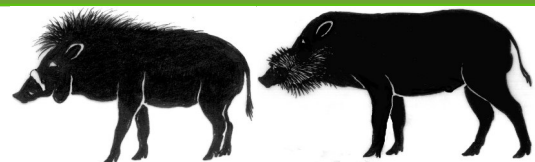
By Catherine Chapman For Mailonline
PUBLISHED: 18:48 BST, 24 July 2017 UPDATED: 19:49 BST, 24 July 2017
<http://www.dailymail.co.uk/news/article-4725766/Pig-China-born-six-legs-two-tails-two-bottoms.html>

A piglet with six legs and two tails has been born in China, as video of the young animal resting in a farmer's hands has emerged. The piglet, just one-month-old, was born on June, 22 in Baicheng,





Articles in the news



northeastern China with two bottoms, two tails and six legs. Video shows a man, presumed to be the piglet's owner, holding the small babe to show off its mutated features. The animal struggles to move in the man's arms but appears to be healthy.

While abnormal, this piglet may be one of the more average anomalies that has been seen lately. Last year, for instance, MailOnline reported on a pig that was born with the face of a monkey in Guizhou Province, China. The animal was described as having two holes as a nose and an overbite that left its long tongue protruding from its mouth. Earlier this year in China's Anhui province, a piglet with a trunk-like nose was also born, and last month, a piglet with two heads was discovered on a farm in China - the latter was kept as a

pet and saved from slaughter, whereas the former unfortunately died two weeks after its birth. It is not known what is to be done with the piglet seen in the video, or whether the unusual animal is even able to walk properly with its six limbs.

The wild boar business is booming in Texas

by Aaron Smith July 17, 2017: 7:11 PM ET

<http://money.cnn.com/2017/07/14/smallbusiness/wild-boar-business-texas/index.html>

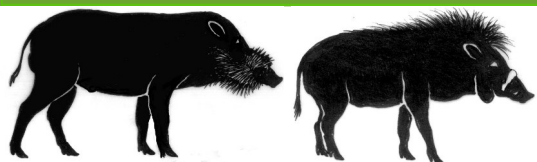
Ravenous wild boars run roughshod over Texas, but entrepreneurs have figured out how to turn the land-ravaging pigs into a money-making resource.

Hunters, ranchers and farmers shoot the boars on sight, an attempt at mass eradication that's encouraged by state lawmakers, who recently legalized hunting them from hot air balloons. Why? Because it's quieter than hunting them from helicopters, as is often done. Spanish conquistadors introduced the boars to Texas in the 1500s as a ready food source. In the 20th century, more pigs were brought to game preserves. Since then, they've been breeding rapidly, at an annual rate of half a dozen piglets per sow. There are about 2.6 million wild boars in Texas and up to 9 million in the U.S., according to Billy Higginbotham, wildlife professor at Texas A&M. They cause \$1.5 billion in damage yearly by rooting up crops and eating livestock, according to estimates. But there is also money to be made off these invasive species. The hog infestation has given rise to a variety of businesses capitalizing on wild boar, ranging from the helicopter tours that shoot them to the big city restaurants that serve them.

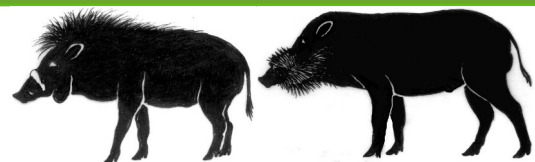
"You've got all of these different entities that are literally taking a sow's ear and making a silk purse out of it," said Higginbotham. Companies like HeliBacon of Bryan, Texas, charge customers thousands of dollars to machine-gun hogs from helicopters, which is harder than it sounds, even with full auto AR-15s. "Your target is running, and it's not necessarily running in the same direction that the helicopter is flying," said HeliBacon managing partner Chris Britt. "Imagine riding in a roller coaster while you're trying to shoot something, and it's moving." Britt said he co-founded the company in 2012, a year after Texas passed its so-called pork chopper bill to help cull the wild pig population with the aid of helicopters.

"This is not technically hunting; this is aerial depredation," said Britt. "I can shoot wild hogs and





Articles in the news



coyotes from an aircraft, but I can't shoot a deer, that would be illegal." He said they take well-heeled clients like hedge fund managers and other white collar workers on corporate retreats four or five times a week, killing thousands of hogs per year. "The feral hogs breed so much I don't know that we've made much of a dent in the actual population," he said. "There's so many of them, and they reproduce so fast. It's not a solution, it's just more of a population management approach."

Special ammo

Killing hogs isn't easy. Ammunition brands like Freedom Munitions sell anti-hog AR-15 bullets like the Boar Buster, designed to punch through their armored hides and "gristle shields," according to Jansen Jones, president of the parent company Howell Munitions & Technology in Lewiston, Idaho.

"Hogs are very tough animals; they've got tough thick bone," he said. "So you need a bullet that can stay together and penetrate thick hide and crush bone."

Not everyone is thrilled with these methods of culling.

"We're against any kind of aerial gunning as a way to manage a conflict with wild animals, especially when it's sort of farmed out like this," said John Griffin, director of urban wildlife for the Humane Society of the United States. "They do take a toll on the environment, but they should be handled more humanely. This is more of a spectacle than a responsible way of managing them."

Hogs can also be trapped live. A company named BoarBuster, from Thomas, Oklahoma, sells mobile-controlled hog traps the size of studio apartments, with live streaming video. The cage, camera and shipping costs \$6,000. Ranchers also use companies like Lone Star Trapping to capture and remove live hogs. Captured hogs are often sold to distributors, and then to butchers or game preserves. Most eventually end up on dinner tables in Texas BBQ joints as well as restaurants in California and New York.

'Different flavors in the meat'

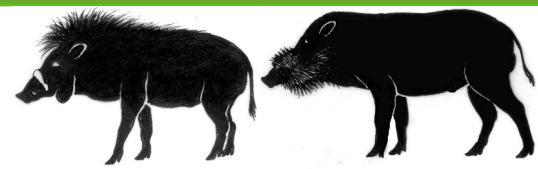
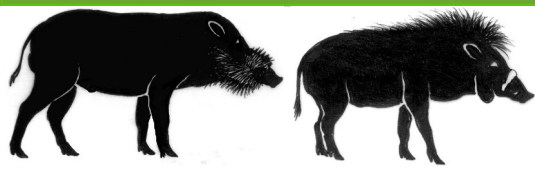
Wild boar is a traditional meat in Italy, where it's served in a ragu sauce with pappardelle pasta. So it's nothing new to New York foodies, who've been dining on it for decades in Italian restaurants like DeGrezia Ristorante in Manhattan. The overpopulation of wild boars in Texas ranch lands has prompted a new wave of culinary creativity. It's become a fixture of Texas cuisine, even though the tough meat is tricky to prepare. "Because the wild boars are wild and they eat a variety of different things you get different flavors in the meat," said Chef Tim Love, who barbecues boar ribs at his restaurant, Lonesome Dove Western Bistro in Austin, Texas. "That makes it exciting. If you do it right it's really delicious; if you don't do it right you're chewing for a week." Love said that he buys the boar meat from Texas distributors. He said he also shoots up to a dozen boars every time he visits his ranch, for purposes of eradication. Texas' law stipulates that hunters are allowed to eat the meat, but only state-approved trappers are allowed to sell it.

They're like gigantic rats," Love said. "But at least they're edible."

Boar is turning up in more and more dishes - including pizza.

Lee Kim, co-owner of Burattino Brick Oven Pizza in Rancho Palos Verdes near Los Angeles, said he decided to "solve this wild boar overpopulation problem once and for all." He sources boar meat from Texas and has a meat processor make it into pepperoni. "It's so tasty," he said. "There's no grease and it is very lean. Try this, I tell you, and you will never go back to normal pepperoni."





Hunting can help European ecosystems

May 30, 2017, Springer

<https://www.sciencedaily.com/releases/2017/05/170530101710.htm>

Hunting as an outdoor activity is underrated in how it helps nature and society to regulate problem animal overpopulations. Such is the case for Europe's wild boar *Sus scrofa*, according to Spanish researchers from the IREC institute (UCLM and CSIC), and Principado de Asturias, published in Springer's European Journal of Wildlife Research.

Recreational hunting in particular is increasingly perceived by the ever-growing urban population as an unsustainable and debauched extractive activity. This perception has an influence on the number of active hunters, and on the recruitment of new ones to the sport.

To investigate how this has an influence on the growth in wild ungulate numbers, Quirós-Fernández and his colleagues focused on the wild boar population, which according to a 2015 review is growing by 20 percent each year in Europe.

The research team focused their attention on Spain's northwestern province of Asturias, where hunting is essentially non-commercial and is still traditional among rural inhabitants. The team investigated annual wild boar hunting bag data collected from game reserves and hunting estates, and the influence that temporary hunting bans in six of these estates had on population numbers. Hunting bag statistics that reflect the quantity of game killed during a hunting season were used, as these provide a reliable index of the relative abundance of wild boar, and are often used to monitor population sizes over long periods of time.

The findings reflect marked differences in the number of wild boar hunted annually from 2000-2001 to 2013-2014. The total wild boar hunting bag for the area grew each year by 5.63 percent during the study period. The annual hunting bag size after a hunting ban was lifted was much larger than that of the pre-ban period, and grew by 40.33 percent in the season following its lifting. This difference indicates that hunters are able to reduce and regulate wild boar numbers.

"Recreational hunters contribute towards regulating the population growth of problem species such as the wild boar," the authors say. "In this context, it is important to note that we advocate preventing wild boar population growth and eventually balancing high densities, while we do not propose the suppression of an ecologically important native species."

The mean annual increase of 5.63 percent in the wild boar hunting bag suggests that current hunting practices alone are not able to control the population. In fact, during this time only half of the quota of animals allowed were hunted. According to this study, recreational hunters should therefore be encouraged to attain higher wild boar hunting bags, because of the economic and ecological advantages to doing so. "This is especially relevant because of the declining number and ageing population of hunters throughout Europe. Future research should also focus on how hunting, diseases and predation have an influence on wild boar population dynamics."

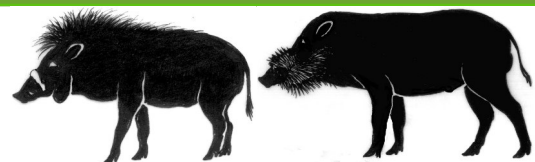
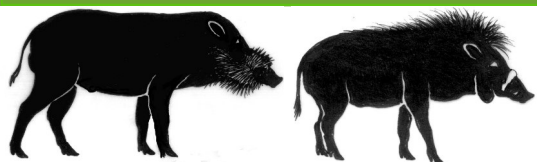
Story Source:

Materials provided by Springer. Note: Content may be edited for style and length.

Journal Reference:

Francisco Quirós-Fernández, Jaime Marcos, Pelayo Acevedo, Christian Gortázar. Hunters serving the ecosystem: the contribution of recreational hunting to wild boar population control. *European Journal of Wildlife Research*, 2017; 63 (3) DOI: 10.1007/s10344-017-1107-4





Wild heart: urban wild boars prefer natural food resources

April 13, 2017, Forschungsverbund Berlin e.V. (FVB)
<https://www.sciencedaily.com/releases/2017/04/170413084830.htm>

Different than expected, wild boars do not come to Berlin in order to use garbage or other anthropogenic food resources. In fact, also in the city they predominantly consume natural resources. This is the surprising result of a study conducted by the Leibniz Institute for Zoo and Wildlife Research (Leibniz-IZW). The researchers analysed the stomachs of 247 wild boars from Berlin and the surrounding countryside. The results have been published in the scientific journal PLOS ONE.

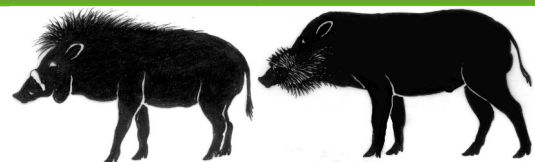
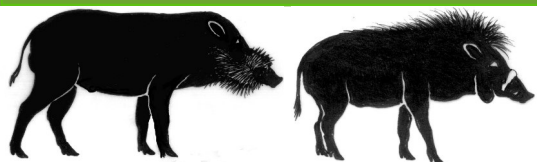
More and more wildlife occurs in cities, also in Berlin, which is often called to be "the capital of wild boar." Twenty percent of the area of Berlin is covered with extensive forests, divided into four main forestry areas which create optimal conditions for wildlife. But wild boars do not only have a high population density in urban forests. They can also be regularly observed in urban parks or private gardens, where they sometimes even give birth to their piglets.

Wild boars as omnivorous species are well known for their flexible diet; the consumed food usually reflects the availability of food resources within their habitat. So far, it was assumed that attractive, easily accessible anthropogenic food resources such as garbage or direct feeding were the main reason for wild boar to enter urban areas. Similar observations were conducted for other wildlife species such as black bears in the USA, macaques in India and foxes in urban habitats within Europe. To test this assumption, the composition and amount of energy of the diet of wild boars in Berlin and rural areas of Brandenburg was analysed by a research team from the Leibniz-IZW. Altogether, 247 stomachs of hunted wild boars were collected and the landscape of the sample locations was investigated.

"Surprisingly, wild boars in Berlin and Brandenburg consume almost exclusively natural food such as acorns, insect larvae, fibre or maize, while food items from potential anthropogenic origin are rare. Only in four out of 247 stomachs we found pieces of bread with salami and cheese," reports Milena Stillfried, PhD student at the Leibniz-IZW and lead author of the study. But her analyses still show differences between urban and rural areas. Not only the landscape composition, but also the availability of natural food sources differs: in Berlin, mainly mast producing mixed forests grow, where wild boars find acorns or beechnuts, whereas Brandenburg is dominated by agricultural areas and coniferous forest with rather poor food supply. The amount of energy of stomach contents was higher in Berlin than in Brandenburg, which is probably a result of increased acorn intake. Analyses of macronutrients such as protein, fat, starch or fibre show that not the life in the city or countryside per se, but the landscape composition within the used areas determines the food quality. As a result, the amount of starch increased in wild boar stomachs with increasing percentage of agricultural areas, while the amount of protein decreased in coniferous forests. Wild boars in rural areas seemed to benefit from human associated landscape structures as stomach contents with a high amount of energy were found in rural areas with a high percentage of asphaltic surfaces.

While wild boars in rural areas avoid encounters with humans, they learn to tolerate human presence in urban areas and are able to find food and shelter within human dominated landscapes. However, it is unclear if they will continue to use mainly natural habitat or if they





might change their behaviour. "Due to the high learning ability of wild boar, it is important to secure garbage bins and prevent direct feeding, because wild boars are likely to shift their diet towards anthropogenic food sources as soon as those are easy to access or natural resources become rare," say Stephanie Kramer-Schadt and Sylvia Ortmann, who initiated the new research focus "urban ecology" at the Leibniz-IZW in 2012.

To prevent conflicts between humans and wild boars, urban citizens should meet some rules. Wild boars in urban areas are known for causing damage in private and public parks and gardens when searching for food and a lot of people are scared of wild boars -- which are usually very peaceful. The current scientific findings about the nutrition of wild boars in Berlin and Brandenburg help to understand the general process, how wildlife species adjust to urban areas. For public authorities, the results can be an important data basis for improving human-wildlife-coexistence.

The study was financially supported by National Geographic and the "Stiftung Naturschutz Berlin."

Story Source:

Materials provided by Forschungsverbund Berlin e.V. (FVB). Note: Content may be edited for style and length.

Journal Reference:

Milena Stillfried, Pierre Gras, Matthias Busch, Konstantin Börner, Stephanie Kramer-Schadt, Sylvia Ortmann. Wild inside: Urban wild boar select natural, not anthropogenic food resources. PLOS ONE, 2017; 12 (4): e0175127 DOI: 10.1371/journal.pone.0175127

Radioactive wild boars roaming towns deserted after the Fukushima nuclear disaster are rounded up and killed amid fears they will attack

By Reuters

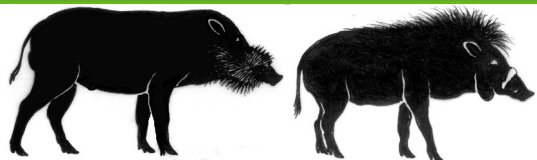
PUBLISHED: 02:00 BST, 9 March 2017 UPDATED: 13:33 BST, 9 March 2017

<http://www.dailymail.co.uk/news/article-4295826/Wild-boars-offer-challenge-homecomers-radiation-hit-Fukushima.html>

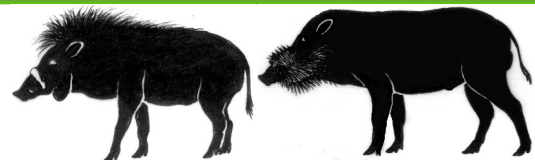


Beyond radiation risks, an unexpected nuisance looms for Japanese returning to towns vacated after the Fukushima nuclear crisis six years ago - wild boars. Hundreds of the animals, which have been known to attack people when enraged, descended from surrounding hills and forests into towns left deserted after the 2011 disaster. Now they roam the empty streets and overgrown backyards of Japan's deserted seaside town of Namie, foraging for





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food. The boars are believed to have become radioactive after eating contaminated food and living in the high-risk exclusion zones since the nuclear disaster. 'It is not really clear now which is the master of the town, people or wild boars,' said Tamotsu Baba, mayor of the town, which has been partially cleared for people to return home freely at the end of the month.

'If we don't get rid of them and turn this into a human-led town, the situation will get even wilder and uninhabitable.' At the end of March, Japan is set to lift evacuation orders for parts of Namie, located just 4 km (2.5 miles) from the wrecked nuclear plant, as well as three other towns.

Residents fled to escape radiation spewed by the Fukushima Daiichi plant, whose reactors went into meltdown after it was struck by an earthquake and tsunami on March 11, 2011. In the nearby town of Tomioka, hunter Shoichiro Sakamoto leads a team of 13 assigned to catch and kill the wild boars with air rifles. Twice a week, they set about 30 cage traps, using rice flour as bait.

'After people left, they began coming down from the mountains and now they are not going back,' he said. 'They found a place that was comfortable. There was plenty of food and no one to come after them.' Since last April, the squad has captured about 300 of the animals, and intends to keep up its work even after the evacuation orders are scrapped, Sakamoto added. More than half of Namie's former 21,500 residents have decided not to return, however, a government survey showed last year, citing concerns over radiation and the safety of the nuclear plant, which is being decommissioned. But at town meetings earlier this year to prepare for the homecoming, residents had voiced worries about the wild boars. 'I'm sure officials at all levels are giving some thought to this,' said Hidezo Sato, a former seed merchant in Namie. 'Something must be done.'

Radioactive boars are roaming Czech mountains after eating mushrooms contaminated by the Chernobyl disaster

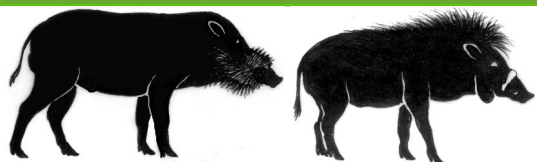
By Hannah Al-Othman For MailOnline

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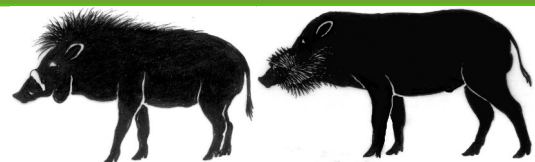
<http://www.dailymail.co.uk/news/article-4249582/Radioactive-boars-roaming-Czech-mountains.html>

Wild boar is a popular locally delicacy in the Czech Republic but fans of the meat have an unusual problem on their hands this winter - the boars are radioactive. The boars became contaminated by one of their most popular food sources - false truffles. A cold and snowy winter is forcing them to feed on false truffles, an underground mushroom common in the Sumava mountain region between the Czech Republic, Austria, and Germany - where wild boars roam free. The mushrooms can absorb high levels of the radioactive isotope Caesium 137. And three decades ago the nuclear catastrophe at Chernobyl released a fair amount of Caesium 137 that eventually drifted down on the Sumava mountains. Now the boars are eating the mushrooms, and ingesting the Caesium 137 along with them. Eating the mushrooms is making their meat radioactive, Jiri Drapal at the State Veterinary Administration told Reuters. 'It is more or less a seasonal issue,' Drapal said. And due to the fact that the isotope stays radioactive for decades, the boars may be glowing for years to come. The half life of Caesium 137 is 30 years - meaning it takes 30 years for the radioactivity of the isotope to fall to half its original value. Then another 30 to fall to half again, and so on. 'We can expect to find (affected) food for a number of years from now,' Drapal said. And that could cause some problems with the supply of boar meat, which is popular in the Czech Republic. It often shows up on restaurant menus in goulash, a thick stew





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made from meat, sauce and dumplings. Any boar that ends up as goulash ought to be safe, as not just boars, but any wild animal that is hunted, must be inspected before its meat can get to customers. Radioactive meat is banned from circulation, Drapal said.

However, it isn't all good news - the bad news is that 614 animals were inspected from 2014 to 2016, and 47 percent were above the limit - almost half, which means that wild boar meat will be in short supply. However, even meat from radioactive animals would be a health hazard only in large doses, Drapal said. You would have to eat it several times a week for couple of months, to get sick, he added.

People and wildlife now threatened by rapid destruction of Central America's forests

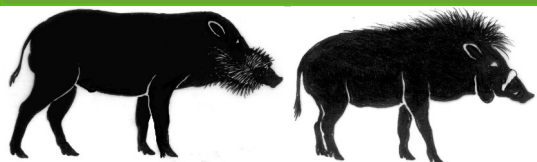
July 26, 2017, Wildlife Conservation Society

<https://www.sciencedaily.com/releases/2017/07/170726091543.htm>

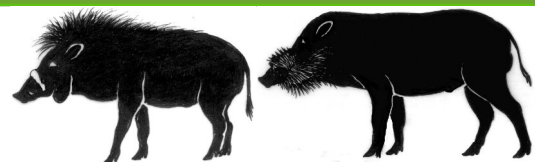
Central America's largest remaining forests are disappearing at a precipitous rate due to illegal cattle ranching, oil palm plantations, and other human-related activities, all of which are putting local communities and the region's wildlife species at high risk. A new comprehensive study by WCS (Wildlife Conservation Society) titled the "Human Footprint and Cow's Hoofprint Analysis" was presented this month for validation and analysis by indigenous groups, protected area agencies, and civil society organizations from nine countries. This spurred the development of a joint commitment known as "The Petén Declaration." Signed by 25 of the attending organizations, the declaration recognizes the causes of forest loss and commits to concrete actions to address them. One of the most alarming discoveries made by the study's research team is that the three largest remaining forest blocks in Central America have been reduced in size by more than 23 percent in the past 15 years. The study was conducted by WCS in partnership with the U.S. Fish and Wildlife Service and the Organization of American States to understand and protect Mesoamerica's last great forests. Data for the analysis was collected using satellite imagery, census data on people and cattle/agriculture, publications, interviews, and via a megaflyover expedition: an ambitious plane-based survey across the region's largest forests. "The disappearance of huge swaths of forests over such a short time period has grave implications for the indigenous peoples in the region and the natural resources on which they depend," said Victor Hugo Ramos, Monitoring and Evaluation Specialist for the WCS Mesoamerica program. The rate of deforestation in Central America also threatens the survival of iconic species including jaguars, tapirs, and scarlet macaws. The white-lipped peccary, an important keystone species for the forests of Central America, is so threatened it may soon become extinct in the region. Traveling in large herds in search of fruit and other food in large forest tracts, white-lipped peccaries serve as both an indicator of forest health and connectivity and a crucial prey species for jaguars. The white-lipped peccary has been extirpated from 87 percent of its historical range in Mesoamerica, and is now only found in a few of the region's largest remaining forests.

Large-scale illegal cattle ranching, much of it taking place within protected areas and indigenous territories, has been determined to be the principal cause of deforestation. This illegal activity is sometimes connected to drug trafficking and money laundering. "We, the indigenous people, are the guardians of the Mesoamerican biospheres who have cared for and protected them for thousands of years," said Taymond Robins of the Nacion Mayangna, an indigenous nation managing 1 million hectares in Nicaragua. "We will continue to fight against the injustice of





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invasion of indigenous lands and territories by colonists, who are decimating natural resources for cattle ranching, timber extraction, and exploration and exploitation of resources for companies and projects that greatly affect the life cycle of biodiversity in Mesoamerica." The expansion of oil palm plantations has also contributed to deforestation in the region by displacing people and cattle into protected areas. The areas under the greatest threat include the Moskitia region within Honduras and Nicaragua and the Maya Forest landscape in Guatemala, Mexico, and Belize. "Considering the threats in our territory, we face great challenges in the governance and protection of natural resources," said Angel Matute, deputy director of the Honduran park service, ICF (Instituto Nacional de Conservación y Desarrollo Forestal, Areas Protegidas y Vida Silvestre). "ICF is committed to working hand in hand with indigenous peoples in recognition of their ancestral rights for the management and conservation of the Honduran Moskitia."

The Petén Declaration includes a commitment to five concrete actions to recover the region's forests: 1) supporting local forests and indigenous communities to obtain land management 2) strengthening the conservation of protected areas 3) supporting the prosecution of environmental crimes 4) focusing on illegal livestock as the main driver of deforestation and 5) protecting environmental champions who risk their lives to protect Mesoamerica's largest forests. "Indigenous leaders, community land managers, and park rangers are putting their lives on the line every day to protect Mesoamerica's forests and the services they provide for all of humanity," said Dr. Jeremy Radachowsky, WCS Regional Director for Mesoamerica and Western Caribbean. "This declaration represents a plea for help. We owe it to them to take this declaration seriously, and seek the financial, political, and technical support necessary to implement these five actions" "Although Central America's forests and wildlife are under severe threat, we remain hopeful they can be conserved to ensure the survival of wildlife and to provide sustainable livelihoods for people living in these areas," said Ani Cuevas, Central America Program Officer for the U.S. Fish and Wildlife Service. "It's essential that conservation solutions are chosen and implemented by Central American leaders, and we look forward to continuing to support these important endeavors."

Story Source:

Materials

provided by Wildlife Conservation Society. Note: Content may be edited for style and length.

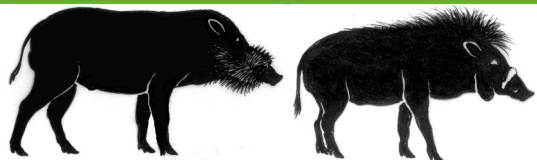
'Racing against time' to save the taguá and its vanishing Chaco home

by John C. Cannon on 5 January 2017

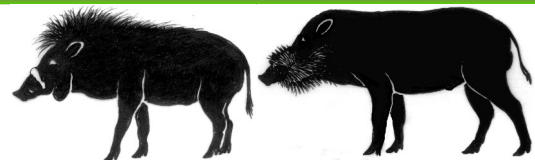
<https://news.mongabay.com/2017/01/racing-against-time-to-save-the-tagua-and-its-vanishing-chaco-home/>

Skittering in small clans among the hard-scrabble brush of the Gran Chaco in South America, the taguá looks like a cross between a svelte pig and an over-sized hedgehog. Also known as the Chacoan peccary (*Catagonus wagneri*), the animal has carved a precarious life for itself in the dry plains and woodlands that make up its namesake ecosystem in Bolivia, Argentina and Paraguay. But in a place where life is already difficult, the disintegration of their environs has made survival even tougher. That's left scientists, conservationists and governments scrambling to save the Chaco and with it this unusual, rapidly dwindling, emblematic species. "It is rare to find an animal





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that large that is so specific to a very precise region,” said Dan Brooks, the curator of vertebrate zoology at the Houston Museum of Natural Science, who began studying animals in the Chaco back almost 30 years ago. The taguá, listed as Endangered by the IUCN, is one of many animals found only in this region.

Slightly smaller than Egypt at 100 million hectares according to WWF, the Chaco is often overshadowed by its wetter and more densely forested neighbor, the Amazon. But its charms aren't lost on scientists. “I immediately fell in love with the place,” said Mariana Altrichter, a conservation biologist at Prescott College and chair of the International Union for the Conservation of Nature's Peccary Specialist Group. “That's kind of hard to understand, because if you are there, very soon you realize, it's very hard to live there.” Originally from Argentina, she studied the effects of hunting on the taguá and its cousins the collared peccary (*Pecari tajacu*) and the white-lipped peccary (*Tayassu pecari*) in the early 2000s in a part of the Argentine Chaco with the unwelcoming name, the Impenetrable.

“It's a very inhospitable place. There's no water. It's very hot. The forest is dense and thorny and everything is like unfriendly to humans,” Altrichter said in an interview with Mongabay. “And yet, it's beautiful.”

Altrichter is at the forefront of a multinational movement to save the taguá from the threat of habitat loss. At the same time, the three countries that hold the Chaco are wrestling with the how best to develop their economies while also protecting their natural resources. Altrichter is working with fellow ecologists, including Brooks, as well as farmers, governments, and local communities, to keep the taguá and its ecosystem from disappearing into history. Building on a workshop held in early 2016, the group published a plan (in Spanish) to save the species in October.

While the spotlight on the Amazon has brought the loss of forest there into sharp relief, rates of destruction have also been on an upward trajectory in the past decade and a half in the Gran Chaco. “It's the most rapidly disappearing ecoregion on earth probably,” said Anthony Giordano, a conservation biologist and the founder and executive director of SPECIES, short for Society for the Preservation of Endangered Carnivores and their International Ecological Study.

An earlier comeback

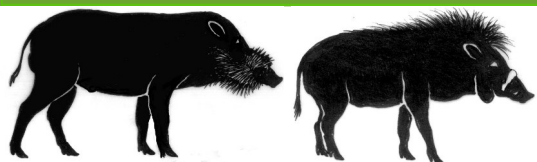
Oddly enough, extinction wouldn't be an unfamiliar position for the taguá, as it's something of a Lazarus species. Scientists knew of it only from fossilized remains until the 1970s, when a team of biologists confirmed local rumors of the existence of a third peccary species in the Paraguayan Chaco, publishing their “discovery” in the journal *Science* in 1975.

“The local people, of course they knew,” Altrichter said. “They always talked about three species of peccaries.”

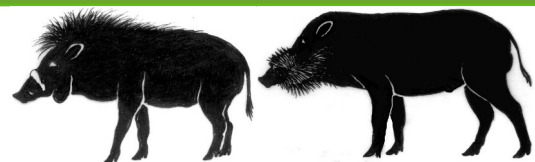
Peccaries are only distantly related to domestic pigs, even though their snouts might look familiar. They split from our bacon-backed companions about 40 million years ago. Since the taguá re-entered the annals of Western science, a small yet committed group of scientists have braved the harsh conditions of the Chaco to learn more about it. In that time, the area has gone through a sea change. “When I lived in Paraguay nearly three decades ago, half of the Trans-Chaco Highway was still unpaved,” Brooks said. Later research in the Chaco would reveal the perils of paved roads and the access they afford hunters to the taguá. Compared to what Brooks originally found, “The situation today is very different,” he said. “The cattle industry is huge in what used to be pristine Chaco dry forest, which sadly is being converted to pastureland at an alarming rate.”

Then, later on, around the time that Altrichter began working in the Chaco, an economic crisis hit Argentina. To compensate, the government tried to devalue its currency, the peso. In addition to





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the shockwaves that rippled through the global economy, it made land in Argentina very cheap.

“It was ridiculous,” Altrichter said. “It was like \$2 a hectare.” That led to an influx of ranchers, who cleared the forest, sold the wood and began grazing cattle. As the threat from ranching has intensified, compounded by a boom in growing soy, the open grasslands have left fewer places for taguá to forage and hide from predators. Data from the University of Maryland and visualized on Global Forest Watch show that tree cover loss in the Chaco intensified dramatically beginning just after the beginning of the 21st century, peaking at nearly 1 million hectares of tree cover loss annually in 2008. In total, the region lost more than 14 percent of its tree cover between 2001 and 2014.

Much of this loss occurred in and around the region’s remaining Intact Forest Landscapes (IFLs), which are areas of primary forest large and undisturbed enough to retain their native biodiversity. In total, the Chaco’s IFLs lost around 6.5 percent of their tree cover from 2001 through 2014, leading to a reduction in their extent of about half by 2013. In other words, Chaco forestland capable of supporting a full complement of wildlife halved in just 13 years.

An intimate bond

There is little doubt that the loss of so much of the Chaco has been a devastating blow for wildlife. But the decline of the taguá has probably also had ricochet effects on the health of the ecosystem itself.

Research by ecologist Silvia Saldívar, who attended the workshop in Asunción, confirmed what many scientists had long suspected – and people living in the Chaco already knew: that the survival of the species and the Chaco are likely intimately tied together.

Saldívar calls peccaries “ecosystem engineers” in her 2014 thesis. Vibrant plant communities sprout up where the taguá’s pointed hooves till the ground and as they nose through the soil for roots to eat, she said.

“Where you have no peccaries, the forest is different,” Saldívar told Mongabay. “It’s less diverse.” An early 1990s assessment of the population pegged the number of taguá in Paraguay to be about 5,000 and noted that smaller populations were living in Bolivia and Argentina at the time. Experts agree that the numbers have likely only slid from there. To get a better grip on current numbers, Saldívar began studying the species in 2012 while at the State University of New York College of Environmental Science and Forestry in Syracuse. Paraguayan by birth, she examined the current threats taguá face in her home country. Traditionally, local community members would kill taguá opportunistically when they came across them. And given the choice, they would take a taguá over other peccaries because the meat tastes better, Saldívar discovered through interviews with hunters.

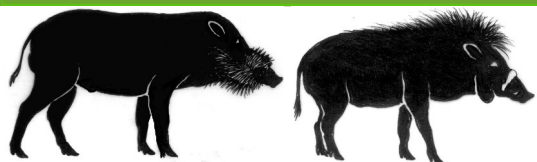
Hunting, even at the low levels practiced by local hunters, has been a concern for the taguá almost since its comeback to the scientific stage. Unlike the other peccaries, the taguá’s range doesn’t extend beyond the boundaries of the Chaco, so researchers soon speculated that it was probably susceptible to overhunting.

Altrichter and a colleague published a paper in 2004 in the journal *Biological Conservation* that found even subsistence hunting may not be sustainable “not so much because of the numbers of animals that they’re hunting,” Altrichter said, “but because their habitat was already small, and it’s

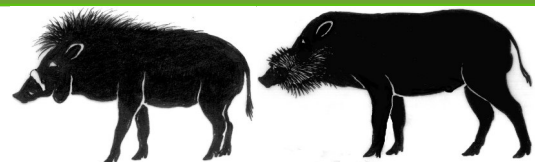


Photo: J. Campos





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a species that is naturally rare.” Scientists believe that programs to promote alternative livelihoods, particularly in Argentina, have reduced subsistence hunting of the taguá, perhaps by as much as half. But as agricultural development opened up the Chaco, leading to new roads and more people passing through, the numbers of animals taken by sport hunters became a bigger problem. Saldívar’s surveys of the area turned up a lot of taguá skeletons along roads in the Paraguayan Chaco – likely kills by truck drivers hauling cattle or soy through the area or other outsiders with their own sets of wheels.

Earlier research had uncovered the taguá’s fondness for companionship, which likely exacerbated the effects of hunting from the road on the species. “The highly integrated social behavior of taguá didn’t help at all unfortunately,” Brooks said. “When a hunter shot one the rest of the herd would scatter, only to return moments later to the fallen family member, whereupon the hunter would shoot another and another until the entire herd was eliminated.” Saldívar’s work confirmed that assessment. “Taguás are really curious,” she told Mongabay. “They stay and look at what you’re doing.”

Untapped local knowledge

Saldívar called the ‘discovery’ of the taguá in the second half of the 20th century “eye-opening.” The lesson was that “you should pay attention to what local people say and what local people know, because even though it’s not the Western way of thinking about it, there’s a lot of knowledge that’s not taken into account.” To Altrichter, adding those voices to the strategy planning to save the taguá has been critical.

“We can run population viability models or habitat suitability models, but the indigenous people are the ones who tell us, ‘Oh no, the Chacoan peccary only has two babies in a year,’” she said. “Or they might tell us, ‘No, the young females don’t reproduce.’”

That principle of inclusion has guided how Altrichter and her colleagues have approached saving the taguá. They invited “everyone who had some stake in the conservation of the species,” including farmers and ranchers, Mennonite communities, indigenous and local communities, and government agencies from Paraguay, Bolivia, and Argentina.

At the meeting in Asunción, despite overtures, “The one sector or stakeholder that was missing – and is generally missing in all of these workshops – are the large international corporations,” Altrichter said. “They’re the ones that are leading all of this deforestation, the ones that are buying thousands and thousands of hectares, coming in with machines and in a few days removing hundreds of thousands of hectares to either do livestock ranching or soy crops.

“They don’t go to workshops,” she added.

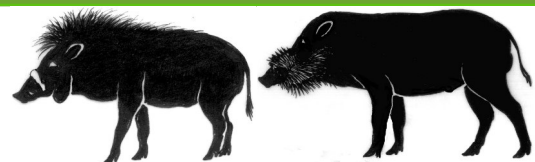
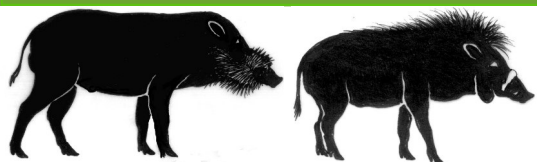
Paraguay’s Ministry of Environment did send representatives. Altrichter said that the survival of the Gran Chaco depends on the involvement of governments in Paraguay, Bolivia and Argentina and that they also have to balance conservation with other priorities. It’s that disintegration of the habitat that’s “arguably a larger threat” than poaching or hunting, Saldívar said. “They’re not trying to stop development. They can’t stop agricultural expansion,” Altrichter said. “The idea is just how to do it in a way that doesn’t completely destroy the environment. “The problem is that they’re racing against time because deforestation is happening so fast.”

Basic biology

The meeting revealed significant gaps in our understanding of basic taguá biology and ecology, even as the realization that the population is on the descent was clear.

Participants in the workshop resolved to work more closely with local taguá breeding programs, such as CCCI, or El Centro Chaqueño para la Conservación e Investigación, which began as a





collaboration between the government of Paraguay, the U.S. Peace Corps and the San Diego Zoo called Proyecto Taguá in 1985. CCCI broadened its mission in 2010, but still has a captive breeding program with 97 taguá. It's led by one of the recovery plan's authors, Juan Campos. Proyecto Taguá, now located in Fortín Toledo, Paraguay, and similar programs could provide a window into the secrets of this difficult-to-study species, not to mention providing animals for reintroduction one day, say the authors of the plan. Bumping up the legal protections of taguá range would also help, they wrote in a paper in the journal *Suiform Soundings*. But currently, they figure that only 12 percent of "highly suitable" habitat is protected. To bridge that gap, they write, the involvement of local communities will be a vital. In one bright spot, the tree cover loss in the Gran Chaco has tapered in recent years, down in 2014 to about half of the record levels of 2008, when the area was hemorrhaging nearly a million hectares a year. Data from 2015 and 2016 indicate further reductions in deforestation. It is unclear if that trend will continue, or if future spikes in the loss of the Chaco lie ahead. "The thing is that the Chaco is the only place left. It was left aside by the producers, because it was harder to get there," Saldivar said. "Now that there's no more space to grow, and there's all of this pressure to make more money, so that's when they started looking at the Chaco as a possibility." "This is scary as hell when you think about it," Dan Brooks said. "There just isn't that much Chaco to convert. "When the Chaco is gone, that's it," he said. "So is the taguá."

Bertha, the world's 'oldest' hippo, dies at 65

published 10 July 2017

<http://www.bbc.com/news/world-asia-40558057>

Bertha - thought to be the world's oldest hippopotamus in captivity - has died in the Philippines, aged 65. The hippo was longest-serving resident of Manila Zoo, and staff say she was there, aged seven, when it opened in 1959. Her age cannot be independently verified as the zoo has no paperwork on her origins. However, the typical life span of a hippo is between 40 and 50 years. "Bertha was among the pioneer animals here," zoo director James Dichaves told AFP news agency. The zoo said she enjoyed a diet of grass, fruit and bread. Its oldest resident is now Mali, a 43-year-old Asian elephant.

Earlier this year, animal rights activists launched a petition calling for Mali to be transferred to a wildlife sanctuary in Thailand.

At least 27 hippos are massacred by villagers in a tourist zone of Niger after they blamed them for destroying crops and harming livestock

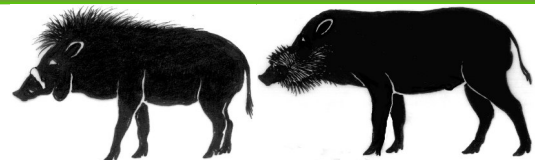
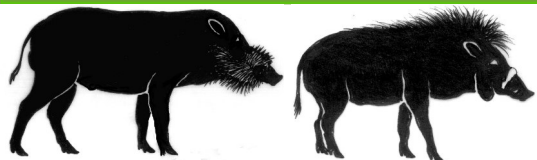
By Sophie Inge For Mailonline

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<http://www.dailymail.co.uk/news/article-4695914/At-27-hippos-massacred-villagers-Niger.html>

At least 27 hippos have been slaughtered in a tourist zone in western Niger by villagers who blame them for destroying crops and harming livestock, local authorities said on Thursday. The 'massacre started in March and then assumed dramatic proportions' mainly in island settlements on the Niger river, the prefect of the Ayorou region, Jando Rhichi Algaher, told AFP. Large





numbers of hippos and several bird species have made Ayorou, about 200 kilometres (125 miles) from the capital Niamey, a popular place for tourists. Patrols by troops 'have helped slow the slaughter', Algaher said.

'The locals have killed a large number of hippopotamuses, although this species is protected,' Environment Minister Almustapha Garba said on state radio. 'We urged the local people not to break the law and took note of their concerns,' added Garba, who promised to pay compensation to the affected farmers. Tension is high in Ayorou following the arrest of about 10 people suspected of killing a hippopotamus. Some of the suspects have been freed, Algaher said. In May, local tribal chiefs issued warnings about hippos, saying they were ravaging crops and threatening boats on the Niger river. In 2014, 12 schoolchildren aged between 12 and 13 were killed when a hippo attacked their boat on the Niger at Libore, a village near Niamey.

Angry hippo DROWNS a rhino as it defends its waterhole during a drought in South Africa

By Jamie Pyatt In Cape Town For Mailonline

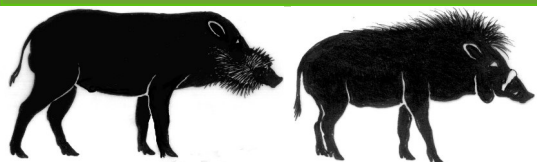
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<http://www.dailymail.co.uk/news/article-4619298/Angry-hippo-drowns-unsuspecting-rhino.html>

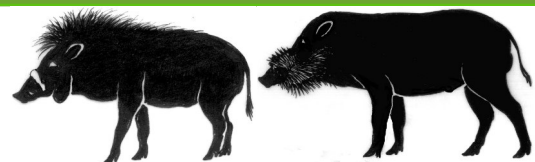
Rare footage shows an angry hippo drowning an unsuspecting rhino after it refused to leave a waterhole during a drought at a South African game reserve. As the rhino backs away from the duo, the first hippo opens its jaws and pounces on the intruder, dragging its head under the water. A game ranger at Inverdoorn safari park, near Cape Town, captured the shocking footage as he guided tourists to the waterhole just as the rhino approached to take a drink in the heat. But with water sparse in the Klein Karoo region in the Western Province, the hippo is clearly not happy to share what is left with a lone rhino with a raging thirst. The rhino appears bemused as the hippo bellows a loud warning and when it is not heeded, the giant beast leaves the safety of the waterhole and confronts it on dry land. The rhino – which is the second biggest land mammal and the hippo the third – would normally be firm favourite to win the encounter between the two big beasts over territory. But in this case the rhino – which had been dehorned to protect it from poachers – has lost the one deadly weapon that would have seen it fend off the jaws of the attacking hippo.

Unable to gore the hippo with its missing horn, the rhino is forced to give ground and it is literally bulldozed backward into the water and rolled over onto its back by its attacker. The hippo, having taught the interloper a lesson, backs off but tragically the rhino is unable to right itself in the glutinous mud and thrashes helplessly in the water until it drowns. The ranger told LatestSightings.com, which posts videos of African wildlife encounters on its





Articles in the news



website: 'This hippo was protecting his territory and was making sure he was not letting anyone else enter. 'We arrived at a dam to find a rhino on its way to get a drink. It seemed to be pretty dry, and this could have been the major cause for the hippos being over protective of the waterhole.'Hippo's become extremely aggressive in drought. As the hippo pushed the rhino into the water, a feeling of adrenaline took over, next was complete and utter shock mixed with disbelief. 'Never in a million years did I expect to see anything like this in my life. 'The hippo was protecting his waterhole and pulled out one massive attack on the baffled rhino. The rhino didn't stand a chance under the hippo's sheer force. 'It was hard to watch and not intervene, but that is nature. This is a very rare, rare sighting indeed. We stayed on at the sighting and watched how the hippo landed up drowning the rhino.

'It was like watching a bulldozer move mounds of earth. Truly incredible to see the power play'. The ranger said the rhino being dehorned to try and save it from poachers had ironically been the difference between life and death in this encounter. The game reserve is not being named to try and protect the rhino that are breeding there. The hippo is one of the most dangerous animals in Africa and kills 500 people a year and can outrun a human.

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These groups consist of technical experts focusing on the conservation and management of wild pigs, peccaries and hippos.

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Pigs, peccaries and hippopotamuses are nonruminant ungulates belonging to the Suborder Suiformes of the Order Artiodactyla (the eventooed ungulates). Within the Suborder Suiformes, pigs belong to the Family Suidae, peccaries to the Family Dicotylidae and hippopotamuses to the Family Hippopotamidae.

