Suiform Soundings

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Please email all contributions to future issues to emeijaard@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.

Photo front page: Borneo bearded pig (*Sus barbatus barbatus*) in East Kalimantan. Photo taken by REA Kaltim Conservation

Table of Contents

Editorial

First of all, a warm welcome to all readers of this new issue of Suiform Soundings.

I should start with expressing my warm gratitude towards Anne-Marie Stewart for her excellent editorial work. After I had initially run the newsletter for the first 7 years, Anne-Marie Stewart took over as editor and ensured the twice-annual production of the newsletter for the next 6 years. After the last issue she asked me to once more take on the editorial duties, and I agreed. Thanks to Anne-Marie, Suiform Soundings has managed to maintain and grow its readership, thus making an important contribution to the public interest in and conservation of wild species of pig, peccary and hippo.

I like to keep track of how we are doing in terms of number of people that download – and presumably read – Suiform Soundings, and also how often papers from the newsletter are cited. The previous issue, 12(1), was downloaded some 400 times, which I think is pretty good. Citation of the papers published in Suiform Soundings is still pretty rare, with an average of 5.2 cites per year. I guess interest in wild pig, peccary and hippo species is limited to a relatively small group of enthusiasts, at least when compared to more popular species groups such as primates, cats, or small carnivores. This is also shown in the much higher citation frequency of other newsletters such as Small Carnivore Conservation or Cat News. But at least that gives us something to target.

Many species of pig, peccary and hippo play important ecological as well as cultural roles. They are key prey species for many larger carnivores and also for millions of often forest-dependent people for whom these species are important protein sources. The decreasing population sizes of most of these species – possibly with the exception of the Wild Boar *Sus scrofa* – is therefore an issue not just of conservation, but also broader societal concern.

Suiform Soundings aims to contribute to the improved conservation of species of wild pig, peccary and hippo. More scientific and public attention to the fate of threatened and non-threatened species should help facilitate societal and political processes that lead to their improved conservation management. This is crucial for species such as the Visayan Warty Pig *Sus cebifrons* and Pygmy Hog *Porcula salvania*, that desperately need better conservation management, but also many other endangered and vulnerable peccaries, hippos and pigs.

The present issue, 13(1), covers a range of interesting topics, including the dynamics and spread of African swine fever; new records of white-lipped peccary; breeding news of babirusa and Chacoan Peccary; scientific illustration of warthogs; some observation of Bearded Pig migration; Pygmy Hog capture operations; captive breeding of Javan Warty Pigs; disease management in wild and domestic pigs; and a story about swimming wild boars in Japan.

I sincerely hope you enjoy this issue and look forward to your feedback and future contributions.

Finally, I would like to sincerely thank Thiemo Braasch, our new Managing Editor, for spending much of his spare time on the design and layout of this new issue Suiform Soundings and Rafael Reyna for expertly handing many other editorial issues. It would be fair to say that without Thiemo and Rafael this issue would not exist.

Erik Meijaard
Jakarta, Indonesia

News from the Conservation Breeding Activities for the Javan Warty Pig in Cikananga

by Stephan Bulk

After the workshop on Southeast Asian wild pigs in Cikananga last November we worked hard to implement the suggestions (and include own new ideas) for the improvement of the breeding enclosures for the Javan Warty Pigs. This work started on November 25th 2013.
The first step was to complete with concrete walls (about one quarter) the five new pig enclosures. These concrete areas were built at the lowest part of the enclosures due to the high rainfall in Cikananga. There, we also built a drainage system to let the water run out of the enclosures. The whole work was finished by November 30th 2013.
Then, I have decided to build brick walls on three sides of the already existing rainshelters in all pig enclosures and to pad them with rice straw and elephant grass. The aim was to be most flexible at all stages to have enough breeding boxes for the pigs. By doing this we avoided to take all pregnant sows to the new enclosure. The work started November 18th and was finished by November 30th 2013.

Occasionally, we have had problems with the pigs hooves. To solve these problems we have modified the central house, which was used for deer formerly. It is comparable easy to handle the pigs in this house and to treat them medically if needed. We built concretes ground floors in all enclosures there except for one small area, which will be used for sun and sand baths. As the pigs are very nervous we have also decided to built a small shelter in every enclosure as a hiding place. Furthermore, every enclosure got a drainage. These activities took place from 14th to 20th February 2014.
At this point we were prepared for the new piglets to come. The separation of the pregnant sows was the most critical part of the keeper's work. He did his job meticulously, patiently and with a very good power of observation. We have had many complications with pregnant warty pig sows in the past. To avoid these complications we separated all sows with their piglets during the important time between March and April. Due to lack of space we also had to use the enclosures with the rain shelters. This was a very good decision as three sows used them to give birth to their offspring.

Figure 1. Male Javan warty pig in Cikananga. Photo: Thiemo Braasch

After all these changes the Javan warty pigs' offspring in Cikananga of this year is as follows:
The sow Dayang gave birth to three piglets on March 28th. It was the second offspring in her life.

The sow Merapi gave also birth to three piglets one day later, also the second offspring in her life. The sow Novi gave birth to three piglets, her first offspring ever. This happened on March 30th. The keepers were very watchful and realized that the sow Semi, a pig of the F1-generation, was pregnant. She was separated from the other adult pigs and then gave birth to three piglets. One other sow gave birth to a piglet, which died soon after. Another sow did not give any birth, apparently, because she had piglets twice last year (in April and November 2013).
The Cikananga Wildlife Center is keeping two Javan warty pig sows from Surabaya Zoo. We do not expect to get offspring from them because they are already five years old and never had any piglets. It seems that they cannot reproduce anymore.
We are happy with this year's offspring (12 piglets in good conditions from 13 piglets born, only one is dead), compared to 13 piglets last year from which only three have survived until now. We do not know the paternity of the piglets as three sows were kept together with three boars, one even with four of them. Therefore, it is difficult to distinguish different blood lines. To keep the blood lines under control we want to build smaller enclosures before the next mating season and to keep the Javan warty pigs as pairs, however, we do not know, if this breeding plan will be successful.

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WPSG website update

by Erik Meijaard, Chair Wild Pig Specialist Group

I would like to provide a brief update about the WPSG website. The figure below indicates that since its launch in January 2013, the average monthly number of site visitors has doubled from between 300 and 400 during much of 2013 to between 600 and 800 in 2014, which is positive news for our group. Most of our visitors still come from the United Stated and United Kingdom (together 46 % of all visits), with the Philippines, Australia, Indonesia, and Brazil accounting for the next 15 % of visits.

Observations on *Sus barbatus*

by Erik Meijaard

Little is known about the ecology of the Bornean Bearded Pig (*Sus barbatus barbatus*), with most insights derived from indirect observations (e.g., hunted animals), brief ecological studies or information from interviews (Caldecott 1991; Caldecott et al. 1993; Kempe 1948; Meijaard 2000; Nielewski & Preuss 2001; Pfeffer & Caldecott 1986). Bearded pigs are well-adapted to the extensive dipterocarp forest of Borneo and Sumatra. This tree family if often dominant in lowland and hill forests, and is characterized by synchronized flowering and mast-fruiting behaviour. Fruiting events are thought to play a major factor in determining group size and ranging behaviour in Bearded Pigs. Caldecott (1991) summarized a range of population states of bearded pigs in Borneo and Malaysia in relation to forest types and fruiting phenology. These states included dispersed, static pig populations exploiting small, dispersed, unpredictable and discontinuous 'background' food sources, with low breeding and growth rates and local movements only. One of the intermediate states were small to large populations moving regularly to exploit concentrated, predictable and discontinuous target food sources, with breeding and growth linked to activity of food sources,, and with both short-range and long-range movements. Finally, Caldecott described the state for which Bearded Pigs are best known, the supra-annual eruptive migrations, as having large and expanding populations exploiting an exceptional supply of background food available over a period sufficient for several litters to be raised to sexual maturity, with high breeding and growth rates characteristic, and long range movements.

Camera trap photos from northern Central Kalimantan taken in November 2013 showed several individual sows with young litters (Figure 1), including one picture of two similar-sized females together with at least 13 piglets.

Photos from the same area taken 6 months later on 20 May 2014, showed relatively large groups of pigs moving through the area with adult females and younger animals (Figure 2). Within the space of 7 hours, one camera positioned along a hill-side trail showed first 1 solitary male pig, then one group of 12 pigs, then a group of at least 30 pigs, then one of 12 pigs, and finally one of 7 pigs. All groups included adults females and young or young adult pigs. I note the unusual skin pigmentation or possibly skin disease in many of these animals (Figure 2).

Figure 1. Photo taken in November 2013 of a Bearded Pig sow and her 8 striped piglets.

Many dipterocarp trees in this area consisting of mixed dipterocarp forest on mineral soils and heath forest on sandy soils were seen to be flowering in March 2014. Considering that farrowing occurred prior to flowering, it is unlikely that its timing was caused by this particular local flowering event, unless both pig reproduction and floral cues were triggered by earlier climatological events, such as an aseasonal drought (Ashton et al. 1988; Sakai et al. 2006). The formation of intermediate-sized pig groups (up to 30 animals) does seem

to coincide with the availability of Dipterocarp fruit several months after flowering.
Despite the small sample size and limited insights provided by these pictures, I call on other people using camera traps in areas where wild pig species occur to send us their dated pictures, as in aggregate these might provide some useful insights into pig behaviour or morphology that will ultimately help us in conservation management.

Figure 2. Bearded Pigs moving in groups consisting of adult females and young adult pigs.

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Apparent albino or light form of Bearded Pig (*Sus barbatus barbatus*) from northern Central Kalimantan, Indonesia

by Erik Meijaard

The camera trap pictures below of a very pale form of Bearded Pig were taken in a mountainous area in north Central Kalimantan Province, Indonesia. The coloration of bearded pigs varies from blackish in young pigs, to a paler reddish brown, yellow-grey or almost buffy white in adults, while mud baths can alter their apparent colour (Meijaard 2000). It is difficult to tell from these photos but the pig in the fore ground does seem to be genuinely paler coloured compared to other animals in the group. Whether it is an actual albino form is impossible to tell from these black and white photos.

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PYGMY HOG CAPTURE OPERATIONS

Three wild pygmy hogs join the captive population as eleven more captive hogs are ready to go back to the wild

by Goutam Narayan and Parag Jyoti Deka

The Pygmy Hog Conservation Programme (PHCP) has added three more wild pygmy hogs (*Porcula salvania*) to the captive population of this Critically Endangered and unique member of wild pig family. The recovery programme, that has successfully reintroduced two populations in Assam, was started with just six wild founders in 1996 and has already released 74 captive bred hogs in the wild over the last six years. Two more social groups of hogs were released in May 2014. The captive population needed new blood to improve the survivability of the future reintroduced populations. After trying for two weeks the project team managed to trap a male and two female pygmy hogs from the last remaining original population on earth to enhance the genetic diversity of the sole captive population of the species.

Figure 1. Capture operations: Nets being deployed.

The International Union for Conservation of Nature (IUCN) ranks pygmy hogs as one of most critically endangered mammals of the world. Indian Government's Ministry of Environment and Forest too puts it on top of a list of ten most endangered mammals of the country. A tiny original population of the species survives only in Manas National Park of Assam, from where the earlier founders as well as the three new hogs were captured.

Figure 2. Elephants line up to chase the Pygmy Hogs.

The habitat of the animal is restricted to alluvial grassland plains south of the Himalayan foothills, specifically in the Brahmaputra valley. The reintroduction sites are located in Sonai Rupai Wildlife Sanctuary and Orang National Park of Assam. A total of 35 pygmy hogs (18 males, 17 females) were released in Sonai Rupai between 2008 and 2010. In Orang, 39 hogs (18 males, 21 females) were released in 2011, 2012 and 2013, and 11 more were released in May 2014. These numbers are significant in the light of the fact that the last naturally surviving population of the species in Manas may have less than 200 animals now.

Habitat restoration through better protection against livestock grazing and grass burning is helping establishment of reintroduced populations that may help prevent early extinction of the species.

Preparations for 2014 capture operations

Required permits to capture up to 6 pygmy hogs from Manas National Park were obtained from the Forest Department, Govt. of Assam and the Ministry of Environment and Forest, Govt. of India. The mahouts and the Range Officers were consulted about using captive elephants and field staff of the Park during capture operations.

Four custom made capture nets were procured. These were locally hand woven using jute fibre and measured about 1 m high, 10-15 m long each, with a mesh size of about 10 cm. Six custom built wooden crates and vehicles for transporting the hogs were also arranged. A kit with all necessary veterinary aid was kept ready and a sedative (Azaperone - Stresnil®) and microchip transponders (Trovan® 100) imported from the UK were acquired.

Surveys to identify capture locations in Manas were conducted five times since 2011 in consultation with *mahouts* and some experienced field staff of the Park. Specific grassland blocks within these locations were surveyed every fortnight between January and March in 2012 and 2013. Pygmy hogs are incredibly shy and are almost never seen. Tracking of these animals is normally achieved

Figure 3. Part of the capture team in Manas (excluding the Project Manager and two staff members who took a hog away).

Figure 4. Caught hogs in bags taken to the cars.

by monitoring their nests, droppings, footprints or foraging marks. It was decided to mount capture operations in March, after the extensive annual grass burning takes place between December and February, when the hogs become restricted to few small unburnt patches.

Capture was attempted in 2012 too but the operations were delayed due to bureaucratic hurdles and the attempts could be made only in May. By then the grass had grown after pre-monsoon showers in April and the hogs had dispersed, making it extremely difficult to trace them. It was not possible to catch any hog due to unsuitable timing and it was decided to carry out the operations in March 2013.

Capture operations

The only known method of catching wild pigmy hogs unharmed is by flushing them from cover into a series of 3-4 nets deployed over a length of 40-50 m in dense grass using elephants and pedestrian beaters. The use of elephants is necessary owing to presence of potentially dangerous animals in the grasslands. The elephants also facilitate passage through the densest and tallest patches of vegetation.

Altogether 72 capture drives were conducted on six days between 7th and 19th March. On the first day the attempt was made in the Panbari or western range of Manas where it was not possible to get any elephant and operations engaged about 48 people, including volunteers from Saurang village, local forest guards and staff from different projects of EcoSystems-India. Despite a dozen drives no pygmy hog was flushed, although a few signs of the animal were seen earlier at the location.

Operations on other five days were carried out in Bansbari or central range of the Park and here it was possible to engage 8-10 trained elephants along with 5-6 juvenile elephants. Beside these 13-15 elephants about 30 personnel including forest guards, mahouts, their helpers (ghasis), and staff from different projects of EcoSystems-India were involved. About 10-15 drives were conducted each day in the mid-morning and early afternoon at over two dozen locations in an area of about 6-7 km^2 around Kuribeel camp. The grass height was around 0.5 - 1 m in burnt areas and over 2 m in dense unburnt patches. Altogether 15 pygmy hogs were flushed in this area in 60 drives, and 3 were captured – a pair on 15th March in a patch about a kilometre north of Kuribeel camp and a female on 18th March in an area about ¾ km NNE of the camp.

All the hogs were flushed within 1 - 1.5 km radius of Kuribeel camp in Bansbari range and drives conducted in potentially suitable grasslands outside this area drew a blank. Several sites where pygmy hog signs and nests were found during the surveys were badly burnt and there was no cover left for the hogs to hide at these locations. During 1996 capture operations (Oliver et al. 1997), 42 pygmy hogs were flushed in 57 drives conducted over six day period. Fifity-two of these drives were conducted in some of 'best' remaining pygmy hog habitat in the Park and were located in more or less the same area from where 11 pygmy hogs were trapped in 1996.

Incidentally, the drives in Bansbari range also flushed 20 hispid hare (*Caprolagus hispidus*) of which 6 were captured in the nets but were released immediately.

Translocation to Potasali centre

The captured hogs were carefully removed from the net and were carried to Kuribeel camp in separate bags. They were sedated with Stresnil® (Azaperone) injection within 10-15 minutes and put in individual crates along with a bunch of grass and some soil from the capture site. They were first taken to project camp near Bansbari Range Office and crates were kept in a cool, ventilated and clean room. After obtaining necessary transport permit from the Range Office the hogs were taken to Potasali Centre of PHCP at night in a project vehicle customised for the purpose. On both occasions, the Project Manager and Vet accompanied the animals and kept them under observation by inspecting them at regular intervals. The hogs reached Potasali without any problem and the opened crates were kept in newly built enclosures with grass cover, allowing the hogs to come out and explore on their own. Although a choice of favourite food was placed in the enclosures, the hogs started nibbling at them only after 2-3 days. They however drank water within a day after arrival.

Acknowledgements: The PCCF-WL and Chief Wildlife Warden, Assam, and the Field Director, Manas Tiger Reserve for permissions. The Range Officers and staff at Bansbari, Panbari and Bhuyanpara Ranges of Manas NP, specifically the mahouts, ghasis and some frontline protection staff of the Park for assistance during capture. Volunteers from Sourang village at Panbari and staff of Assam Haathi Project, Greater Adjutant Project and PHCP.

PHCP is a collaborative project of IUCN/SSC Wild Pig Specialist Group, Durrell Wildlife Conservation Trust (DWCT), Forest Department, Govt. of Assam and the Ministry of Environment & Forest, Govt. of India. It is implemented in Assam by EcoSystems-India. The project is currently supported by IUCN-SOS (www.sospecies.org) and DWCT (www.durrell.org).

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Figure 5. Pygmy Hog female near nest.

Rare Babirusa Triplets and Chacoan Peccary Triplets at Los Angeles Zoo

by Jeff Holland

On 27 May 2014 the Los Angeles Zoos female babirusa (*Babyrousa celebensis*) gave birth to triplets. The birth of triplets in babirusa is a rare occassion having happened only once before, also at the Los Angeles Zoo on 16 December 1989. On average the babirusa will give birth to a single offspring and occassionally twins. Unfortunately only two of the three piglets survived.

The North American population of babirusa currently has 62 animals in 15 institutions. This is the largest the population has been since the babirusa arrived in zoos in North America back in 1929. In the wild the endemic babirusa is considered Vulnerable by the IUCN and is under constant threat from hunting and habitat destruction.

On 3 June 2014 the Los Angeles Zoo also had triplets of Chacoan peccaries (*Catagonus wagneri*) born. These three peccary pups are the 21st, 22nd and 23rd peccary pups born at the Los Angeles Zoo since 2001 when the zoo first began working with the species. The current North American population of Chacoan peccaries stands at 68 animals in 16 institutions. This does not include the 12 animals residing at the Tierpark Berlin or the 75 animals at the Chacoan Conservation and Research Center (CCCI) in Toledo, Paraguay.

The IUCN considers the Chacoan peccary as Endangered and there are fewer than 3,000 remaining in the Chaco of Paraguay and Bolivia. The species is thought to be extinct in Argentina, but further investigation is needed to confirm. The species, like the babirusa, is under threat from hunting and habitat destruction. Currently CCCI is the only Conservation Project dedicated to the conservation of the Chacoan peccary. For more information please go to www.CCCipy.org

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Figure 1 (above): Female babirusa and her two piglets.

Figure 2 (below): Chacoan peccary piglets.
Both photos taken by T. Motoyama, Los Angeles.

Distribution and status of swimming wild boars (*Sus scrofa leucomystax* and *Sus scrofa riukiuanus*) in Japan

by Shunjo Takahashi

Swimming wild boars

Swimming bearded pig (*Sus barbatus*) (Oliver,1995; Meijaard *et al*.,2011) and babirusa (*Babyrousa babyrussa*) (Melisch,1994) have been reported. In Japan, recently, swimming wild boars have been frequently observed. There are two subspecies of wild boar in Japan, *Sus scrofa leucomystax* and *Sus scrofa riukiuanus*. The former has maintained its habitat in the Main Islands of Honshu, Shikoku and Kyushu, on the other hand the latter in the Nansei Islands(Amami Island, Tokuno Island, Okinawa Island, Ishigaki Island and Iriomote Island).

Recently there are numerous, apparently reliable, accounts of wild boars crossing sea and lake, from the area they have occurred to coastal or offshore islands.The photo of figure 1 was taken by Japanese Marine Safety Office whilst on patrol on 30 October 2008 at about 12.25 hours. At this time, a single wild boar (*Sus scrofa leucomystax*) was observed crossing the Sea of Japan. This wild boar was found trying to swim from the Main Island of Shikoku to Shoudo Island, about 7km away (Takahashi, 2013). In the Edo era (1603-1867), farmers built stone fences to protect their crops in Shoudo Island. This old fence named *Shishi-gaki* (figure 2) was constructed around the Island to prevent the entry of wild boars (Takahashi, 2010). This *Shishi-gaki* was estimated to be over 100km long. In 1875, however, wild boars were said to have become extinct due to swine fever. In this island, today, farmers started to build electric fences and wire netting fences again for wild boars which came here by swimming. In this island, recently the feral *ino-buta* (the cross between domestic pig and wild boar) also occurred. Both wild boar and feral *ino-buta* appear to have merged. As indicated figure 3, wild boars have occurred on many islands since around 1980. The number of these islands is over 100, and wild boar is new-comer in many islands. Today wild boars are known or reported from many coastal and offshore islands, as well as islands of Lake Biwa in Japan. They are sometimes observed by fishermen, crews of regular liner and Marine Safety Offices.Maximum distances of swimming have been estimated at about or over 20km. Wild boars have been observed swimming, having

Figure 1. This photo of a swimming wild boar was taken by Japanese Safety Office whilst on patrol on 30 th October 2008 at about 12:25 am.

Figure 2. Stone fence on Shoudo Island.

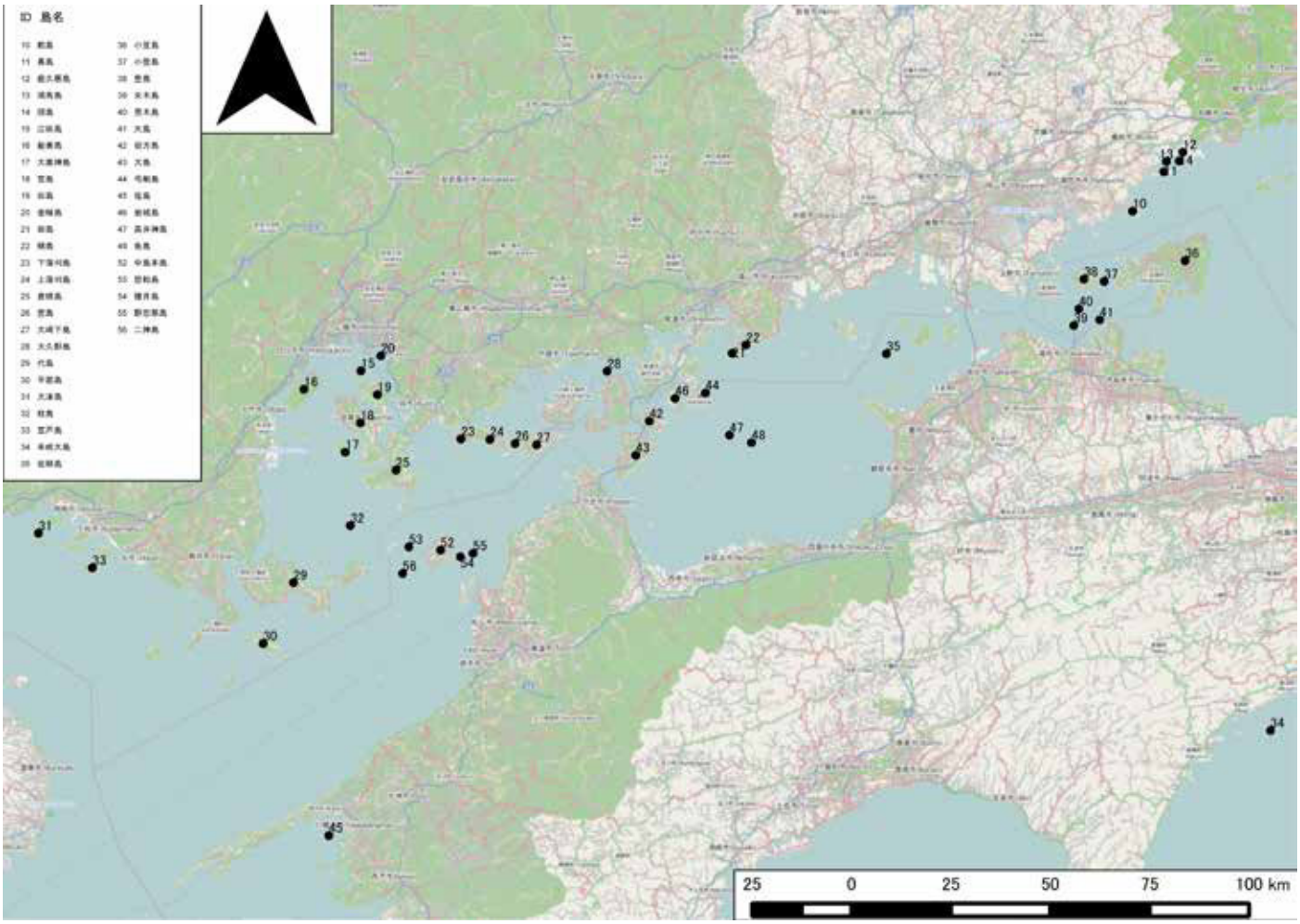

Figure 3. Islands in the Inland Sea of Japan where wild boars swam to the shore. The author collected the information through field surveys and questionnaires.

part of their head such as snout, eyes and ears above the water surface. Sometimes their backs and standing tails also above the water surface. A swimming speed was measured at about 4 km/h in a case of the wild boar (*Sus scrofa riukiuanus*) that crossed the channel between Amami Island and Kakeroma Island, a distance of about 2 km, on 14 February 1994. Wild boars are powerful swimmers and able to swim a long distance. Mass media is interested in these situations because new-comers bring serious damage to agricultural crops. Figure 4 is a press report on swimming wild boar, and this photograph was also taken by Japanese Marine Safety Office whilst on patrol on 15 November 2002 at about 12.05 hours. In this time, two wild boars (*Sus scrofa leucomystax*) were observed crossing the Inland Sea of Japan in Hiroshima Prefecture.

Backgrounds and motives for swimming to islands

Recently the range of wild boar has extremely extended in Japan. We can recognize that human activities such as increasing abandonment of cultivated land, fruit garden and bamboo garden, have encouraged expanding wild boar range (Takahashi, 2012). Many wild boars took over these new habitats in these areas and now they distribute quite widely. This invasion of wild boar also occurs due to decreasing rural manpower through the recent aging of society. In recent years, we have seen remarkable problems such as damage to agricultural crops done by wild boar. The annual cost

of agricultural damage done by wild boar is estimated at over ¥5 billion.Hunting with dogs for wild boars, in both hunting season and control season, has also extremely increased in coastal areas and cape areas to which wild boars extended. Unfortunately, this intense hunting pressure has resulted in pushing wild boars into sea and lake. This is a big factor. Wild boars which are chased and dive into the water seek to move away from the pursuer. After swimming, some wild boars succeed in landing on island. However, on the other hand there are reports of dead wild noars drifting ashore. Some hunters and local people believe that wild boars swim for seeking food, as well as mating. We have to examine these possibilities in the area where islands necessarily close enough for wild boars to detect them. Detection would occur by smell and sight.

Wild boars are known to have an acute sense of smell. Winds carrying smells from an island could induce wild boars to make a swim. Some hunters believe they are not short-sightedness, however they are said to be short-sightedness animals. In Japan, wild boars swim at both daytime and nighttime. Anyway, they can swim well.

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Figure 4. Press report about swimming wild boar. This photo was taken by Japanese Safety Office whilst on patrol on 15 th October 2008 at about 12:05 am.

Illustrating a "Kneeling" Warthog

by Nora Sherwood

I recently graduated from the University of Washington's Natural Science Illustration Certificate Program, and am now working as a science illustrator and wildlife artist. The program is just one of a handful that focus entirely on "art in the service of science". It lasts one full school year, and courses include botanical, vertebrate, invertebrate and wildlife illustration. We learned how to accurately depict subjects, often combining several specimens to arrive at a rendering that illustrates an accurate ideal rather than portraying one idiosyncratic specimen. We also learned how to partner with scientists to highlight and emphasize important or distinguishing features in a way photographs cannot, often providing diagrammatic views from a variety of angles or scales, in cut-away or cross section views.

During the program, one of our final projects was to construct a series of images (bones, muscles and exterior) of an animal in 3/4 view in some sort of "action pose," a project that involved putting to use everything we had learned. I selected the warthog for my final project, and was able to access a skull through the University of Washington's mammal collection. I was also able to sketch and photograph a pair of warthogs at the Woodland Park Zoo in Seattle. But despite my own searching

Figure 1. Many pieces of tracing paper were sacrificed to come up with a final sketch of the skeleton.

as well as that of the university's biology librarian, I did not have access to an image of a warthog skeleton until I was kindly helped by Dr. Jean-Pierre d'Huart.

Warthogs' long legs give them a rather graceful and bouncy gait, and also allow them to run very fast. But because of the disproportionately large head, short neck, small body and long legs, it is difficult for the warthog to get its head down to the ground to graze. Other mammals have developed interesting adaptations to address this same challenge, including the elephant's trunk and the giraffe's long neck. I was particularly interested in the warthog's amazing "kneeling" adaptation to lower its head to the ground, and wanted to focus on it for my project. As I am sure you know, thick wrist callosities on their carpal bones make it possible for warthogs to comfortably feed in this position. These wrist callosities form in the embryo, indicating that their presence is a genetic mutation. Because they are born with the calluses, even baby warthogs will kneel to feed!

It took me many hours and many pieces of tracing paper to "pose" the warthog's bones into the kneeling position. I started by breaking the body into its major components (head, neck, rib cage, hips, legs) and drawing them as blocks to gain an understanding of their basic geometry and their relation to each other. One thing I discovered in the process is that in the pose I chose, my warthog's back-end is facing more forward than is his neck and head. The back right leg is almost facing forward while the head is definitely in 3/4 view. That's a good example of the sort of thing that needs to be considered to draw the leg and hip bones and ribs correctly.

From there it was relatively easy to lay the muscles on top of the bones, although I have to admit that I adapted domestic pig muscles for that layer (so there may be inaccuracies there). Finally I made a drawing of the warthog itself. All the layers were first rendered in graphite, and then in colored pencil, working on film so that I could visually overlay them while I was working on them. The final image was assembled in Photoshop so that I had complete control over the opacity of each layer and could decide how much of the bone and muscle to show through each layer. Finally I created the educational "poster," which also includes a skull composite I had rendered.

I have to say this project was at times very difficult (and even frustrating), but I really enjoyed learning more about warthogs, their habits and habitat. I have now rendered highly detailed images of many animals and plants. The close scrutiny required to create this type of art never fails to reveal amazing beauty, even in the most humble subjects. I hope to use the skills I have gained to help scientists communicate with one another and with their audience (peers, students, the general public). !

Figure 2. Warthog layers - bones, muscles and exterior in „kneeling" poisition.

Figure 3 (next page). Final education layout.

Warthog

(Phacochoerus africanus)

Hair and skin

Warthogs have long manes that run down their spines, and sparse hair that covers their skin.

Temperature control

Because they don't have fur or subcutaneous fat, warthogs are susceptible to temperature extremes. Wallowing in mud helps keep them cool, and burrowing in dens keeps them warm.

Warts

This youngster has not developed significant "warts" yet, but will in time. The warts that give warthogs their name protect eyes and jaws during ritualized head duels.

Legs

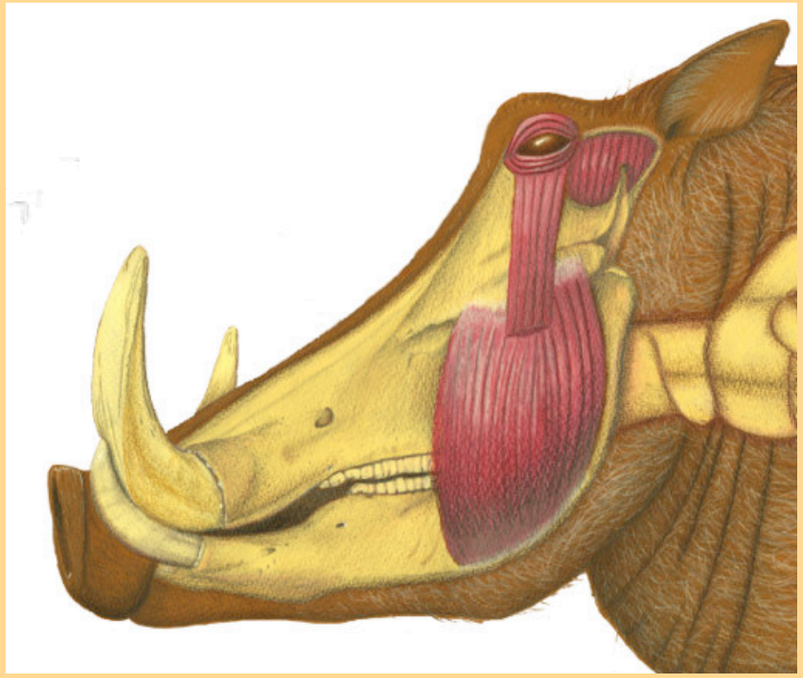
Long legs gives warthogs their characteristic springy step, and also allow them to flee from predators at surprisingly fast speeds of up to 35 miles an hour.

Wrist callosities

Calluses on warthogs' writsts allow them to "kneel" to eat. In this position they can shuffle around to graze and dig up roots.

Diet

Grasses are the main diet, but warthogs will also eat fruits, bark, fungi, earthworms, scorpions and even small birds



In addition to facial warts, the warthog's four **tusks** (shown above) are their most noticeable feature. These tusks are large canine teeth which grow continuously during the warthog's life, and can be as long as 10 inches. The top tusks are primarily used in ritualized head duels among warthogs to establish domination or even for play within the sounder (group of warthogs).

As the lower tusks constantly rub against the upper tusks , they are honed to a razor-sharp edge. These tusks are usedin a slashing motion for serious self-defense against predators.

Warthogs have a rather graceful and bouncy gait. But because of the disproportionately large head, short neck, small body and long legs, it is difficult for the warthog to get its head down to the ground to graze. Other mammals have developed interesting adaptations for similar reasons, including the elephant's long trunk and the giraffe's long neck. The warthog's amazing adaptation is its ability to "**kneel**" on its wrists to lower its head to the ground. This behavior is made possible by the presence of thick wrist callosities on their carpal bones. These wrist callosities form in the embryo, indicating that their presence is a genetic mutation. Because they are born with the calluses, even baby warthogs will kneel to feed.

Mature males have three sets of **warts** on their faces, while females have two sets (none on the snout). These warts protect their heads from blows received during highly ritualized head duels.

Sources:
East African Mammals, Jonathan Kingdon
Wikipedia

African swine fever and the risks of its spread to new territories and wild pig species

by Ferran Jori

African swine fever (ASF) is one of the most devastating infectious diseases of swine. Caused by a DNA virus from the *Asfaviridae* family, it does not affect humans or other species than wild and domestic pigs, but represents a serious challenge for the pig industry worldwide. Highly contagious and with a very high mortality rate, the disease is endemic in most of Sub-Saharan Africa and Madagascar. African wild pigs –warthogs (*Phacochoerus* spp.) and bushpigs (*Potamochoerus* spp.) play a role in the maintenance and dissemination of the disease: they are susceptible to the virus but they are resistant to the infection (Jori and Bastos, 2009) and they contribute in maintaining and disseminating the virus in the environment. In East and Southern Africa, the virus is maintained in a sylvatic cycle between warthogs (*Phacochoerus africanus*) and the argasid ticks from the *Ornithodoros moubata* complex. For bushpig species, it is known that they can become naturally infected. However, their role in the maintenance and transmission of the virus to domestic pigs remains unclear and deserves further investigation (Jori and Bastos, 2009; Ravaomanana et al., 2011).

The disease can take several forms and its symptoms, fairly unspecific (fever, loss of appetite, prostration, diffused hemorrhages), can be confused with many other swine diseases (see http://asforce.org/flyers/asforce-en.pdf). What really distinguishes the disease is its high morbidity and mortality, a large proportion of the infected animals dying 1 to 3 weeks after infection.

Since the discovery of the virus in Kenya (Montgomery, 1921), ASF has colonized new territories out of Africa on a number of occasions (Sanchez-Vizcaıno et al., 2012) affecting domestic pigs, feral pigs and wild boars (*Sus scrofa*). In 1957, the virus spread from Angola to Portugal and from there to several European countries in the 1960s and to the Caribbean and Brazil during the 1970s. It was eradicated from all these new territories, except for the island of Sardinia where it remains endemic until today. In 1988, the disease was introduced into Madagascar where it remains endemic. In 2007, the disease spread again from Mozambique into Mauritius (Jori et al., 2013) and the Caucasus (Georgia). Since then, it has spread northwards and westwards into 6 neighboring countries: the Republic of Iran (Rahimi et al., 2010), the Russian Federation, Ukraine (Khomenko et al., 2013), Belarus, and Latvia, and more recently it has reached the EU territory, with some cases reported in Lithuania and Poland (Anonymous, 2014). Although, ASF transmission was partly caused by unregulated transportation of infected pork and pig products, there is evidence that direct contact between wild boars and domestic pigs likely played a central role in the spread of the virus (Gogin et al., 2013). Just in Russia, more than 400 outbreaks have been declared in domestic pigs and around 600 cases in wild boars. In that country, infection in wild boar occurs mostly at the end of the spring and winter, which is the time when those populations scavenge on illegally disposed ASF-infected pig carcasses from domestic farms. Many of the cases of transboundary spread have been also attributed to wild boar (Khomenko et al., 2013). It is known that ASF virus does not generally persists for a long time in isolated wild boar populations. In that species, the virus is just as severe as in domestic pigs (Jori and Bastos, 2009). Therefore, in the absence of new sources of virus, the disease spreads rapidly leading to localized epidemics where most of the population dies (Khomenko et al., 2013; Perez et al., 1998). With those high mortality rates, it is unlikely that wild boar can act as a suitable reservoir as do African wild pigs. More likely, wild boar populations act as sentinels for unreported ASF circulation in domestic pigs. However, in cases of extreme wild boar densities, the disease could be maintained for longer periods. Therefore, information about

the location, abundance and density of wild boars is helpful to anticipate and predict the spread dynamics of the virus (De la Torre et al., 2013; Khomenko et al., 2013).

With new large endemic ASF regions developing, any country with a pig production sector is at risk of the introduction of the disease. This risk is particularly high for countries in Asia which maintain by far the largest population of domestic pigs in the world (Costard et al., 2009). In this scenario, the potential role of wild pigs in the dissemination of the disease and its consequences cannot be ignored, particularly considering that many Asian countries hold large populations of wild boars, but also important remaining populations of endangered wild pig species (Meijaard et al., 2011). To date, the effect of ASF on Asian pig species is unknown but is potentially devastating. To address this challenge, CIRAD is involved in a regional network developed to monitor and manage emerging animal disease risks in South East Asia (http://www.grease-network.org/). Equally, the EU and China are working together in a concerted action to survey the emergence of infectious and transboundary diseases in China through the LinkTADS Project (http://www.linktads.com).

From that perspective, knowledge on the occurrence, spatial distribution, density and abundance of wild pig species in Asia and South Asia can be useful to manage endangered wild pig populations and to anticipate the dynamics of pig diseases such as ASF in wild and domestic pigs. Outbreaks of ASF anywhere outside its presently known range should be closely monitored by the IUCN/SSC Wild Pig Specialist Group to anticipate whether ASF could add further pressure to already highly threatened endemic pig species.

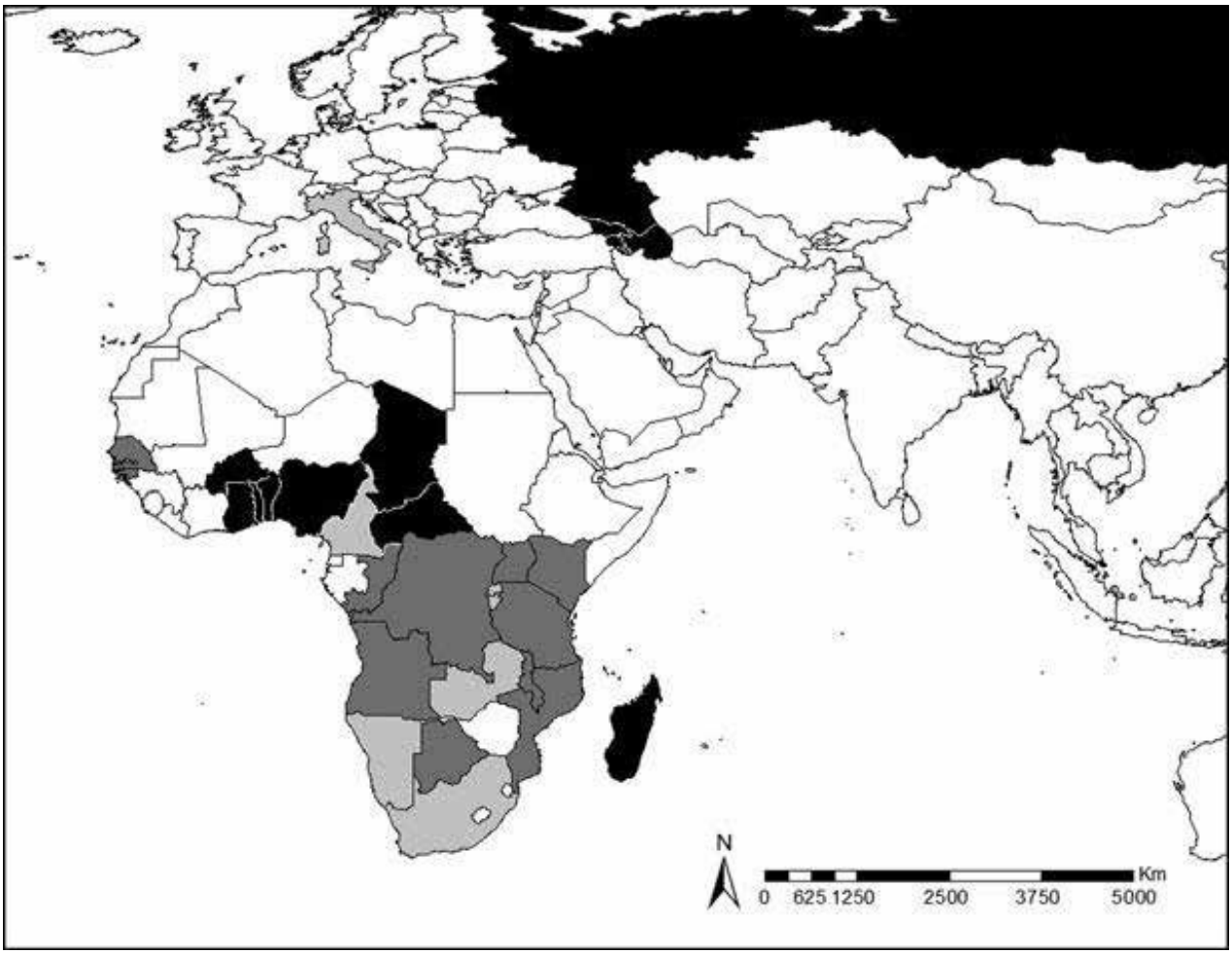


Figure 1. Countries affected by African swine fever.Light grey indicates countries where disease is limited to a few areas; medium grey, countries where infections occured before 1995; and black where infections occured after 1995. (Source: Sanchez-Vizcaino et al. 2012)

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Understanding the dynamics and spread of African swine fever virus at the wildlife-livestock interface: insights into the potential role of the bushpig, *Potamochoerus larvatus*

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Abstract
African swine fever virus (ASFV) is a serious animal disease of pigs, causing high mortality in domestic swine. In Africa, the presence of a sylvatic cycle involving wild pigs and soft ticks means that the risk of introduction of ASFV into domestic swine is always present. Although warthogs are considered the main wild vertebrate host of the virus in the endemic African setting, they are not the only wild African suids with a potential role in ASF epidemiology. The bushpig, *Potamochoerus larvatus,* is an elusive, nocturnal pig known to be susceptible to ASF, and with a natural interface with both warthogs and domestic pigs. The bushpig therefore may play a significant role in ASF epidemiology and serve as a link between the sylvatic and nonsylvatic cycle. This paper presents initial results from an ongoing study investigating the role of the bushpig in the epidemiology of ASF at the wildlife-livestock interface. African swine fever (ASF) is a fatal, haemorrhagic disease of domestic pigs,

Keywords: African swine fever (ASF), bushpig, *Potamochoerus larvatus*, epidemiology

Introduction

African swine fever (ASF) is considered one of the most devastating diseases of pigs. It is a highly contagious disease, caused by a DNA virus (ASFV) resulting in up to 100 % mortality in naïve domestic pigs. There is currently no vaccine or treatment and ASF control is carried out by diagnosis and elimination of infected animals. ASFV is currently endemic in large parts of sub-Saharan Africa (Penrith et al., 2013), where it has a severe impact on livelihoods, food security and trade (FAO, 2010). The epidemiology of ASF is complex with a sylvatic cycle involving the natural asymptomatic reservoirs of the virus, specifically the common warthog (*Phacocheorus africanus*) and soft ticks of the genus *Ornithodoros*. There is also a more recently evolved nonsylvatic cycle in which the virus is transmitted directly or indirectly from pig to pig and appears capable of persisting in domestic pigs in the absence of sylvatic hosts (Jori and Bastos, 2009; Jori et al., 2013). Historically the sylvatic cycle predominated and ASF outbreaks occurred as a result of spill over to domestic pigs at the wildlife-livestock interface. This corresponded well with the distribution of warthogs in Eastern and Southern

Africa (de Glanville et al., 2014). In recent decades, however, the importance of the traditional sylvatic cycle has diminished, and pig to pig transmission is now considered the most important modality of ASF spread and persistence in endemic areas (Penrith et al., 2013). This is attributable to increasing numbers and densities of domestic pigs, and the extent of live pig movements and trade, combined with a reduced contact between warthogs and domestic pigs, as warthogs become restricted to national parks and other protected areas.

Although warthogs are considered the main wild vertebrate host of the virus in African agrosystems, they are not the only wild African suids with a potential role in ASF epidemiology. The bushpig, *Potamochoerus larvatus,* is an elusive, nocturnal, medium sized wild pig with a relatively wide range in Eastern, Central and Southern Africa, known to be susceptible to ASFV. Naturally infected animals, detected by PCR have been reported from several countries, and like warthogs, experimentally infected bushpigs exhibit no acute clinical reactions. Infected bushpigs can transmit ASFV to susceptible domestic pigs directly, unlike the warthog, which has only been demonstrated to transmit indirectly through the tick vector (Anderson et al., 1998). The overlap between bushpig and domestic pig habitat is likely to be significant in many regions, since bushpigs unlike warthogs are known to move into communal lands to feed on crops. Anecdotal reports even describe free ranging female pigs being mounted by male bushpigs, suggesting the possibility of inter-generic hybridization and the possible introgression of *Potamochoerus spp*. genetic material into domestic pigs, although scientific confirmation is currently lacking. Close interaction in areas where ASFV is circulating may result in virus exchange between the two genera. Overlap between warthog and bushpig habitats in the national parks and reserves may also result in virus transmission in one or both directions, perhaps mediated by soft ticks. The bushpig may play a significant role in ASF epidemiology and serve as a link between the sylvatic and non-sylvatic cycle. The aim of the ongoing study is to investigate the role of the bushpig in the epidemiology of ASF at the wildlife-livestock interface. This short report presents initial data.

Materials and Methods

Capture and sample collection

Sampling sites were identified at the interface between farmland and national parks (Murchison Falls National Park and Lake Mburo National Park, respectively), in Uganda, with assistance of local hunters and the responsible District Veterinary Officer (DVO), and inside the park borders with assistance of Uganda Wildlife Authority (UWA) staff. Capture was performed using game capture nets (50x3 mts, 150mm square mesh, 3.5mm nylon braid khaki, ALNET Ltd, SouthAfrica; see fig 1), and bushpigs were sedated with tiletamine and zolazepam (Zoletil 100, Virbac Laboratories, France) at a dose of 300-350 mg/ adult pig (Kock et al., 2006). Serum and blood was collected from captured bushpigs and stored on ice in cool boxes, and one bushpig from each location was equipped with a GPS/GSM tracking collar of the harness type (Savannah Tracking Ltd, Kenya). To increase the sample size, local hunters were encouraged by the DVO to report bushpigs killed during hunts, to enable sampling. From these bushpigs samples of spleen, heart, lung and kidney were collected.

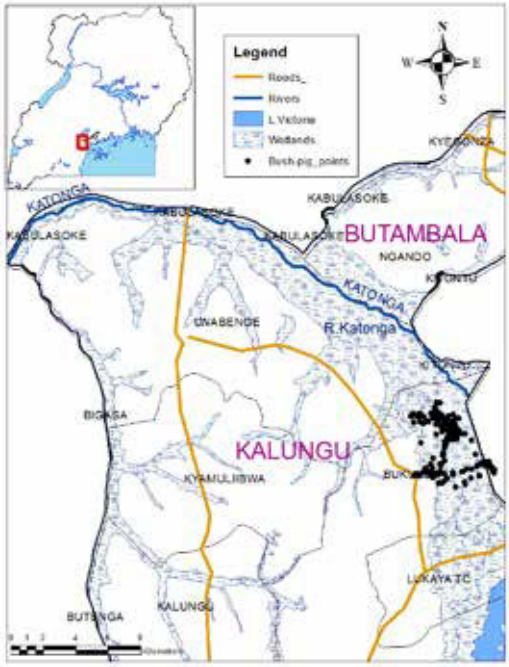

Figure 1. Map showing the location and home range of a bushpig that was captured and monitored during two months between late October and mid December 2010. Black dots represents collected GPS positions of the bushpig. For a more detailed map see figure 4.

Laboratory analyses

After each capture exercise, samples were transported on ice to the Molecular Genetics Laboratory in the College of Agriculture and Environmental Sciences, Makerere University, Kampala. Serum tubes were centrifuged at 2000 g for 10 minutes to separate serum from the clotted blood. Serum and whole blood were then aliquoted into duplicate 2 ml cryovials (Cryo.s, Greiner Bio-one, Wemmel). All samples were stored in duplicate at -20°C and -80°C as working and long-term storage sample aliquots, respectively. Serum samples were screened for presence of ASFV specific antibodies using a commercially available blocking ELISA (Ingezim PPA, INGENASA, Spain) in accordance with the instructions of the manufacturer. Positive samples were re-tested using the recently released SVANOVIR® ASFV-Ab (Boehringer Ingelheim Svanova, Uppsala, Sweden) indirect ELISA. The SVANOVIR® ASFV-Ab ELISA kit was used according to the instructions by the manufacturer.

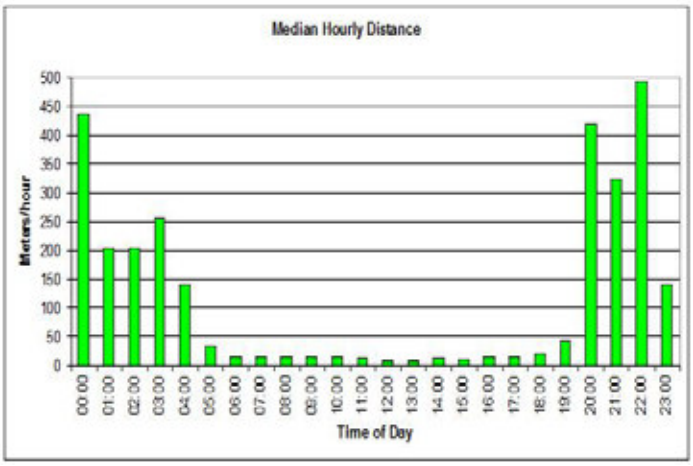

Figure 2. Average diurnal activity pattern: The bushpig showed as expected limited movements during the day and with peak distances travelled between sunset and midnight.

All blood and tissue samples were screened for presence of ASFV nucleic acids. In brief, genomic DNA was extracted using DNeasy Blood & Tissue kit (Qiagen, Duesseldorf, Germany) following the manufacturer's protocol. The extracted DNA was then used as template in a commercially available ASF real time PCR assay targeting the p72 gene (Tetracore Inc., Rockville, USA) according to the instructions of the manufacturer. The assay was optimized for use on a SmartCycler® (Cepheid Inc., Sunnyvale, California, USA).

Bushpig movement data

Hourly GPS position data from the deployed tracking collars was transmitted every 6 hrs to a database at Savannah Tracking Ltd (www.savannahtracking.com). Data was downloaded to the Savannah Data Manager software for further export and GIS analysis. Movement data could further be visualized in realtime through Google earth (www.google.com/earth)

Results and discussion

To date six bushpigs have been captured and sampled, and tracking collars have been deployed on four individuals in three different locations. In addition, samples have been collected from five bushpigs captured and killed by local hunters.

Blood and/or tissue samples from 11 bushpigs were tested for ASFV DNA, and so far one tested positive on PCR (CT 35.8). This bushpig was captured by local hunters in the farmland adjacent to the northern borders of Murchison Falls National Park, an area where several outbreaks of ASF have been reported and confirmed in domestic pigs during the last few years (Aliro et al., 2012). Serum samples from seven bushpigs were tested for presence of specific antibodies against ASFV, and two tested positive in both the blocking and indirekt ELISAs used. This is the first time seropositivity to ASFV has been demonstrated in bushpigs[1]. These bushpigs were captured within Lake Mburo National Park, an area with an abundant warthog population.

[1]Also reported as preliminary results in a student thesis by Björnheden, 2011, The Swedish University of Agricultural Sciences, Uppsala. http://stud.epsilon.slu.se/2355/4/Bjornheden_L_110314.pdf

Although tracking collars were deployed on four bushpigs, movement data was only successfully collected from two individuals. One bushpig was killed shortly after capture and the collar was left in a location from which it was subsequently recovered. The other bushpig was found dead at the site where it was initially captured, possibly due to stress and hyperthermia after capture and sedation (Jori et al., 2013). One of the remaining collared bushpigs was captured within Lake Mburo National Park, and all movements during the 6 weeks it was monitored were registered within the park borders and there was no possibility for interaction with domestic pigs. This was one of the seropositive bushpigs, and the absence of a natural interface with domestic pigs within the park borders thus indicates that the seropositivity was a result of exposure to ASFV within the sylvatic cycle, rather than through contact with domestic pigs. The fourth bushpig was captured in a swampy area bordering farmland where there was a high level of production and rearing of domestic pigs (see Figure 1). This pig was monitored for two months until it was killed by local hunters. Movement data showed limited movements during daytime, with most movement observed between sunset and midnight (Figure 2). The maximum daily travel distances were up to 12 km (Figure 3). During the day the bushpig rested in swamps or thick bush with nightly movements into farming areas where domestic free ranging 136 pigs are kept (Figure 4).

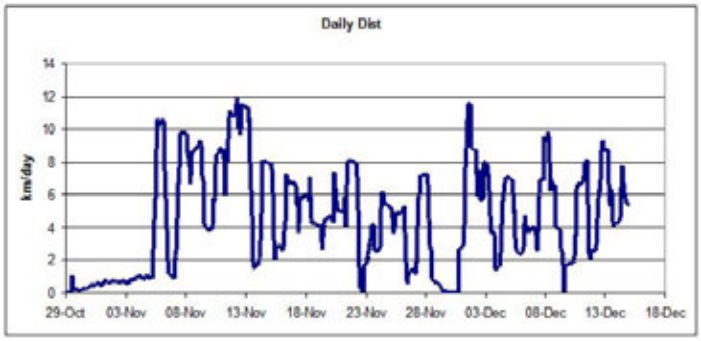

Figure 3. Daily travel distance: The bushpig moved up to 12 km per day but with very large variation between days with what could appear to be 2-3 day cycles of high and low movement. Note the initial resting phase following capture.

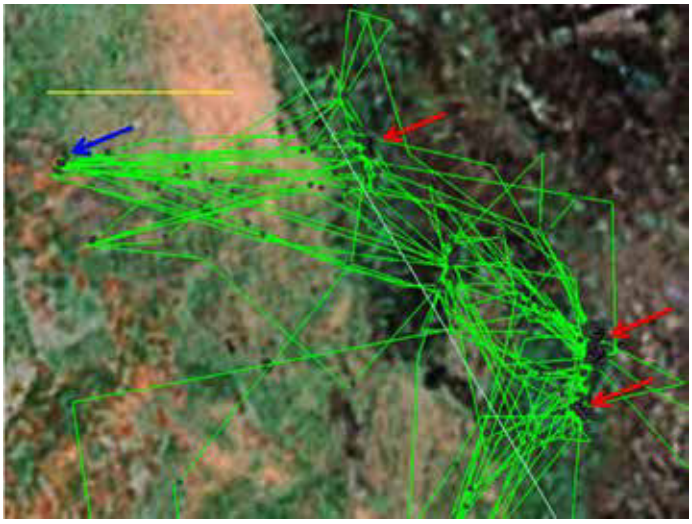

Figure 4. Bushpig movements monitored between 28th of October and 15th of December 2010. Yellow line = 1 km. sites in the swamps. Blue arrow: night time crop raiding of farms. Yellow line = 1 km.

These results confirm that bushpigs can be naturally infected by ASFV, and demonstrate for the first time that seroconversion occurs in some animals. This is also the first study in which tracking technology has been used to study the potential interaction of bushpigs and domestic pigs. The data clearly demonstrate a spatial overlap between bushpig and domestic pig home ranges. Additional GPS tracking data from bushpigs and from domestic pigs and from multiple seasons is required for in depth modelling of the spatial and temporal interactions between the two species, supported by molecular characterization of the virus genotypes present with in both species in order to determine the likelihood and direction of transmission between the two.

In conclusion, our findings are consistent with a role for the bushpig in the epidemiology of ASF, but additional data is required to confirm this.

Acknowledgements

We thank the field veterinarians and local hunters in Masaka and Gulu and UWA staff in Lake

Mburo and Murchison Falls National Parks for invaluable assistance during bushpig capture and sampling. This work was financed through the USDA/FAS cooperative agreement 58-3148-1-252. Support was also obtained through the Swedish Research Links Programme (Swedish Research council).

Figure 5. Bushpig in Lake Mburo National Park, Uganda. Foto: Karl Ståhl

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White-lipped peccaries with skin problems in the Maya Forest

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In recent years wild individuals of white-lipped peccary (*Tayassu pecari*) inhabiting the Maya forest, a tri-national forest shared by Mexico, Guatemala, and Belize, have been shown on camera traps with skin lesions that suggests Scabies infection is present in the population (Moreira-Ramírez *et al.,* 2007). As part of a monitoring program on ponds in the Calakmul Biosphere Reserve in Mexico and the Maya Biosphere Reserve in Guatemala carried out by the authors, several camera traps have been placed in strategic sites adjacent to the ponds during the dry season of 2008 to 2014. During all these years many photos of white-lipped peccaries wallowing or visiting the ponds during the dry season were obtained, however, in some occasions individuals with skin abnormalities such as hairless spots have showed up.

We have recorded white-lipped peccaries with hairless patches on the Mexican and the Guatemalan side of the Maya forest (Table 1).

Table 1. Dates, site and characteristics of the observations of white-lipped peccary with skin problems in the Maya forest.

Date	Site	Observations
May 5th, 2007	Mirador-Río Azul National Park, Guatemala	A white-lipped peccary in good body condition with pretty damaged skin. This individual was the first white-lipped peccary photographed with skin problems (Fig. 1a).
June 18th, 2011	Nuevo Becal ejido, Calakmul region, Mexico	A white-lipped peccary was captured for radiotelemetry purposes. It had damaged s kin and also hairless spots (Fig 1b).
June 3rd 2013	Holmul area, Maya Biosphere Reserve, Guatemala	A white-lipped peccary in good body condition was seen with hairless patches on the skin. This individual has been seen in a group with white-lipped peccaries that seem to have normal skin (Fig. 1c).
May 1st, 2014	Calakmul pond in the Calakmul Biosphere Reserve, Mexico	A white-lipped peccary with hairless patches of skin is photographed walking within a group of apparently healthy animals (Fig. 1d).

Figure 1a. White-lipped peccary in Mirador-Río Azul National Park within the Maya Biosphere Reserve on May 5th 2007. Photo: José Moreira-Ramírez, Wildlife Conservation Society - Guatemala Program.

Figure 1b. White-lipped peccary skin problem in Nuevo Becal, Calakmul, Campeche on June 18th 2011. Photo: Marcos Briceño-Mendez, El Colegio de la Frontera Sur.

Figure 1c. White-lipped peccary showing skin hairless area in the Maya Biosphere Reserve on June 3rd 2013. Photo: Rony García-Anleu, Wildlife Conservation Society - Guatemala Program.

Figure 1d. White-lipped peccary in Calakmul Biosphere Reserve on May 1st 2014 with hairless skin areas. Photo: Elisa Sandoval-Serés, Universidad de Guadalajara.

Scabies infection on pigs is caused by a species of microscopic mite (*Sarcoptes scabiei* var.*suis)* and is a disease that greatly affects the swine production in the entire world because it increases mortality, compromises the immune system, reduces fertility and can favor other skin problems (Smets & Vercruysse, 2000; Laha, 2014). Scabies infection causes loss of hair first and then while advancing is causing a swollen skin and can cause death in extreme cases. *S. scabiei* have been found in humans, domestic animals and wildlife (Menzano *et al*., 2007). In wild ungulates, scabies' infection (*S. scabiei* var*. caprina*) has been found on the Alpine chamois (*Rupicapra rupicapra*) and the Alpine ibex (*Capra ibex*), species that share the habitat with domestic goats (Rossi *et al.,* 1995).

The mites penetrate the skin producing a skin lesion that is accompanied by associated stress and weight loss. The skin lesion could be associated with bacterial infections. The lesions are characterized by red spots, dead epidermis accumulated on the skin surface, and loss of hair (Laha, 2014). It is known that scabies could easily be transmitted among members of the same species once one is infected. In the case of the white-lipped peccary a highly social species that generally live in large groups from 10 to 300 generally (Sowls, 1997), the disease, theoretically, should be transmitted faster than in solitary animals. However, photographic evidence shows that only some

individuals of each group are infected with no signs that the parasite has been transmitted to the whole group (authors pers. obs).

The pattern we have found in the population of white-lipped peccaries of the Maya forest deserves scientific attention as we still do not know if this is indeed a Scabies infection, we do not know the species that is causing this problem, we do not know this disease has entered the population, and why other animals of the same groups have not been infected yet despite the problem has been seen there since more than 7 years ago. Understanding these facts will help to elaborate plans for protecting this species that is very rare outside the Maya forest and that is highly susceptible to disease transmission as has been demonstrated in other areas of its distribution range (Fragoso, 1997).

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Figure 2. Photo of the same White-lipped peccary of figure 1d in Calakmul Biosphere Reserve with hairless skin areas. Photo: Elisa Sandoval-Serés, Universidad de Guadalajara.

Distribution and conservation status of the White-lipped peccary (*Tayassu pecari*) in Panama

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The white-lipped peccary (WL peccary) *Tayassu pecari,* listed as vulnerable on the IUCN red list (IUCN, 2013), ranges from South Eastern Mexico, through Central America to Northern Argentina (Reid, 2009). Within this area, the Isthmus of Panama is a key area for the species because it connects the populations of Central America and South America populations (Webb, 2003). *T. pecari* is considered endangered in Panama (ANAM, 2008) as the species may persist in some forested areas of Panama, but its presence has not been verified in most of the potential distribution areas. Very little information is available about the species in the area because no studies of WL peccary have never been undertaken in Panama. Basic information on WL peccary's occurrence and distribution is however necessary to assess the suitability of protected areas for the conservation of viable WL peccary populations in Panama and to make informed conservation decisions (Moreno, 2006, 2013).

We assessed the current distribution and conservation status of the WL peccary in Panama by compiling occurrence data from 29 sites scattered across the forested areas of Panama, covering nine distinct regions (Table 1). The data combined camera trapping data, field surveys of tracks and direct observation, and interviews with biologists, sociologists, nature guides and local people. Previous studies have shown that robust large mammal data can be obtained from non specific camera-trap surveys (Noss et al. 2003; Rayan et al. 2012).

Our assessment reveals gaps in the distribution range of *T. pecari* in Panama (Fig. 1). The species is most likely extinct in some provinces and persists in few highly remote and relatively intact parts of Panama (Table1, Fig. 1).

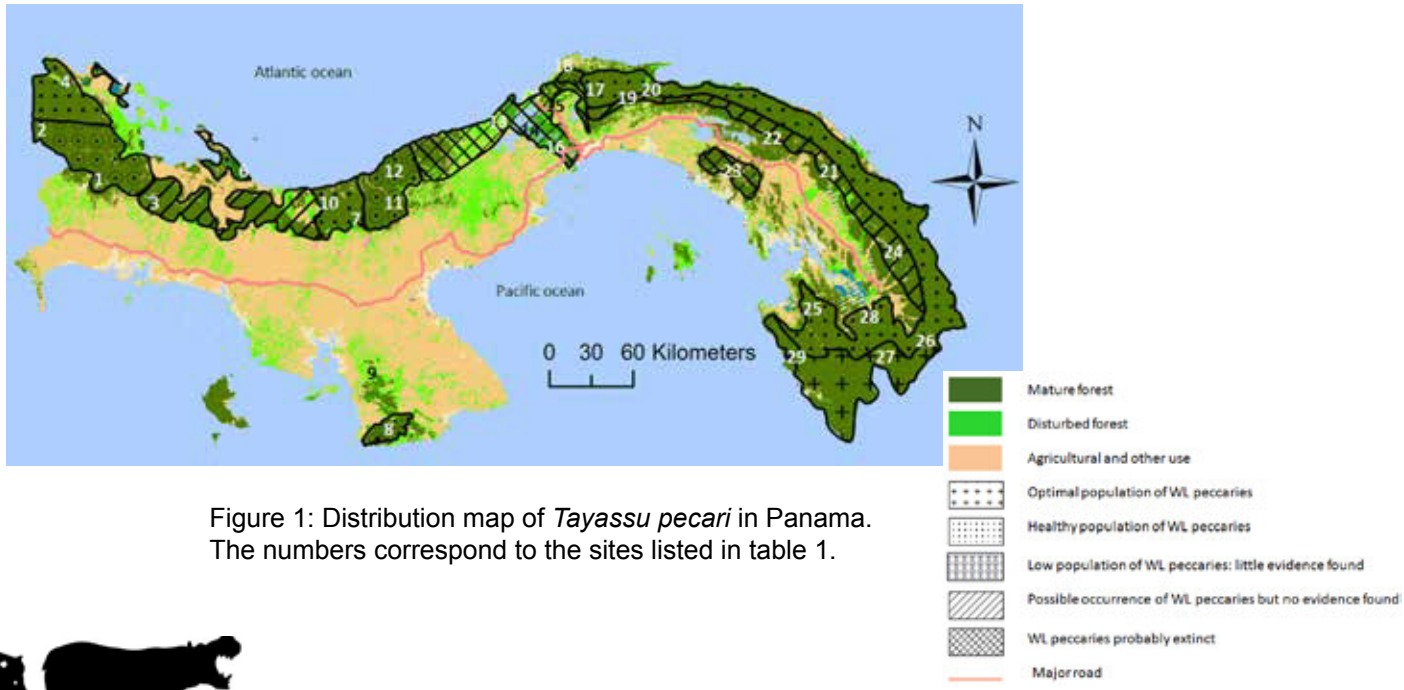

Figure 1: Distribution map of *Tayassu pecari* in Panama. The numbers correspond to the sites listed in table 1.

T. pecari occurs mainly on the Atlantic side of Panama in relatively undisturbed forests that shelter other endangered species as well (Moreno & Bustamante, 2007; Meyer et al. 2013; MWH, 2013). The healthiest population appears to be the one in the forest block East of the Panama Canal, in the remote parts of Alto Chagres and the comarcas de Guna Yala, Wargandi, Mandungandi and Embera-Wounan (Brown & Moreno 2013; Medina, 2013) but especially in the remote Darién NP, where a herd of 115 individuals was observed in 2005 (Moreno 2006, Moreno 2013), and where we photographed herds of 40-60 individuals recently. All the above mentioned forests are connected to each other forming a large continuous area where animals can move freely without major anthropomorphic barriers such as highways or cities. Besides, these areas have low human population densities and are mainly inhabited and managed by indigenous people – the Gunas, Emberas and Wounaan – who maintain forested areas and practice subsistence hunting (Ventocilla et al. 1995; MICI, 2013). The traditional hunters have a substantial knowledge about the life of *T. pecari* and harvest sustainably. The species is actually one of the most symbolic animals for the Gunas, and the older people speak of it with great reverence (Ventocilla et al. 1995).

On the west part of Panama, some sightings of WL peccary herds were reported in the lowland forests of the Atlantic coast of Veraguas and in Santa Fe NP (L. Martinez, com. pers), where the highest observation of WL peccaries – i.e. Cerro Fabrega: 3 200 masl (I. Tejada & J. Pino pers. com.)- was reported both for Panama and the other countries of its distribution range (Moreira, 2009). Surveys in the wetland of Damani-Wariviara confirmed a population of *T. pecari* in the area (USAID, 2013; L. Fernandez, T. Santiago, Mr. Ausencio, pers. com.).

Despite the very rich and healthy mammal community in the forest of Donoso in Colon province which is part of the Mesoamerican Biological Corridor, only two photos out of 24,456 trap nights using 55 camera trap stations recorded WL peccaries (MWH, 2013). These photos presented only one and two individuals, and confirm the low population of *T. pecari* in the area. This is even more concerning that just 20 years ago, the same area had a healthy population of WL peccary, according to local hunters who would regularly see herds of more than 50 individuals (C. Jaramillo pers. com.).

The species is no longer reported in Central Panama. The region has been intensively monitored for decades due to the presence of the Panama Canal. In this area signs of WL peccary are nonexistent. Neither intense camera trapping (Meyer 2011; Meyer et al. 2013; Moreno et al. 2014a), nor line transects (Wright et al. 2000; Mendez-Carvajal et al. 2003), and game wardens and local communities have ever recorded signs of WL peccaries in the area or reported any kill since decades. However, the species used to occur in that part of the country. *T. pecari* was present in Barro Colorado Island (BCI) when it became isolated from the mainland in 1914 and became a reserve in 1923. In 1932, poachers discovered BCI populations and quickly eliminated WL peccaries along with other species (Enders, 1935). The Panama Canal area is the bottleneck of the Mesoamerican Biological Corridor but is also a barrier for the movements of species, due to the increasing human population, forest fragmentation and associated high level of poaching (Wright et al. 2000; Moreno & Bustamante, 2008; Meyer, 2011). Several corridors have been proposed for connecting natural areas east and west of the Canal, including the Filo de Santa Rita Corridor that connects Chagres NP to Soberania NP (USAID, 2009). However, the corridor consists of small patches of forests in a matrix of cattle pastures, with a high human density and with two major roads that make this area difficult to cross. Although Garcés (1999) and Arosemena (unpub. data) mentioned the occurence of *T. pecari* in Cerro Hoya, the population is most likely very low since several more recent studies did not report any evidence of the species in the Peninsula de Azuero (Mendez-Carvajal and Santamaria 2004;

Fort and Nielsen, 2012). Recently, few sightings arose from hunters who killed two WL peccaries in 2014 inside Cerro Hoya National Park (J. Fort pers. com.). Further investigation is necessary in the site to confirm about the status and population of the species. Similarly, the lack of WL peccaries presence sign in the other remaining forest south of the Pan American highway in the Serrania de Maje over the past decades leads us to believe that the species is extinct in this area (Mendez-Carvajal et al. 2010; Moreno et al. 2014b).

The main reasons that most probably drove the species to extinction and quasi-extinction in many regions of Panama are poaching and habitat destruction (Moreno 2013). Along with other species (i.e. *Cuniculus paca*, *Mazama temama*, *Pecari tajacu)* the WL peccary is one of the preferred game species in Panama (Moreno 2006) . As soon as a herd is known to roam around, people pass the word, go to hunt and frequently harvest 4 to 15 individuals at a time (R. Moreno, pers. obs.). Besides, *T. pecari* is very sensitive to habitat disturbance both in highland and lowland forests. As such, with the jaguar, they are the first large mammals to disappear when an access road is opened into a virgin area (Ventocilla et al. 1995). For example, *T. pecari* population dropped dramatically when a banana company came in the 1920's and cleared the forest on the Mandinga Plain. Moreover, agricultural practices have eliminated the WL peccaries food plants in many areas (Ventocilla et al. 1995).

Table 1: Sites in Panama with information on WL peccaries presence with the survey method.

Province		Site	Method			*T. pecari* ocurrence	source
Chiriqui	1	Volcan Baru	T	PC		X	Ancon 2004a
	2	Cerro Fabrega (PILA)	T	PC		0	I. Tejada and J. Pino pers. com.
	3	Fortuna		PC		0	A. Guevara and E. campos pers. com.
Bocas del Toro	4	Palo Seco	T	PC	CT	0	M. Ponce, J. Arauz and J. Rincon pers. com.
	5	San San-Pond Sac		PC		0	Ancon 2004b
	6	Damani-Wariviara	T	PC		0	USAID 2013, L. Fernandez and Ausencio pers. com.
Veraguas	7	Santa Fe	T	PC		0	E. Flores, A. Guevara and L. Martinez pers. com.
	8	Cerro-Hoya	T	PC		0	Garcés 1999, Fort and Nielsen 2013, Arosemena unpub. data
	9	Montuoso		PC	CT	X	Pers. obs., Mendez-Carvajal and Santamaria 2004
	10	Veraguas Atlantic Forest	T	PC		0	A. Guevara and L. Martinez pers. com
Cocle	11	El Copé		PC		X	L. Martinez pers. Com.
Colon	12	Donoso		PC	CT	0	Pers. obs., MWH 2013, C. Jaramillo pers. com.
	13	San Lorenzo NP	T	PC	CT	X	MWH 2013
	14	BCNM	T		CT	X	Meyer et al. 2014, Meyer 2011
	15	Central Panama	T	PC	CT		Meyer et al. 2014
	16	Soberania NP	T	PC	CT	X	Moreno and Bustamente, 2008; Meyer et al. 2014; Moreno et al. 2014a
	17	Chagres NP	T	PC	CT	0	A. Amaya, D. Beto, J. de la Cruz Mendoza and A. Toribio pers. com.
	18	Portobelo NP	T	PC	CT	X	H. Esser, unpub. data
Panamá	19	Cocobolo		PC	CT	0	Meyer et al . 2014, E. Espinoza pers. com.
Guna Yala	20	Nusagandi	T	PC	CT	0	Brown and Moreno 2013
	21	Wargandi		PC		0	MICI 2013
	22	Madugandi		PC		0	MICI 2013
Darien	23	Cerro Chucanti	T	PC	CT	X	Pers. obs., Mendez-Carvajal et al 2010, Moreno et al. 2014b
	24	Cemaco		PC		0	Medina 2013
	25	Serrania de Bagre		PC		0	J. Vargas and G. Berguido pers. com.
	26	Paya		PC		0	E. campos, J. Moreno and L. Martinez pers. com.
	27	Cana	T	PC	CT	0	Moreno 2006, Moreno 2013
	28	Pirre	T	PC	CT	0	Pers. obs., Donoso & Samudio 2012, ANAM game wardens pers. com.
	29	Cerro Sapo	T	PC		0	R. Zambrano, J. Aranda and ANAM gamewardens pers. com.

The information compiled in this assessment is an important addition to the poor knowledge about WL peccaries in Panama. The survey confirms the critical situation of the species in Panama. A key point is the importance of restoring the connectivity between forest fragments in Panama since WL peccaries needs large areas to sustain breeding populations (Fragoso, 1998; Fragoso, 2004; Keurohglian et al. 2004; Reyna-Hurtado et al. 2009) and may not persist in smaller isolated protected areas such as Soberania NP for instance. Restoring connectivity will also allow gene flows between WL peccary's populations. This is especially true for the region of Central Panama, a key area for the species that literally divides the existing populations of *T. pecari* and may eventually reduce the genetic viability of the entire population. To improve conservation intervention more research is needed regarding WL peccaries population density, habitat requirements and migration routes in Panama. Determining whether the few herds that are occasionally observed are the same or different ones will also help understanding the ecology of the WL peccaries in Panama.

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Records and conservation of white-lipped peccary in the region of Iguaçu National Park, Brazil

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Abstract
White-lipped peccary is threatened by habitat loss and hunting in all of its range. In the Atlantic forest the species is only present in fewer than 10% of the remaining forest patches. In this biome diverse populations of *Tayassu pecari* suffered rapid decline and extinction, so for developing conservation actions for the species it is fundamental to identify where the species is still present. Here we describe a recent record of *T. pecari* near the Iguaçu National Park, Brazil, where the species was thought to be extinct since the mid-1990s. We discuss the conservation of species in this landscape.
Key-words: *Tayassu pecari*, hunting, Araucaria forest, Tayassuidae, wildlife translocations

Introduction

White-lipped peccary (WLP, *Tayassu pecari*) is a Neotropical ungulate threatened by habitat loss and overhunting (Peres & Palacios, 2007; Altrichter *et al.*, 2012). The species' range has declined more than 21% compared to its historical distribution over the last 100 years, and in 48% of areas where it is still present it had low or medium probability of long-survival (Altrichter *et al.*, 2012). In Brazil, except in the Amazonian forest and Pantanal, the habitat of WLP suffered substantial reduction and degradation, and WLP populations are in decline. Based on these assessments, the species is considered threatened in the Caatinga, Cerrado and Atlantic forest biomes (Keuroghlian *et al.*, 2012). In the Atlantic forest WLPs are absent in 92% of the forest fragments, and 65% of fragments are unsuitable for this species (Jorge *et al.*, 2013).

The presence of WLPs in forest fragments depends on the quality of remaining habitat (Keuroghlian & Eaton, 2008), but it is also related to hunting pressure, which may be greater in fragments than continuous habitats (Cullen Jr. *et al.*, 2000). Though even in continuous areas of the Amazonian forest the density of this species is strongly correlated with hunting level (Peres & Palacios, 2007). In fact in the Atlantic forest the species has disappeared from large patches as the Morro do Diabo State Park (30,070 ha, Jorge *et al.*, 2013), several areas of Paranapiacaba massif (460,000 ha, Brocardo *et al.*, 2012; Jorge *et al.*, 2013), Turvo State Park (16,709 ha, Kasper *et al.*, 2007), Rios das Cobras Indigenous Area (18,682 ha, Delgado, pers. com.), and Iguaçu National Park (170,000 ha, Azevedo & Conforti, 2008).

The local extinction of WLP in several areas of Atlantic forest may have consequences on forest recruitment, as well as on populations of their predators (Paviolo *et al.*, 2008; Keuroghlian & Eaton, 2009; Brocardo *et al.*, 2013; Jorge *et al.*, 2013). Thus, with the rapid decline and local extinction of WLP, it is necessary urgent actions to conserve the species as well as mapping its occurrence (Altrichter *et al.*, 2012; Keuroghlian *et al.*, 2012; Jorge *et al.*, 2013). Here we described a recent record of WLP near Iguaçu National Park and discuss the conservation of this species in the area.

Methods

The Iguaçu National Park (INP) is located in the west of Paraná State, Brazil. This region remained forested until the end of 1940s, then between 1950 and 1975 deforestation and colonization processes took place, and today the majority of the region has been converted for grain crop production, pastures and reforestation with exotic species. Native forest cover now primarily occurs in small fragments, except for the INP (Fig. 1, Brocardo, 2013). The creation of IPN in 1939, before the colonization of the region guaranteed the conservation of pristine areas of Interior Atlantic forest and Araucaria Forest, and also the native fauna (Brocardo, 2013). However, even with its 170,000 ha of forest, the INP has suffered local wildlife extinctions. The WLP's disappearance from the INP in the mid-1990s is related to the high level of illegal hunting in the interior and in the borders of the park (Azevedo & Conforti, 2008).

We investigated the mammal richness of INP and five fragments around this park (67 ha, 72 ha, 90 ha, 132 ha, 753 ha) using a combination of camera traps, line transects and track record. Additionally, we compiled recent published data and obtained personal information about the occurrence of WLP in adjacent areas to INP. In this review, we considered only fragments located within 100 km from the INP boundary, because this seems a likely dispersal distance of WLPs (through genetic analysis Biondo *et al.*, 2011 observed dispersal between populations separated by 80 km). We also analyzed the status of *ex situ* populations that originated from wild populations of the INP region, which could be used to reintroduction programs.

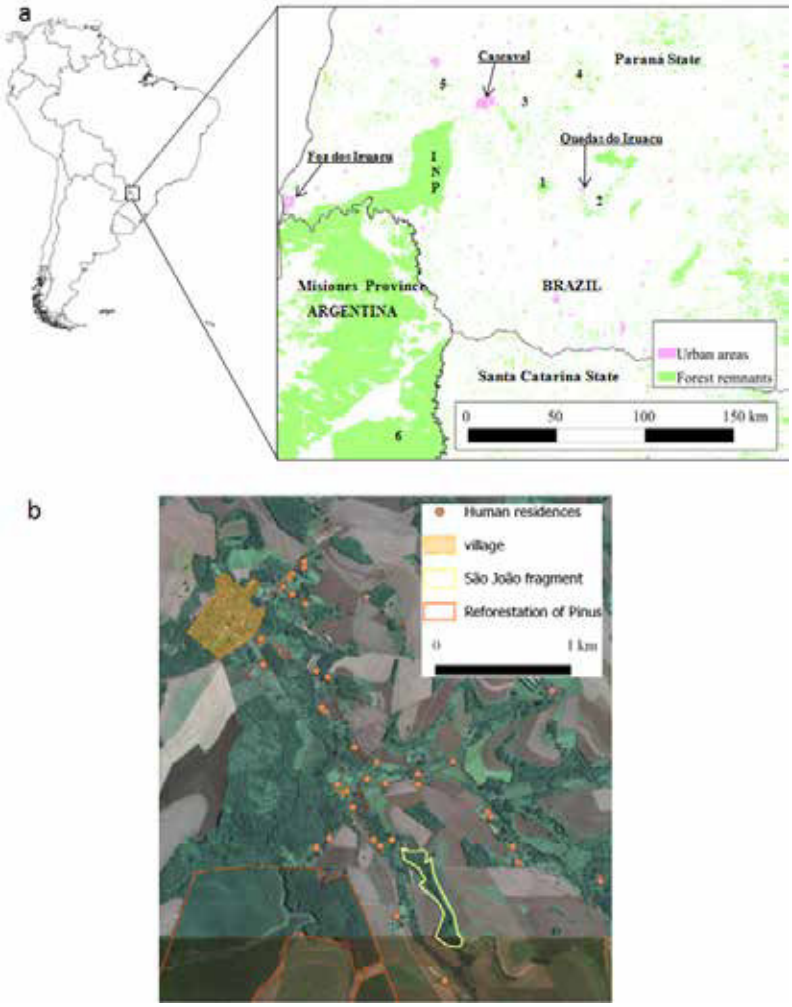

Figure 1. a) Iguaçu National Park (INP) and recent records of white-lipped peccaries: 1- Rio Guarani State Park, 2- Corredor do Iguaçu Private Reserve of Natural Heritage, 3- São João fragment, 4- Piquiri fragmented landscape, 5- São Francisco fragmented landscape, 6- Yabotí Biosphere Reserve (for details see Table 1), towns mentioned in the text are underlined; b) Details of São João fragment's landscape.2012).

Results

We did not record *Tayassu pecari* in the INP or any fragment that we surveyed. Yet, we were informed of WLP occurrence in a small fragment by landowners. The fragment is about 11.4 ha (São João fragment; S24°59'21" W53°13›36››), consisting of secondary Araucaria forest. Nevertheless it is connected to other small fragments, large reforestations of *Pinus* and riparian forest (Fig. 1b). According to the landowners, the WLP group arrived in March, 2012, and since then the owners have fed the animals with corn to prevent them from being killed because of crop raiding. We confirmed the occurrence of WLP by visual records, track records and camera trap monitoring (Fig.

Figure 2. White-lipped peccaries recorded in São João Fragment.

2). Through camera trap video records it was possible to identify 14 peccaries, including 4 juveniles.

Other records of species occurrence near INP were in the Rio Guarani State Park and Corredor do Iguaçu Private Reserve of Natural Heritage in Paraná State. We were also informed by local people of the occurrence in two other areas in Paraná, forest fragments near the Piquiri river and São Francisco river. In Misiones, Argentina the species has recent records in Yabotí Biosphere Reserve (Table 1, Fig. 1).

Ex situ populations originating from the INP region are present today only in two captive breeding establishments, one in the Municipal Cascavel Zoo (nine animals; Cascavel – Paraná), and another in a private captive breeding (60 animals; Foz do Iguaçu – Paraná). In the Cascavel Zoo the breeding was initiated with wild specimens captured in the Cascavel municipality between 1987 and 1992. In the private captive breeding of Foz do Iguaçu, founding breeders originated from Cascavel Zoo and other private breeding facility in Quedas do Iguaçu -Paraná, which used wild animals (about 10 individuals) from this municipality (Fig. 1a).

Discussion

The absence of WLP in sampled fragments and even within INP was already expected. The region lacks information about mammalian occurrence, but an inventory in other fragments of this region also indicated the absence of WLP (Brocardo & Cândido-Jr, 2012), and in the INP there was no record of the species in the 2000s (Azevedo & Conforti, 2008). Thereby the presence of WLP in a small fragment (São João fragment, 11.4 ha) was surprising.

Jorge *et al.* (2013) noted the survival of WLP only in Atlantic forest areas larger than 100 ha. Moreover, data demonstrate that habitat quality of fragments is an important factor for WLP population maintenance (Keuroghlian & Eaton, 2008). We believe that resilience of WLPs in this small forest patch is related to food implementation by landowners, as well as the use of other forest fragments, riparian corridors, reforestation of *Pinus*, and the consumption of crops from farm areas. However the long term survival of WLP population in this landscape is improbable, both for the inability of the small area to maintains a viable population, and the constant threat of poachers. Furthermore, the high human presence may cause conflicts against WLPs because they consume crops and can attack domestic dogs (see Fig. 1b).

We believe that the translocation of these animals is the best way to guarantee not only their survival, but also to ensure the preservation of their gene pool. In the region, the more appropriate site to receive these animals is the INP. Although WLPs can disperse for nearly 100 km away (Biondo *et al.*, 2011), and they are able to recolonize sites where they were previously extinct (Beisiegel *et al.*, 2014), these dispersions occur in continuous areas. So, it is unlikely that the São João fragment's population can reach the INP, because they have to move through 40 km of open countryside and cross four highways. In addition the new Brazilian Forest Code exempts private landowners from forest restoration in areas with established agricultural activities (Soares-Filho *et al.*, 2014), which complicates the management of landscapes for establishing biodiversity corridors.

Table 1. Recent records and information of *Tayassu pecari* presence near Iguaçu National Park (INP)

Area	Size (ha)	Protection	Coordinates	Distance from INP	Connection to INP
Rio Guarani State Park (Paraná, Brazil)[1]	2,235	Public Protected Area	S25°29'13'' W52°44'58''	53 km	By riparian forest of Iguaçu river
Corredor do Iguaçu PRNH (Paraná, Brazil)[2]	5,151	Private Protected Area	S25°26'29'' W53°08'40"	96 km	By riparian forest of Iguaçu river
São João fragment (Paraná, Brazil)[3]	11.4	Private lands	S24°59'21'' W53°13'36''	42 km	Without connection
Piquiri fragmeted landscape (Paraná, Brazil)[4]	5,000	Private lands	S24°52'32'' W52°51'49''	70 km	Without connection
São Francisco fragmented landascape (Paraná, Brazil)[4]	2,350	Private lands	S24°51'50'' W53°38'37''	15 km	Without connection
Yabotí Biosphere Reserve (Misiones, Argentina)[5]	316,000	Public Protected Areas and private lands	S26°54'22" W53°57'03	100 km	By Misiones Green Corridor

[1] Margarido et al. 2009, [2] Margarido et al. 2009, Araupel (http://www.araupel.com.br/sustentabilidade/rppn/) ,
[3] Our record,[4]Information of local people; [5] Paviolo et al. 2009

While hunting still occurs in INP (Fragoso *et al.*, 2011), in other natural areas of the region the hunting levels are higher (Brocardo, unp. data). The reintroduction of WLP in the INP could increase populations of the endangered jaguar (*Panthera onca*) (Conforti & Azevedo, 2003). WLPs are also extremely important for maintaining plant diversity, thereby the reestablishment of their populations in the Atlantic Forest may help to restore an important source of disturbance in the understory (Brocardo *et al.*, 2013).

To increase the effectiveness of reintroduction of the species in INP, other wild herds from nearby areas in Brazil (Table 1) could be used for translocations, although this first requires better knowledge of the distribution and size of all remaining populations. An adequate program of management and reproduction of captive animals is also necessary, since there are only two known captive populations that originate from the region of INP, and they were formed by few founders. Herds created from captive animals may be used to reinforce the wild population. Programs for reintroduction and translocation have demonstrated satisfactory effects for species conservation, as well as for the reestablishment of ecosystem services (Ripple & Beschta, 2003; Narayan *et al.*, 2008). Translocations will likely increase as a tool for *in situ* conservation as the extent of habitat fragmentation increases (WAZA, 2005).

We know that translocation or reintroduction of animals in Brazil, especially, to a protected area, involves many legal processes, but urgent measures must be taken by governmental environmental agencies, otherwise we can lose one of the latest populations of an endangered species in the region of INP.

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Stakeholder's practices and representations of contacts between domestic and wild pigs: a new approach for disease risk assessment?

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Abstract
The emergence and re-emergence of diseases, in which 60 to 70% are zoonotic, raise a number of economic, environmental, and public health issues, especially important as breeding systems are in close contact with wildlife. In the Corsican pastoral system, free roaming livestock and wild animals share the same resources, creating a high potential risk of contact and inter-specific transmission of pathogenic agents. Researchers are facing the challenge of thinking more efficient

ways to design sanitary risk assessments and disease management systems, by adapting classic epidemiological/ ecological approaches to systemic conceptions, that take into account more socially oriented components (such as stakeholder's strategies and knowledge, production system choices, etc.). We aim to present an original approach to understand the practices and representations of farmers and hunters, as potential factors for the emergence of diseases. Such an approach would be complementary to ecological and epidemiological approaches for evaluating the risk of contacts between animals and the risk of pathogen transmission. Indeed, it provides a systemic understanding of the issues on emerging diseases, and tries to renew scientific and technical paradigms for the management of these diseases.
Key words: wild boar / pigs / wildlife / pathogen transmission / practices / representations / risk assessment

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Context and objectives: understand the contacts between wildlife and livestock to renew disease risk assessment and management paradigms

The emergence and re-emergence of diseases, in which 60 to 70% are zoonotic (AFSSA, 2006; FAO, 2009), raise a number of economic, environmental, and public health issues. In extensive breeding systems characterized by a close contact between livestock and wildlife, these issues are particularly important. In pastoral systems, livestock and wild animals share the same resources, generating a high potential risk of inter-specific transmission of pathogenic agents. The risk of disease emergence is even higher when species are taxonomically close, as it is the case of wild boar and domestic pigs (Wu et al., 2012). But studies on the nature of contacts between wildlife and domestic animals is still limited (Jones et al., 2008.; Brahmbatt et al., 2012; Jori et al., 2012; Miguel et al., 2013). Understanding these contacts and the associatedpractices is a key element to design relevant risk assessment approaches. Whereas assessment methods are generally exclusively based on epidemiological and/or ecological approaches, the complexity of the system (i.e. The close link between ecosystem, breeding system, hunting system,…), would require wider and more socially oriented scope to understand the disease emergence mechanisms. Reconsidering the management of these diseases at the interface "human-animal-ecosystem" (report "One Health", MAE 2011), researchers are thus facing the challenge of thinking new ways to build sanitary risk appraisal designs and disease management devices. In Corsica, pig breeding is mainly based on traditional forest-pastoral system (outdoor free-range breeding), which mobilizes resources and involves transhumance summer practices. The production system is oriented towards the development of dry sausage, processed on-farm (Casabianca and Sainte Marie, 1998). The producer is often a "food chain producer" combining activities of breeding, multiplying, feeding and slaughtering (a large part of breeding pigs are still slaughtered on-farm), and transforming and selling, often directly to consumers. Meanwhile, agricultural decline in recent decades has led to a notable increase of wild boar populations, which are often intensively hunted. Hunting is a strong and culturally rooted activity in rural areas (8 to 10% of the Corsican population practices hunting). It is nowadays estimated that about 40,000 wild boars are shot annually in Corsica, by a crew 200 to 250 hunters. Wild boar potentially carries several infectious or parasitic diseases of major economic importance such as Aujeszky's disease. From the public health perspective, they can be the source of many zoonotic diseases such as brucellosis, trichinosis, toxoplasmosis tuberculosis and Hepatitis E (Richomme, 2009; Richomme et al., 2010; Meng et al., 2009). Some of these diseases are present in Corsica and

others such as African swine fever are raising awareness as the geographic proximity of Sardinia, where it is endemic, represents a potential risk of emergence. Finally, this production system in which the animals are very often roaming free, involves strong interactions with the surrounding ecosystems. Therefore it is an ideal model for understanding the dynamics of pathogens between the wild and domestic components and assessing risk factors influencing their transmission and dissemination.

We propose in this paper an original analysis of actors' practices and representations of those contacts, aiming to assess the risk assessment procedures and disease management approaches, and to provide new perspectives for further interdisciplinary research.

Methods: investigating breeders and hunters

Considering the complexity of such a system and issues, understanding the mechanisms of disease emergence requires the integration of data from ecology and veterinary sciences as well as economics and social sciences. This study was carried out by surveys on hunting and farming activities, aiming to highlight the importance of actors' practices and representations, as potential factors for the emergence of diseases. It also aimed to understand the features of farming systems (i.e. Knowledge and environmental factors leading to farmers 'choices). The surveys were conducted as semi-structured interviews on a sample of 60 farmers and hunters (20 farmers, 20 hunters and 20 farmers-hunters), spatially distributed in various areas of free-range pig production in the Haute-Corse and South-Corsica, according to their importance of livestock. The interviews focused on the farming system components, diseases present in the herd, the observed or suspected contacts between wild boars and pigs, the farmers' and hunters' knowledge on animal behavior and clues of the presence of wild boar (tracks), the importance of the crossed animals in swine offspring, or in hunting bags, etc. Finally, an additional approach focused on the mapping of these representations, according to each farmers' and hunters' perception, in order to highlight and visualize the risk of emergence across the region, and analyze that risk under different geographical features (vegetation, resources, access to lands, climate, etc.) The data are quantitative and qualitative. From the actor's speech, pieces of information are identified as descriptive criteria, and processed in analytical tools built specifically for the analysis of discursive material (Miles and Huberman, 2003).

Results and discussion: pratices and risk assessment

1. Presence of crossbred boars (hunting and livestock): breeding system issues

The first and most important results concern the presence of crossbred boars in farms and hunting lists. Farmers refer to sows giving regularly birth to crossbred animals, every year. In some farms, especially in Haute-Corse (around 30% of farms), sows are left roaming free in pastureland when they are on heat, thus being exposed to a high risk of getting covered by a wild boar, given their high density in these areas. On the contrary, some farmers, especially those involved in a quality channel (PDO Corsican charcuterie) or in the local breed management design (regional association for the management of Corsican "Nustrale" pig breed), closely monitor their reproductive system: mating is time-bounded and organised in special areas (closed parks).On the other hand, hunters report an increasing number of crossbred boars in their hunting results, particularly in hunting areas located near the pasture lands (80% in certain areas). Some elder hunters even speak of the disappearance of the genuine wild "Corsican" boar because of changes in the phenotype (ear shape, posture, etc.) and the observed behaviour of the animal (the crossed wild boars are less difficult to flush out and often fight back against hunt ing dogs). The Corsican traditional farming system is not homogeneous as the practices may differ significantly from one farm to another. But the presence of crossbred animals is a wide shared observation in all surveyed areas. This phenomenon seems to

be increasing steadily according to interviewees. It highlights frequent contacts between domestic and wild animals and questions the design of farming systems based on practices enhancing these contacts.

2. Managing the contacts : Is it really a problem for farmers and hunters ?

As animals share the same resource, other types of contact can also occur in addition to mating. We distinguished direct contact (covering and “snout to snout”) and indirect contact (ingestion of plants previously in contact with another animal) which are potentially important. Farmers and hunters recognize that animals are “almost constantly” in contact, but they highlight the fact that they are not in the same place at the same time (daylight for pigs, nightfall for wild boars). Despite the potential importance of these contacts, only a few breeders adopt radical strategies to reduce them. The most effective strategy seems to be to closely monitor the reproduction period and keep the females indoors during the oestrus period, in order to limit cross species breeding. However, this practice requires an additional amount effort and investment from the farmer that only a few interviewed individuals were keen to implement. Some farmers have reported the use of boars accompanying sows in the pasture lands, with the objective to deter the intrusion of wild boars in the herd. Signs of fighting on the “protective” boar (scars, wounds) are frequently observed, highlighting regular contacts between males, when implementing this strategy. Finally, another system shared by most of farmers consists in killing those wild boars they meet in the pasture area. Moving systematically with a hunting rifle, farmers seeking their herds on their journey shoot all wilds boars they eventually observe close to their animals. But given the frequency of contacts observed, and the small number of farmers who have implemented specific strategies to limit such contacts, it is worth wondering if those interactions between pigs and wild boars represent a real problem for farmers? Few of them (around 10%) admit willing to change their breeding system in regard of this phenomenon, as this would generate an additional workload. Finally, these results highlight the fact that analyzing stakeholder behaviour is indeed an essential approach to understand issues concerning the risk of disease emergence.

3.Practices at risk : lack of monitoring and waste management

Can we therefore qualify these practices as risky? If answering to this question would require further analysis, we can still highlight the fact that the lack of monitoring of animals during the heat is likely to represent a risk factor for enhancing contacts. But other practices that could facilitate the transmission of diseases between species were also identified, particularly concerning the management of waste (animal carcasses). At farm level, we observed making use of a service of carcass disposal is an unusual practice. It seems common to carry a dead animal in an unfrequented place in the forest and to leave it there (while occasionally the animal is buried). The risk of ingesting the remains of pig carcasses by wild animals (wild boars, foxes, stray dogs,...) is thus potentially important. Furthermore, few farmers (2%) admit to feed their herd with remains of slaughtered pigs. Concerning hunters’ practices, we observed that a common behavior is to leave the offal (guts) behind after dressing off the wild boar carcass, or to feed hunting dogs with the carcass offal. As the dog is a potential host for many parasites and viruses, it thus participates in maintaining the biological cycle of pathogens. Among the farmers-hunter category, pigs are sometimes directly fed with wild boar remains, causing thereby a risk of direct contamination. Ingestion of remains of dead livestock by wildlife (boars, foxes, ...), or remains of animals hunted by domestic animals (dogs, pigs) seems to be a widespread phenomenon resulting from practices that appears to be common in pig production and hunting areas. It raises the need to incite actors to change their practices, in order to reduce the risk of disease emergence.

Conclusion and perspectives: combining scientific approaches to appraise risk

These few results underline the importance and need of understanding the practices and perceptions of the different actors that shape the spatial distribution of animals and the risk of disease emergence. If scientific literature widely considers wildlife as a reservoir of diseases, these results highlight the bidirectional pathway of pathogen circulation between the domestic and the wild components. Combined with epidemiological and ecological approaches, of which the objective is to obtain a reliable assessment of the dispersion of a disease, this type of approach provides a systemic posture. The complexity of a pathoecosystems is indeed partially shaped by actors' practice. Therefore, transdiciplinary and combined approaches between epidemiologists social scientists and ecologists, would allow scientists and managers to better understand this complexity, and provide decision makers with relevant data to shape management designs that address more efficiently the challenge of the emergence and re-emergence of diseases at the wildlife-livestock–human interface.

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Distribution, Abundance, Ecology, and Conservation Status of the Desert Warthog (*Phacochoerus aethiopicus*) in Northern Kenya

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Summary

Two species of warthogs are present in eastern Africa; the common warthog *Phacochoerus africanus* (Gmelin 1788), and the desert warthog *Phacochoerus aethiopicus* (Pallas 1766). A good understanding of the biogeography, abundance, habitat requirements, ecology, and behavior of the poorly known *P. aethiopicus* is important to the development of effective conservation plans for this species. The primary objectives of this Project were to: (1) obtain information on the distribution and abundance of *P. aethiopicus* and P. africanus in northern Kenya; (2) establish a baseline against which long-term trends in distribution and abundance of both species can be determined; (3) obtain ecological and behavioral data; and (4) assess the conservation status in the region of both species. Rapid assessment methods were used to determine distribution and relative abundance of each species. Most of the data were obtained during 8,463 km (623 hours) of vehicle transect during October 2012 – October 2013.

The extent of occurrence of P. aethiopicus in Kenya is ca. 134,000 km² and that of *P. africanus* ca. 207,000 km². The encounter rate with *Phacochoerus* in northern Kenya was 0.006 individuals/km and 0.128 individuals/hour (n=51). *Phacochoerus aethiopicus* was encountered at 0.001 individuals/km and 0.015 individuals/hour (n=6), while *P. africanus* was encountered at 0.005 individuals/km and 0.113 individuals/hour (n=45). This Project is the first to report *P. aethiopicus* on the southern foothills of Mt. Forole, extending the known range ca. 120 km to the west. This Project is also the first to validate *P. africanus* for the region between Lake Turkana and the Uganda border, extending the known range west of Lake Turkana ca. 200 km to the north. No evidence was found for *P. aethiopicus* west of the Eastern (Gregory) Rift Valley; the known western limit is slightly west of Baragoi (36.810°E). The two taxa are known to be sympatric at three sites; central Kenya (ca. 8,700 km²); central southern Kenya (ca. 6,900 km²); eastern Kenya (ca. 3,900 km²).

The main threats to *Phacochoerus* and most other wildlife in the study area are habitat degradation, loss and fragmentation, competition with livestock, and poaching. *Phacochoerus aethiopicus* occurs in at least eight, probably 11, protected areas. All protected areas are, however, affected by

unsustainable, often illegal, human activities. These include poaching, livestock grazing/browsing, and farming.
Numerous range and altitude extensions for taxa other than *Phacochoerus* were obtained during this Project, including the eastern patas monkey *Erythrocebus patas pyrrhonotus*, Mau Forest guereza *Colobus guereza matschiei*, Somali lesser galago *Galago gallarum*, freckled nightjar *Caprimulgus tristigma*, and Speke's sand lizard *Heliobolus spekii*.

The full report can be found at:
http://www.wildsolutions.nl/Publications/DeJongButynski-WarthogSurveyReport%20-%20May%2014.pdf

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Evolution of pig trade between China & US

16 July 2014

http://www.news24.com/Green/News/Evolution-of-pig-trade-between-China-US-20140716

Beijing - European pig producers have found a lucrative market selling porkers to China for breeding purposes.

But a study published on Tuesday shows that this business is a remarkable tale of trade flowing in reverse.The super-pigs exported to China these days are distant descendants of Chinese pigs that were brought into Europe around two centuries ago to improve cantankerous local hogs. Domesticated pigs trace their lineage back to wild boars, that originated in Southeast Asia around four million years ago, according to the study. The species expanded its geographical range over the aeons, eventually developing into two very distinct populations, the farmed pig of East Asia and the European wild boar. A team of geneticists led by Mirte Bosse of Wageningen University in the Netherlands sequenced the DNA of 70 pig breeds from across Europe and Asia. They found telltale signatures, or haplotypes, from Chinese breeds that were brought into European boars in the late 18th and early 19th century, a trade that is also spelt out in commercial documents of the time. Chinese pigs brought in “great mothering characteristics, superior meat quality, strong resistance to diseases, better adaptation to living in sties and producing large litters” of 15 piglets or more, the paper said. “Our findings provide a unique insight into the genomic haplotype patterns resulting from breeding practices from first domestication until the intensive breeding industry we know today.” - AFP

US pigs raised with a taste for whiskey

25 June 2014

http://www.news24.com/Green/News/US-pigs-raised-with-a-taste-for-whiskey-20140625

Woodward - Twenty-five pigs mill around in open pens on a tiny farm in Woodward, Iowa. They are fat, robust and being raised to taste of rye whiskey. Small-batch distillery Templeton Rye is feeding them the mash used in making its distinctive American whiskey, hoping that the rich taste of the grain will grab consumers' attention.Templeton is especially long on rye, with more than 90% of its mash coming from the high-protein grain, and malted barley for the remainder.The spent mash is folded into the pig feed, making up 20 % of the ingredients, as advised by a swine nutrition specialist. The pigs seem to like it, digging into their feed with happy grunts and snorts. "It smells very good, almost like candy", said Scott Bush, founder and president of Templeton Rye Spirits. The distillery has chosen for the test the Duroc breed, known for its distinctive auburn winter coat, succulence and heavy muscling. Bush said the pigs were nearly at their ideal weight for eating: 95 kg, with just a few weeks to go before heading to the slaughterhouse. "How much mash is going to affect that taste, we don't know yet", he said. The possibility that a whiff of whiskey will arise from ham, ribs or chops has whetted the appetites of scores of pork lovers: The distillery has received about 200 orders, from four countries. Some of the orders for the 25 pigs were accompanied by long letters explaining why the customer desired the pig. Pigs will be "shipped with head and feet" to customers paying $ 699 per animal, Bush said. Aron Mackevicius, the executive chef at the 7M Grill in Omaha, Nebraska, is one of them. He enthusiastically described how he will cut up the pig and create a special menu, from appetizer to dessert. "My family has a bakery and one of the specialties is the bacon bun", a small, slightly sweet bread stuffed with bacon, he said. The chef said he hoped the pig "has a bit of a rye flavour" that will make it unique. "When I first heard about the project I was excited that somebody was taking such a bold move, a very intriguing concept", he said. According to Bush, the idea sprang up one night as the team chatted over glasses of Templeton Rye. "All of us are from Iowa" the number-one pork producing state in the country, said Bush. "But we also go all around the country to these gastro-culinary events, and the culinary world is still dominated by wine. "But it is changing, especially with whiskey. The idea was that we are going to ask chefs to pair the pigs with cocktails of Templeton Rye."

Capone bootlegger ties

Their whiskey is based on the recipe used by bootleggers in the tiny town of Templeton during Prohibition, the nearly 14-year period when alcoholic beverages were banned nationwide starting in 1920. Templeton Rye was the beverage of choice of Chicago mobster and bootlegger Al Capone, Bush said. "As it was illegal there are not a lot of documents, but a lot of oral history", he said, including from Capone's great-niece."Capone mostly sold Canadian whiskey but what he was drinking with friends was Templeton Rye." It is this heritage the distillery wants to share, extending it through the pigs-to-plate project. The project is "break-even for the company" but above all is "more of an experiment", Bush said, leaving the door open to doing it again.- AF

Russia: Boy invents 'lard-o-meter' to measure pig fat

11 June 2014

http://www.bbc.com/news/blogs-news-from-elsewhere-27792713

A Russian schoolboy has invented a humane device to measure how fatty pigs are, it's been reported.

Aydar Minibayev, 12, says he spent three years making the Shpikomer - which translates as "Lard-o-meter" - as part of a school science project, the LifeNews website reports.

It works by measuring the resistance to an electrical current running through a collar around the pig's neck. Aydar says because fat has great resistance, and meat almost none, he can measure the thickness of the fat without causing the animal pain. "Previously fat thickness was measured in

pigs by cutting into it then popping it back in," he tells the website. "This is very cruel."

Aydar's invention exceeded his teachers' expectations, according to the school's headmistress, Olga Miromanova. "All pig farmers ask themselves - have I over-fattened my animal? This remarkable device solves that problem humanely," she says.

It's thought the invention could benefit shoppers who dislike fatty meat. But in Ukraine it could be popular for the opposite reason, as pork fat, known as salo, is considered a great delicacy, says the Ridus news website.

The young inventor now plans to launch his Lard-o-meter into mass production. Until then, he's using it to help neighbours choose a pig for the festive table.

EU worries over pig virus prompt new blood import rules

7 May 2014

Matt McGrath Environment correspondent, BBC News

http://www.bbc.com/news/science-environment-27308721

The EU Commission has agreed new rules to limit the spread of a deadly swine disease that has killed millions of piglets in the US. Porcine Epidemic Diarrhoea virus (PEDv) has wiped out around 10% of the American herd in a year. While the EU rejected an outright ban on live pig imports, it has restricted blood products used in pig feed. However a Canadian minister said measures were "disappointing" and not based on science. While the virus isn't harmful to humans or food, concern has grown in Europe over its potential economic impact PEDv is spread in faecal matter and attacks the guts of pigs, preventing them from absorbing liquids and nutrients. Older animals can survive, but fatality rates among piglets run between 80% and 100%.

Deadly spoon

So virulent is the agent that one expert estimated that a spoonful of infected manure would be enough to sicken the entire US herd. France announced last week that it was set to suspend imports of live pigs and sperm from the US, Canada, Japan and Mexico. However the French delayed their ban to allow the EU Commission to consider a pan-Union response. At a meeting in Brussels, experts from member states reviewed the most recent scientific information on PEDv and decided against a ban on imports of live pigs. They argued that live imports aren't a major problem, with around 250 animals being brought in from Canada and the US last year. No live consignments are scheduled to be sent to Europe at present. EU officials did toughen up the rules on the imports of blood products from countries where the virus is active. Spray dried pig plasma is used in feedstuffs that are given to weaned piglets. Earlier this year, Canadian researchers said that they had found the infective agent in dried blood imported from the US. Europe imports about two tonnes of pig blood for feeding purposes every year. "The feed is suspected," said Dr Bernard Vallat from the World Organisation for Animal Health (OIE). "Blood from slaughterhouses with insufficient heat treatment is suspected to be the origin. We don't have a scientific publication on that but it is highly suspected," he said.

Rising temperatures

The new EU rules stipulate that these products can now only be imported after they have been heat treated to 80 degrees C. The products must then be stored for six weeks to kill any virus that might have contaminated the blood after the treatment. However the Canadian agriculture minister

Gerry Ritz said the EU move was “disappointing”. According to agency reports, the minister said the new restrictions weren’t based on science. The virus is believed to have its origins in China. In North America, the disease has moved rapidly, with around 4,000 outbreaks in 30 US states, in four Canadian provinces and in parts of Mexico. Experts in the field believe that lax biosecurity is an important factor. In June last year, a US study found that 17% of trucks going into a slaughterhouse were positive for the infection.“They also discovered that 11% of the trucks that had been negative when they went into the slaughterhouse were subsequently positive when they left,” said Dr Zoe Davies from the UK’s National Pig Association (NPA). “It’s how many animals you are moving around, that’s how its being spread.” In the UK, the NPA says it has already secured support from all major importers to restrict pigs from infected countries. It says that more than 92% of pigs reared in the UK are not fed on blood products. PEDv was first diagnosed in the UK in 1971 but that strain was a milder form and pigs quickly adapted to it and became immune. However, the fact that European pigs have a history of exposure to a related virus may give some hope of protection, according to Dr Vallat. “It circulated before in Europe but it was a different strain. If there is some remaining circulating virus there is a possibility that animals would be protected - but it is not sure.” This perspective though is challenged by Dr Zoe Davies, who says that Europe is now highly vulnerable to the infection. “Everyone seems to think that because we’ve had versions of PEDv in the past we will have some immunity to this new strain and we know categorically that this is not the case.” “We’ve tested our own herds and we think around 10% of the animals have antibodies to the older strains, we are effectively a naive herd, which is why we are worried.”

In the US, pig prices have risen considerably as a result of the losses to the virus while demand for pork shows no sign of abating. According to pig producers in the US, the industry is in for a strong financial year.

“One of the consequences of the problem, the restriction of the products in the market, mean perhaps prices could grow,” said Dr Vallat. “For the non-infected herds it is good news.”

Altered Images: Malaysian printer blacks out pigs’ faces

24 January 2014

http://www.bbc.com/news/blogs-news-from-elsewhere-25884523

A handful of pigs’ faces have been censored in the Malaysian edition of the International New York Times, it seems. The black marks were the work of Malaysian printing firm KHL, which blotted out the faces in a story about farming in the United States, according to the Malay Mail. A representative said it was their policy to obscure pigs because Malaysia was “a Muslim country”.

There is no law banning pictures of pigs in Malaysia - a secular country with many faiths - but local media are careful not to offend Muslims who make up two-thirds of the country’s 28 million people, the Malay Mail says. A government spokesperson said the images were not outlawed, but that publishers should bear in mind “the sensitivities of various cultures”. There appears to be increasing concern about offending Muslims in the country - last year a TV provider ran a warning ahead of a documentary about Pope Francis, and allegedly cut the words “Ya Allah!” from an Indian film this month. In 2005 the children’s film Babe was banned from cinemas because of its subject matter, and the similarity of the title to the Malay word for pig - “babi”. Complaints from viewers saw the ban overturned, however, and it appeared on television the following year.

Leopard attacks warthog in burrow

28 May 2014

http://www.news24.com/Travel/Guides/Bush/WATCH-Leopard-attacks-warthog-in-burrow-20140528

Skukuza - It's not every day one gets to see a leopard. And certainly not everyday one gets to see a leopard kill.

But a leopard diving into a warthog burrow to extract a juicy snack? Well that's just insane. However, that's exactly what visitors to the Klaserie Private Nature Reserve, which forms part of the greater Kruger National Park, got to see recently. Thankfully they had their cameras at hand and managed to capture a video of the intense struggle.

Kenya: Why Warthogs Have a Greater Appreciation of Life

17 March 2014

By Dr Richard Ayah

http://allafrica.com/stories/201403170819.html?viewall=1

There are some animals that are so unique that they are difficult to describe. A warthog is really just a warthog. The body is shaped like a gym bound pig. Short, they stand about 40 centimetres at the shoulder, yet they are sturdy and solid looking reflecting their weight. A full-grown warthog can weight up to 100kg. Males weigh more than females. This calculates to a body mass index of about 700. Doctors are worried when your body mass index, a calculation that divides your weight by the square of your height, is above 30. But the real distinguishing feature of a warthog is the disproportionately large head, which has thick pads on either side of the face. Then just behind the snout again on either side tusks emerge. The upper tusks form a semi-circle, while the lower tusks are sharpened to act as a sharp cutting tool. Warthogs eat mainly grass, kneeling down to reach the short grass but are also known to dig for bulbs and tubers during the dry season. And they can run. You may think that because it looks like a domestic pig it is fat. The warthog is not and has only a thin layer of insulating fat in the skin. In the wild they are seen with the characteristic tail held 90 degrees upright, like a flag. In full sprint the warthog reaches a speed of 55 kilometres per hour. A different animal all together but still very familiar is the housefly, Musca domestica. Originally a native of central Asia, today the housefly is found anywhere humans are found.

Today the housefly is a cosmopolitan pest adapted to living in both urban and rural areas. This is because its favourite food is found in animal faeces. On the farm it thrives on chicken and cow manure. In urban areas, kitchen waste will do, though a gourmet meal is to find human faeces, which typically has a lot of nutrients from a fly perspective. The housefly is 5 to 8 mm long, with the female usually larger than the male. The way to tell a female fly from a male fly is to look into its

eyes. In the female fly the eyes are wide apart, whereas in the male the eyes almost touch. Despite the contrasting lifestyles, both animals have a fairly constant life. The adult housefly usually lives for between 15 to 30 days. It lives longer if there is access to suitable food especially sugar and will not mate unless food is present. The warthog on the other hand lives for about 15 years, if a predator does not catch it. The animals obey a rule in nature that suggests that the larger the animal the longer it lives. So many insects live a matter of days, while larger animals such as elephants live in decades. Human beings are an exception, when viewed from body weight perspective. Not only is the figure relatively high but globally, male and female life expectancy has increased from 56.4 years and 61.2 years respectively to 67.5 years and 73.3 years in the decade from 1990 to 2010. This increase in life expectancy has mainly been because of significant reduction in child deaths associated with communicable diseases such as diarrhoea. While Kenya has to an extent benefited from a reduction in child deaths, it has not followed the world wide trend in improving life expectancy. Life expectancy for females in Kenya was 61.25 years in 1990 and dropped to 58.26 years in 2011. The major contributing factors continue to be HIV/Aids, malaria, communicable diseases and inequality in health service provision. An increase in life expectancy is however not the end of the story. The quality of the additional years is also important. Here is the major difference between a communicable disease and a non-communicable disease. A communicable disease like malaria asks you to make up your mind. Do you fight it or go? Within 10-14 days of being bitten by a mosquito the malaria will rage in the body and a week later you will either be cured or dead. A non-communicable disease like diabetes or hypertension creeps up on. Years of increasing weight become overweight, then obesity. The blood sugar control deteriorates over a period of time. Once the disease sets in there is still time to reverse it but eventually a new setting point exists then the complications come in one at a time. Many people live longer but not at full health because of a non-communicable disease.

So whereas the fly can move from one seemingly unhealthy meal to the next eating all kinds of sugar, faecal matter and so on, it does so in the knowledge that next week it will be dead anyway. The warthog has a greater appreciation of life and tries to live a healthier life. So when you see a warthog flying its tail flag high, don't laugh - it has reason to.

Pablo Escobar's hippos: A growing problem

25 June 2014

By William Kremer BBC World Service

http://www.bbc.com/news/magazine-27905743

A herd of hippopotamuses once owned by the late Colombian drug baron Pablo Escobar has been taking over the countryside near his former ranch - and no-one quite knows what to do with them. It was in 2007, 14 years after Escobar's death, that people in rural Antioquia, 200 miles north-west of Bogota, began phoning the Ministry of Environment to report sightings of a peculiar animal. "They found a creature in a river that they had never seen before, with small ears and a really big mouth," recalls Carlos Valderrama, from the charity Webconserva. He went to look, and found himself faced

with the task of explaining to startled villagers that this was an animal from Africa. A hippopotamus. “The fishermen, they were all saying, ‘How come there’s a hippo here?’” he recalls. “We started asking around and of course they were all coming from Hacienda Napoles. Everything happened because of the whim of a villain.

Situated halfway between the city of Medellin and Bogota, the Colombian capital, Hacienda Napoles was the vast ranch owned by the drugs baron Pablo Escobar. In the early 1980s, after Escobar had become rich but before he had started the campaign of assassinations and bombings that was to almost tear Colombia apart, he built himself a zoo. He smuggled in elephants, giraffes and other exotic animals, among them four hippos - three females and one male. And with a typically grand gesture, he allowed the public to wander freely around the zoo. Buses filled with schoolchildren passed under a replica of the propeller plane that carried Escobar’s first US-bound shipments of cocaine. While Don Pablo masterminded the operations of the Medellin Cartel from his villa on the hill, the locals gazed at the strange animals and even stranger concrete dinosaurs that Escobar built for his son. When Hacienda Napoles was confiscated in the early 1990s, Escobar’s menagerie was dispersed to zoos around the country. But not the hippos. For about two decades, they have wallowed in their soupy lake, watching the 20sq km (8 sq mile) park around them become neglected and overgrown - and then transformed back into a zoo and theme park, complete with water slides. All the while, the hippos themselves thrived, and multiplied.

Nobody knows how many there are. The local environmental authority, which bears responsibility for them, estimates between 50 and 60, with most living in the lake at the park. But 12 are known to have paddled past the flimsy fence and into the nearby Magdalena River - and maybe many more. Here, conditions for hippos are idyllic. The river is slow moving and has plenty of shallows, perfect for larger animals which don’t actually swim but push themselves off banks, gliding through the water. Moreover, the region never experiences drought, which tends to act as a natural brake on the size of herds in Africa. How much the hippos like Colombia can be judged from how much sex they are having. In Africa they usually become sexually active between the ages of seven and nine for males, and nine and 11 for females, but Pablo Escobar’s hippos are becoming sexually active as young as three. All the fertile females are reported to be giving birth to a calf every year. “It’s just like this crazy wildlife experiment that we’re left with,” says San Diego University ecologist Rebecca Lewison. “Gosh! I hope this goes well.” Valderrama, whose job until recently included watching over the hippos in the Magdalena, has seen animals up to 250km (155 miles) away from Hacienda Napoles. Fishermen are terrified of the three-tonne herbivores, he says. At night, the animals roam the countryside, wandering into ranches, eating crops and occasionally crushing small cows. Colombian people, he believes, are more vulnerable than Africans because they see hippos as cuddly, “floppy” animals. The respected El Colombiano newspaper recently reported that children in a school near Hacienda Napoles are sharing a pond with the animals, and having direct contact with hippo calves at home. “My father brought a little one home once,” an unnamed girl told the paper. “I called him Luna (Moon) because he was very sweet - we fed him with just milk.” Another child, a boy, told the paper: “My father has captured three. It is nice because you have a little animal at home. We bottle-feed them because they only drink milk. They have a very slippery skin, you pour water and they produce a kind of slime, you touch them and it’s like soap.” But adult hippos are dangerous. Despite their ungainly appearance, they are very agile in the water and can charge on land at up to 18 mph (29km/h). It’s often said that hippos are responsible for more human deaths in Africa than any other animal - though it may be more accurate to say they cause more deaths than any other wild mammal. Attacks happen when humans encroach on hippo territory, says Lewison. But the animals aren’t like crocodiles, she points out - they don’t see a thing and instinctively want to kill it - so in a sparsely populated area it may be safe to let Escobar’s hippos be. In the 30-year history of Escobar’s herd, there have been no reports of anyone being killed or even seriously injured. But living near the animals is inevitably a risk, Lewison says - one that local people have to decide whether they are willing to take.

For Carlos Valderrama, however doing nothing is not an option. “We have seen that hippos are very territorial and very aggressive,” he says. “They are not a tame animal. The risk for local populations to just leave them to browse around will be huge.” The ideal solution would be to relocate them, he says. But it’s not easy to move a hippo, and even if the government were to kit out teams of experienced vets with trucks and helicopters, there’s nowhere to put the animals. They can’t be returned to Africa because there is a risk that they carry diseases. That leaves captivity. A handful of hippo calves have been transferred to zoos in Colombia, but there are currently no takers for the adults. Beyond that, options are limited. Some - including those at the Hacienda Napoles park - favour containing the numbers with a programme of castration. But not only would this be costly and dangerous for the vets, it’s thought many hippos would die. “Hippos are very sensitive to chemical compounds,” explains Lewison. “It doesn’t make any sense - they’re enormous! - but they have this incredible sensitivity to sedation.” Valderrama also points out that it would be very difficult to ensure that all the males had been attended to, given that no-one knows how many there are - and it only takes one overlooked bull to do the procreation work of a whole herd.

Another idea, favoured by David Echeverri of the local environmental authority, is to build a reserve with proper hippo-proof fences. But it would be a huge challenge to round up all the feral hippos of Antioquia, and would cost an estimated $500,000 (£290,000). “It is not going to be accepted in general by environmentalists and biologists here, because Colombia doesn’t have a lot of money,” says Patricio von Hildebrand, a biologist working in the Amazon region. “They don’t think the money should be invested in maintaining a few hippos rather than conserving the original species in Colombia.” Hildebrand has another, more radical solution: “I think they should barbecue them and eat them.” He isn’t joking. During experiments with electric fences a while ago, he recalls, someone misjudged the voltage and electrocuted one of the Hacienda Napoles hippos. “What did the local people do? They took him, they chopped him up, they barbecued him and they ate him!” The animal is said to have tasted similar to pork. Valderrama doesn’t recommend eating the meat, in case it is infected with a transmittable disease - one dead hippo was found to be carrying leptospirosis which can cause meningitis - but he does see the complete elimination of male hippos as the most practical solution. This was also the view of international experts from the World Wildlife Fund and the Disney Foundation, who visited Colombia in 2010 - they described the hippo situation as a “time bomb”. But Echeverri can see how this story would play internationally, and wants to avoid it. “We do not want to choose the easy option and give the world this negative image, not with such a charismatic animal,” Echeverri says. “The country is changing the image it gives the world - we don’t want to be in the headlines for such a story.”

In 2009, Colombia did make the headlines for hunting down and killing a bull hippo, Pepe, that had been deemed a public nuisance. Even though a professional hunter shot the animal, a group of soldiers had helped to corner it, and a photograph of them posing next to the body caused an outcry.The hunt for two other hippos, a female, Matilda, and her calf, Hip, had to be called off. Valderrama, who was astonished at the backlash, calls it “the floppy effect”. The reason why nothing has been done about the hippos, he says, is that whatever decision the government makes will be controversial. “They already castrated one, and there are people saying, ‘Oh why do you have to castrate them? Just let them be. Castrate the politicians.’” He believes, however, that Colombians are starting to see beyond the soft side of hippos, and perceive the real risks they pose. The mixture of feelings in some ways resembles the complex attitude Colombians had towards Pablo Escobar himself. Many thousands turned out for his funeral, after he was gunned down on the roof of his safe house in Medellin on 2 December 1993, thanks partly to his good works - he built homes for the poor and paid for football pitches to be floodlit. Yet it is impossible that any resident of Medellin in the early 1990s could have been untouched by the murderous violence that preceded Escobar’s death. In 1989, he came close to derailing Colombia’s democratic system when three of the six presidential candidates were assassinated.

Even today a section of poor Colombian society still has fond memories of the bandit, says the

Medellin-based travel writer David Lee. He describes a recent trip to Escobar's grave, when he witnessed an old woman approach and begin tapping the headstone - a way for her to make her presence felt wherever Escobar might now be residing. Most backpackers who make the trip to Hacienda Napoles don't go for the waterslides or the hippos, Lee says, but to take a path that leads from an enclosure containing the park's mascot, Vanessa - a small hippo that responds to her name - up to Escobar's mansion. It was ravaged by looters after the drug baron's death, but a sign says the house will not be restored because "it's technically difficult and morally impossible". "Colombians are having a hard time trying to figure out what to do with Escobar's legacy - and that includes his property," says Lee. The parallels between El Patron and his pets formed a central theme of the 2010 documentary film Pablo's Hippos - and the animal was used by Mexican novelist Juan Pablo Villalobos as a metaphor for the absurd, ugly, violent world of the drug baron even before he had heard of Escobar's herd. In his novella Down the Rabbit Hole, a seven-year-old boy persuades his drug kingpin father to add a Liberian pygmy hippo to the collection of wild animals kept at their Alice-in-Wonderland palace, including man-eating tigers. Villalobos regards the real-life runaway hippos as a sort of living, breeding metaphor for Escobar's place in Colombia's national psyche. "It's like a sign of what's happened in Colombia in the last 20 years," he says. "And this past is still present, and Colombians maybe don't know how to deal with this memory, with Pablo Escobar's he ritage. "All those contradictions are still alive there, and I think now in the most absurd way - in hippos reproducing in a river."

Autonomous airboats monitor hippo dung in Kenya's Mara River basin

27 May 2014

Source: Carnegie Mellon

http://www.sciencedaily.com/releases/2014/05/140527124504.htm

Summary: Small, autonomous airboats, disguised to look like crocodiles, helped scientists measure water quality this spring in Kenya's Mara River. An estimated 4,000 hippos use the river as a toilet with potentially deadly effects for fish living downriver.
Small, autonomous airboats, disguised to look like crocodiles, helped scientists measure water quality this spring in Kenya's Mara River. An estimated 4,000 hippos use the river as a toilet with potentially deadly effects for fish living downriver. The airboats, developed at Carnegie Mellon University's Robotics Institute and operated by a CMU spinoff, Platypus LLC, skimmed over the surface of several hippopotamus pools in the river, where they scanned the river bottom for deposits of hippo dung and made various measurements of water quality. No human would dare venture onto this brown water in which so many hippos slosh around. But the animals, considered among the most dangerous in Africa, generally tolerated the two-foot-long boats much as they do the river's crocodiles.

One did give chase, but briefly.
"Those were 30 seconds that none of us will forget," said Paul Scerri, an associate research professor in CMU's Robotics Institute and president of Platypus. In the end, the 13-pound boat, made of vacuum-formed plastic and filled with the same sort of airbags commonly used as packing material in parcels, managed to outrun the 2-1/2 ton hippo. The robotic boats supported the work of researchers Amanda Subalusky, Christopher Dutton, and David Post of Yale University, and Emma

Rosi-Marshall from the Cary Institute of Ecosystem Studies, who have been studying water quality on the Mara since 2008. They suspect that hippos, which spend their nights grazing in the savanna grasslands and their days wallowing and defecating in the river, are responsible for water quality problems, particularly during periods of low flow. Each hippo produces about 22 pounds of wet dung each day, Subalusky said. When the river is running high, this dung simply moves down river, but during low flows the dung settles to the bottom of hippo pools, where bacteria feed on it and consume lots of oxygen. During subsequent high flows, oxygen levels downriver crash and fish kills can occur. She and Dutton suspect this is because hippo feces is being flushed from the hippo pools. The problem is, they haven't been able to get close enough to find out.

"Hippos are very territorial and aggressive and have been known to attack boats," Subalusky explained. "We have to work with armed rangers when we get in the river anywhere, but we would never be able to get into a hippo pool."

One of their mentors connected them with Scerri, who arranged for Christopher Tomaszewski, Abhinav Valada and John Scerri of Platypus to take three of the boats to Kenya in March. The boats use Android smartphones for onboard computing and are designed to navigate autonomously, working alone or in groups to perform water monitoring in bodies of water or aid first responders following floods.

During the trio's three week stay in Kenya, they were able to deploy the boats, one at a time, over 10 different hippo pools. "It's a different sort of scientific process in the field there," said Scerri, who visited the project for four days. "You go where you can and do what you can." The sonar sensors aboard the boats were used to create depth maps of the pools and to measure the depth of the fecal deposits, while other sensors checked such water quality parameters as water temperature, oxygen content and electrical conductivity.

The data are still being analyzed and are unpublished, so the researchers can't draw any conclusions yet. But as luck would have it, they were able to measure several pools both before and after a flushing event, so they have reason to hope that the findings will be meaningful.

The boats were disguised as crocodiles at the suggestion of a local Maasai guide and, with one exception, the hippos seemed unfazed by the presence of the strange machines. A winch system added to one of the boats failed and the water-cooled boats suffered from clogged intakes at least once, but otherwise the boats fared well, Scerri said.

Carnegie Mellon. "Autonomous airboats monitor hippo dung in Kenya's Mara River basin." ScienceDaily. ScienceDaily, 27 May 2014. <www.sciencedaily.com/releases/2014/05/140527124504.htm>.

South Africa's world famous hippo turns 14

13 March 2014

http://www.news24.com/Travel/South-Africa/SAs-world-famous-hippo-turns-14-20140313

Johannesburg - Jessica the tame hippopotamus celebrated he r14th birthday with a coconut birthday cake on Tuesday. "It went off well yesterday [Tuesday]. One of her boyfriends spent the day here and even stayed overnight. He is still here today," said Tonie Joubert on Wednesday. Joubert raised

Jessica after finding her at a few hours old on the banks of the Blyde River with her umbilical cord still attached. Jessica now lives with the Joubert family near Hoedspruit in Limpopo. Joubert said she had a coconut birthday cake, and also enjoyed some other goodies. “We gave her some cake and she loved it. We also gave her some whole-wheat buns; normally we give her bread but she loved the buns also.” She also got five kilograms of carrots. Joubert said it was not raining there for her birthday on Tuesday despite heavy rainfall in other parts of the country. “We had some tourists here and people gave her birthday kisses.” Jessica is one of the country’s most renowned tame animals. She weighs over 1400kg, and is a movie star with her own fan club and web page. She loves Rooibos tea and drinks 20 litres of it a day. She walks in and out of the Joubert house whenever she wants to, and sleeps on a mattress on the veranda with her best mates, five English bull terriers. In April 2001, Jessica became a movie star at the age of one-and-a-half. At last count, 97 documentaries had been done on her around the world. “The most documentaries done on a single animal”, said the proud dad. These included playing a role in the South African movie Mr Bones, documentaries for Animal Planet, National Geographic, and the Discovery Channel. She even got to feature on the Oprah Winfrey show. - SAPA

US zoo euthanases old hippo

15 January 2014

http://www.news24.com/Green/News/US-zoo-euthanases-old-hippo-20140115

Cleveland - A Nile hippopotamus believed to be the oldest in North America has died at an Ohio zoo.

The Cleveland Metroparks Zoo says the male hippo was euthanased on Monday due to “advanced age-related ailments.” The zoo says the hippo was named Blackie and was about 59 years old. A zoo announcement says Blackie sired three male offspring after arriving at the zoo from Africa in 1955. Blackie was born in a game sanctuary in Tanzania. The zoo says hippos typically live 30 to 40 years in the wild and can live longer in captivity. - AP

New literature on Suiformes

Veterinary, Genetic and Physiological Studies

Manunza A, Zidi A, Yeghoyan S, Valentin Adrian Balteanu VA, Carsai TC, Scherbakov O, Ramírez O, Eghbalsaied S, Castelló A, Mercadé A and Amills M (2013). A High Throughput Genotyping Approach Reveals Distinctive Autosomal Genetic Signatures for European and Near Eastern Wild Boar. PLoS One; 8(2): e55891.

The lack of a Near Eastern genetic signature in modern European porcine breeds indicates that, although domestic pigs from the Fertile Crescent entered Europe during the Neolithic, they were completely replaced by their European counterparts in a short window of time. Whilst the absence of such genetic signature has been convincingly demonstrated at the mitochondrial level, variation at the autosomal genomes of European and Near Eastern Sus scrofa has not been compared yet.

Herewith, we have explored the genetic relationships among 43 wild boar from Europe (N = 21), Near East (N = 19) and Korea (N = 3), and 40 Iberian (N = 16), Canarian (N = 4) and Mangalitza (N = 20) pigs by using a high throughput SNP genotyping platform. After data filtering, 37,167 autosomal SNPs were used to perform population genetics analyses. A multidimensional scaling plot based on genome-wide identity-by-state pairwise distances inferred with PLINK showed that Near Eastern and European wild boar populations are genetically differentiated. Maximum likelihood trees built with TreeMix supported this conclusion *i.e.* an early population split between Near Eastern and European *Sus scrofa* was observed. Moreover, analysis of the data with Structure evidenced that the sampled Iberian, Canarian and Mangalitza pigs did not carry any autosomal signature compatible with a Near Eastern ancestry, a finding that agrees well with previous mitochondrial studies.

Eisenberg T, Kutzer P, Peters M, Sing A, Contzen M, and Rau J (2014). Nontoxigenic tox-bearing *Corynebacterium ulcerans* Infection among Game Animals, Germany. Emerg Infect Dis. Mar 2014; 20(3): 448–452.

Corynebacterium ulcerans may cause diphtheria in humans and caseous lymphadenitis in animals. We isolated nontoxigenic tox-bearing *C. ulcerans* from 13 game animals in Germany. Our results indicate a role for game animals as reservoirs for zoonotic *C. ulcerans*.

Binanti D, Mostegl MM, Weissembacher-Lang C, Nedorost N and Weissenböck H (2014). Detection of *Pneumocystis* infections by *in situ* hybridization in lung samples of Austrian pigs with interstitial pneumonia. Med Mycol; 52(2): 196–201.

Pneumocystis carinii f. sp. *suis* is a fungus multiplying in the respiratory tract of pigs which occasionally is associated with interstitial pneumonia. Identification of *Pneumocystis* in tissue samples is considered difficult and there are only scarce data on its occurrence in European pigs. This investigation presents an *in situ* hybridization (ISH) procedure for identification of *Pneumocystis* spp. in paraffin wax embedded tissue samples and its application for labeling the agent in lung samples of pigs with interstitial pneumonia. Thirty-two out of 100 lung samples from pigs on Austrian farms were identified as positive, five of them with multiple, 12 with moderate and 15 with few organisms but Grocott's methenamine silver staining demonstrated that only 20 cases were unequivocally positive for *Pneumocystis carinii*. In addition to interstitial pneumonia *Pneumocystis*-positive pigs were more frequently affected with granulomatous pneumonia than *Pneumocystis*-negative pigs. Frequently concurrent infections with different viral or bacterial lung pathogens were noted but there was no positive correlation between *Pneumocystis*- and PCV-2-infections. With other infections, no clear-cut differences between *Pneumocystis*-positive and *Pneumocystis*-negative animals were found. This study shows that *Pneumocystis* infections occur frequently in Austrian pigs with interstitial pneumonia. It remains to be shown which are the factors triggering severe multiplication and whether infection with *Pneumocystis* alone is able to induce lung disease in pigs.

Kich JD, Uthe JJ, Benavides MV, Cantão ME, Zanella R, Tuggle CT, and Bearson SMD (2014). TLR4 single nucleotide polymorphisms (SNPs) associated with *Salmonella* shedding in pigs. J Appl Genet.; 55: 267–271.

Toll-like receptor 4 (TLR4) is a key factor in the innate immune recognition of lipopolysaccharide (LPS) from Gram-negative bacteria. Previous studies from our group identified differences in the expression profile of *TLR4* and genes affected by the TLR4 signaling pathway among pigs that shed varying levels of *Salmonella*, a Gram-negative bacterium. Therefore, genetic variation in this

gene may be involved with the host's immune response to bacterial infections. The current study screened for single nucleotide polymorphisms (SNPs) in the *TLR4* gene and tested their association with *Salmonella* fecal shedding. Pigs ($n = 117$) were intranasally challenged at 7 weeks of age with 1×10^9 CFU of *S*. Typhimurium χ4232 and were classified as low or persistent *Salmonella* shedders based on the levels of *Salmonella* being excreted in fecal material. *Salmonella* fecal shedding was determined by quantitative bacteriology on days 2, 7, 14, and 20/21 post exposure, and the cumulative levels of *Salmonella* were calculated to identify the low ($n = 20$) and persistent ($n = 20$) *Salmonella* shedder pigs. From those 40 animals, the *TLR4* region was sequenced, and 18 single nucleotide polymorphisms (SNPs) in *TLR4* were identified. Twelve SNPs have been previously described and six are novel SNPs of which five are in the 5′ untranslated region and one is in intron 2. Single marker association test identified 13 SNPs associated with the qualitative trait of *Salmonella* fecal shedding, and seven of those SNPs were also associated with a quantitative measurement of fecal shedding ($P < 0.05$). Using a stepwise regression process, a haplotype composed of SNPs *rs80787918* and *rs80907449* ($P \leq 4.0 \times 10^{-3}$) spanning a region of 4.9 Kb was identified, thereby providing additional information of the influence of those SNPs on *Salmonella* fecal shedding in pigs.

Khan SU, Atanasova KR, Krueger WS, Ramirez A and Gray GC (2013). Epidemiology, geographical distribution, and economic consequences of swine zoonoses: a narrative review. Emerg Microbes Infect.; 2(12): e92.

We sought to review the epidemiology, international geographical distribution, and economic consequences of selected swine zoonoses. We performed literature searches in two stages. First, we identified the zoonotic pathogens associated with swine. Second, we identified specific swine-associated zoonotic pathogen reports for those pathogens from January 1980 to October 2012. Swine-associated emerging diseases were more prevalent in the countries of North America, South America, and Europe. Multiple factors were associated with the increase of swine zoonoses in humans including: the density of pigs, poor water sources and environmental conditions for swine husbandry, the transmissibility of the pathogen, occupational exposure to pigs, poor human sanitation, and personal hygiene. Swine zoonoses often lead to severe economic consequences related to the threat of novel pathogens to humans, drop in public demand for pork, forced culling of swine herds, and international trade sanctions. Due to the complexity of swine-associated pathogen ecology, designing effective interventions for early detection of disease, their prevention, and mitigation requires an interdisciplinary collaborative "One Health" approach from veterinarians, environmental and public health professionals, and the swine industry.

Boschert V, Berger A, Konrad R, Huber I, Hörmansdorfer S, Zöls S, Eddicks M, Ritzmann M and Sing A (2014). Corynebacterium species nasal carriage in pigs and their farmers in Bavaria, Germany: implications for public health. Vet Rec. 2014 Jul 18. pii: vetrec-2014-102634

Reports on cases of human diphtheria caused by toxigenic Corynebacterium ulcerans that were linked to occupational swine contact as well as isolation of C ulcerans from wild boars have suggested that pigs might serve as reservoir for human infections. Therefore, a prevalence study on Corynebacterium species nasal carriage in pigs and their farmers was performed between August 1 and December 31, 2009, in 41 swine farms from Bavaria, Germany. All 411 asymptomatic pigs and 29 of 30 healthy farmers were colonised with Corynebacterium strains of up to 11 different species. No potentially toxigenic Corynebacterium strain was isolated either from the pigs or from their farmers, respectively. The patterns of the species composition in the pigs and the farmers were

very similar, suggesting a potential transmission of strains between animals and humans.

Rajao DS, Anderson TK, Gauger PC and Vincent AL (2014). Pathogenesis and Vaccination of Influenza A Virus in Swine. Curr Top Microbiol Immunol. 2014 Jul 18. [Epub ahead of print]

Swine influenza is an acute respiratory disease of pigs caused by influenza A virus (IAV) and characterized by fever followed by lethargy, anorexia, and serous nasal discharge. The disease progresses rapidly and may be complicated when associated with other respiratory pathogens. IAV is one of the most prevalent respiratory pathogens of swine, resulting in substantial economic burden to pork producers. In the past 10-15 years, a dramatic evolution of the IAV in U.S. swine has occurred, resulting in the co-circulation of many antigenically distinct IAV strains, derived from 13 phylogenetically distinct hemagglutinin clusters of H1 and H3 viruses. Vaccination is the most common strategy to prevent influenza in pigs, however, the current diverse IAV epidemiology poses a challenge for the production of efficacious and protective vaccines. A concern regarding the use of traditional inactivated vaccines is the possibility of inducing vaccine-associated enhanced respiratory disease (VAERD) when vaccine virus strains are mismatched with the infecting strain. In this review, we discuss the current epidemiology and pathogenesis of swine influenza in the United States, different vaccines platforms with potential to control influenza in pigs, and the factors associated with vaccine-associated disease enhancement.

Herrero-Medrano JM, Megens HJ, Groenen MA, Bosse M, Pérez-Enciso M and Crooijmans RP (2014). Whole-genome sequence analysis reveals differences in population management and selection of European low-input pig breeds. BMC Genomics;15(1):601

Background:

A major concern in conservation genetics is to maintain the genetic diversity of populations. Genetic variation in livestock species is threatened by the progressive marginalisation of local breeds in benefit of high-output pigs worldwide. We used high-density SNP and re-sequencing data to assess genetic diversity of local pig breeds from Europe. In addition, we re-sequenced pigs from commercial breeds to identify potential candidate mutations responsible for phenotypic divergence among these groups of breeds.

Results:

Our results point out some local breeds with low genetic diversity, whose genome shows a high proportion of regions of homozygosis (>50%) and that harbour a large number of potentially damaging mutations. We also observed a high correlation between genetic diversity estimates using high-density SNP data and Next Generation Sequencing data (r = 0.96 at individual level). The study of non-synonymous SNPs that were fixed in commercial breeds and also in any local breed, but with different allele, revealed 99 non-synonymous SNPs affecting 65 genes. Candidate mutations that may underlie differences in the adaptation to the environment were exemplified by the genes AZGP1 and TAS2R40. We also observed that highly productive breeds may have lost advantageous genotypes within genes involve in immune response - e.g. IL12RB2 and STAB1-, probably as a result of strong artificial in the intensive production systems in pig.

Conclusions:

The high correlation between genetic diversity computed with the 60K SNP and whole genome re-sequence data indicates that the Porcine 60K SNP Beadchip provides reliable estimates of genomic

diversity in European pig populations despite the expected bias. Moreover, this analysis gave insights for strategies to the genetic characterization of local breeds. The comparison between re-sequenced local pigs and re-sequenced commercial pigs made it possible to report candidate mutations to be responsible for phenotypic divergence among those groups of breeds. This study highlights the importance of low input breeds as a valuable genetic reservoir for the pig production industry. However, the high levels of ROHs, inbreeding and potentially damaging mutations emphasize the importance of the genetic characterization of local breeds to preserve their genomic variability.

Luo Y, Li S, Sun Y and Qiu HJ (2014). Classical swine fever in China: A minireview. Vet Microbiol; 6;172(1-2):1-6.

Classical swine fever (CSF), caused by Classical swine fever virus (CSFV), is an OIE-listed, highly contagious, often fatal disease of swine worldwide. Currently, the disease is controlled by prophylactic vaccination in China and many other countries using the modified live vaccines derived from C-strain, which was developed in China in the mid-1950s. This minireview summarizes the epidemiology, diagnostic assays, control and challenges of CSF in China. Though CSF is essentially under control, complete eradication of CSF in China remains a challenging task and needs long-term, joint efforts of stakeholders.

Boniotti MB, Gaffuri A, Gelmetti D, Tagliabue S, Chiari M, Mangeli A, Spisani M, Nassuato C, Gibelli L, Sacchi C, Zanoni M and Pacciarini ML (2014). Detection and Molecular Characterization of *Mycobacterium microti* Isolates in Wild Boar from Northern Italy. J Clin Microbiol;52(8):2834-43

Approximately 23,000 hunter-harvested wild boars from the pre-Alpine area of northern Italy were examined for tuberculosis over a 9-year period (2003 to 2011). Retropharyngeal and mandibular lymph nodes from the wild boars were examined grossly, and 1,151 of the lymph nodes were analyzed in our laboratory by histology (728 samples) and culture isolation (819 samples). Mycobacterium tuberculosis complex (MTBC)-specific PCR (1,142 samples) was used for molecular-level detection in tissue samples, as was a gyrB restriction fragment length polymorphism (RFLP) assay (322 samples). Lesions compatible with tuberculosis and indistinguishable from those described in cases of Mycobacterium bovis infection had been observed since 2003. Mycobacterium microti was identified directly in 256 tissue samples by the adopted molecular approaches. However, only 26 M. microti strains were obtained by culture isolation due to the well-known difficulties in isolating this slow-growing mycobacterium. During 2006, a prevalence study was performed in two provinces of the area, and the diffusion of M. microti was calculated to be 5.8% (95% confidence intervals surrounding the estimated prevalences [CIP95%], 3.94 to 7.68%). Over the following years (2007 to 2011), the presence of M. microti appeared to be stable. All isolates were genotyped by spoligotyping and exact tandem repeat analysis (ETR types A to F). In addition to the typical vole type (SB0118), a new spoligotype lacking the 43 spacers was found. Spoligotyping was also applied directly to tissue samples, and a geographical cluster distribution of the two spoligotypes was observed. This is the first report studying the diffusion and genetic variability of M. microti in wild boar.

Costard S, Mur L, Lubroth J, Sanchez-Vizcaino JM and Pfeiffer DU (2013). Epidemiology of African swine fever virus. Virus Research; Volume 173 (1): 191–197

African swine fever virus used to occur primarily in Africa. There had been occasional incursions into Europe or America which apart from the endemic situation on the island of Sardinia always had been successfully controlled. But following an introduction of the virus in 2007, it now has expanded its geographical distribution into Caucasus and Eastern Europe where it has not been controlled, to date. African swine fever affects domestic and wild pig species, and can involve tick vectors. The ability of the virus to survive within a particular ecosystem is defined by the ecology of its wild host populations and the characteristics of livestock production systems, which influence host and vector species densities and interrelationships. African swine fever has high morbidity in naïve pig populations and can result in very high mortality. There is no vaccine or treatment available. Apart from stamping out and movement control, there are no control measures, thereby potentially resulting in extreme losses for producers. Prevention and control of the infection requires good understanding of its epidemiology, so that targeted measures can be instigated.

Nogueira-Filho SL, Borges RM, Mendes A and Dias CT (2014). Nitrogen requirements of white-lipped peccary (Mammalia, Tayassuidae). Zoo Biol.; doi: 10.1002/zoo.21141

A study was conducted to determine the protein requirement of the white-lipped peccary (*Tayassu pecari*) performing a nitrogen (N) balance digestion trial. In a 4×4 Latin square design, four adult captive male peccaries were fed four isoenergetic diets containing four different levels of N (13.3, 19.2, 28.7, and 37.1 g N/kg dry matter). After 15 days of adaptation, the total collection of feces and urine was carried out for five consecutive days. By regression analysis between N intake and N in feces and urine, the metabolic fecal nitrogen (MFN = 3.1 g/kg of dry matter intake) and daily endogenous urinary N (EUN = 91.0 mg/kg$^{0.75}$) were determined. Likewise, by regression analyses between consumption of nitrogen and the nitrogen balance [NBN consumed-(fecal N + Urine N)] we estimated the daily requirement of 336.5 mgN/kg$^{0.75}$. Therefore, if food intake is unrestricted, white-lipped peccaries require a minimum content in their diet of about 4.5% crude protein as percentage of dry diet. These values are similar to those found in frugivorous wild ruminants, which reinforces the proposition that peccaries have a digestive physiology nearer to that of ruminants than of domestic pigs. Furthermore, the low nutritional maintenance requirements for white-lipped peccary may explain how this species thrive in the Neo-tropical region eating predominantly palm-fruits that normally have low crude protein contents.

Santos EA, Sousa PC, Martins JA, Moreira RA, Monteiro-Moreira AC, Moreno FB, Oliveira MF, Moura AA and Silva AR (2014). Protein profile of the seminal plasma of collared peccaries (*Pecari tajacu* Linnaeus, 1758). Reproduction; 147(6):753-64.

This study was conducted to characterize the major proteins of the peccary seminal plasma, based on the semen samples collected from nine adult and reproductively sound animals. Our approach included the use of two-dimensional electrophoresis followed by Coomassie blue staining and analysis of polypeptide maps with PDQuest Software (Bio-Rad). Proteins were identified by tandem mass spectrometry (LC-MS/MS). We detected 179 protein spots per gel and 98 spots were identified by mass spectrometry, corresponding to 23 different proteins. The combined intensity of those spots accounted for 56.2±6% of the intensities of all spots and 60.9% of the intensities of spots presented in every protein map. Protein spots identified as clusterin represented 19.7±8.3% of the integrated optical densities of all spots detected in the seminal plasma maps. There was a negative association ($r=-0.87$; $P<0.05$) between the intensity of a clusterin spot and the percentage of sperm with functional membrane. Spermadhesin porcine seminal plasma protein 1 and bodhesin 2 comprised 5.4±1.9 and

8.8±3.9% of the total intensity of all spots respectively. Many proteins appeared in a polymorphic pattern, such as clusterin (27 spots), epididymal secretory glutathione peroxidase (ten spots), inter-α-trypsin inhibitor (12 spots), and IgG-binding protein (ten spots), among others. In conclusion, we presently describe the major seminal plasma proteome of the peccary, which exhibits a distinct high expression of clusterin isoforms. Knowledge of wild species reproductive biology is crucial for an understanding of their survival strategies and adaptation in a changing environment.

Butti C, Ewan Fordyce R, Ann Raghanti M, Gu X, Bonar CJ, Wicinski BA, Wong EW, Roman J, Brake A, Eaves E, Spocter MA, Tang CY, Jacobs B, Sherwood CC and Hof PR (2014). The cerebral cortex of the pygmy hippopotamus, *Hexaprotodon liberiensis* (Cetartiodactyla, Hippopotamidae): MRI, cytoarchitecture, and neuronal morphology. Anat Rec (Hoboken); 297(4):670-700.

The structure of the hippopotamus brain is virtually unknown because few studies have examined more than its external morphology. In view of their semiaquatic lifestyle and phylogenetic relatedness to cetaceans, the brain of hippopotamuses represents a unique opportunity for better understanding the selective pressures that have shaped the organization of the brain during the evolutionary process of adaptation to an aquatic environment. Here we examined the histology of the cerebral cortex of the pygmy hippopotamus (*Hexaprotodon liberiensis*) by means of Nissl, Golgi, and calretinin (CR) immunostaining, and provide a magnetic resonance imaging (MRI) structural and volumetric dataset of the anatomy of its brain. We calculated the corpus callosum area/brain mass ratio (CCA/BM), the gyrencephalic index (GI), the cerebellar quotient (CQ), and the cerebellar index (CI). Results indicate that the cortex of H. liberiensis shares one feature exclusively with cetaceans (the lack of layer IV across the entire cerebral cortex), other features exclusively with artiodactyls (e.g., the morphologiy of CR-immunoreactive multipolar neurons in deep cortical layers, gyrencephalic index values, hippocampus and cerebellum volumetrics), and others with at least some species of cetartiodactyls (e.g., the presence of a thick layer I, the pattern of distribution of CR-immunoreactive neurons, the presence of von Economo neurons, clustering of layer II in the occipital cortex). The present study thus provides a comprehensive dataset of the neuroanatomy of H. liberiensis that sets the ground for future comparative studies including the larger Hippopotamus amphibius.

Walzer C, Petit T, Stalder GL, Horowitz I, Saragusty J and Hermes R (2014). Surgical castration of the male common hippopotamus (*Hippopotamus amphibius*). Theriogenology;81(3):514-8

In a prospective, clinical, surgery study we report here for the first time, in detail, on the surgical castration of 10 captive adult male common hippopotami (*Hippopotamus amphibius*). The successful procedures, a species-specific modification of standard equine castration techniques, provide valuable insight into the spatially dynamic nature of the common hippopotamus testis. The use of ultrasonography to locate the testis before and during the procedures and species-specific positioning during surgery greatly facilitated this distinctive procedure. Additionally, this surgical method provides an important additional tool for captive management of the common hippopotamus. Castration of individual males not only facilitates population control but can potentially also be employed to limit intermale aggression.

Taxonomic, Morphological, Biogeographic and Evolutionary Studies

Burgos-Paz W, Souza CA, Megens HJ, Ramayo-Caldas Y, Melo M, Lemús-Flores C, Caal E, Soto HW, Martínez R, Álvarez LA, Aguirre L, Iñiguez V, Revidatti MA, Martínez-López OR, Llambi S, Esteve-Codina A, Rodríguez MC, Crooijmans RPMA, Paiva SR, Schook LB, Groenen MAM and Pérez-Enciso M (2013). Porcine colonization of the Americas: a 60k SNP story. Heredity; 110(4): 321–330.

The pig, *Sus scrofa*, is a foreign species to the American continent. Although pigs originally introduced in the Americas should be related to those from the Iberian Peninsula and Canary islands, the phylogeny of current creole pigs that now populate the continent is likely to be very complex. Because of the extreme climates that America harbors, these populations also provide a unique example of a fast evolutionary phenomenon of adaptation. Here, we provide a genome wide study of these issues by genotyping, with a 60k SNP chip, 206 village pigs sampled across 14 countries and 183 pigs from outgroup breeds that are potential founders of the American populations, including wild boar, Iberian, international and Chinese breeds. Results show that American village pigs are primarily of European ancestry, although the observed genetic landscape is that of a complex conglomerate. There was no correlation between genetic and geographical distances, neither continent wide nor when analyzing specific areas. Most populations showed a clear admixed structure where the Iberian pig was not necessarily the main component, illustrating how international breeds, but also Chinese pigs, have contributed to extant genetic composition of American village pigs. We also observe that many genes related to the cardiovascular system show an increased differentiation between altiplano and genetically related pigs living near sea level.

Ecological and Conservation Studies

Conwaya AL, Hernandeza SM, Carrolla JP, Greena GT and Larsona L (2014). Local awareness of and attitudes towards the pygmy hippopotamus *Choeropsis liberiensis* in the Moa River Island Complex, Sierra Leone. Oryx; DOI: http://dx.doi.org/10.1017/S003060531300077X

The pygmy hippopotamus *Choeropsis liberiensis* is an Endangered species found only in the Upper Guinea rainforests of West Africa. Using a two-phase approach, with initial semi-structured interviews followed by more extensive questionnaires, we examined local residents' awareness of and attitudes towards the pygmy hippopotamus along the Moa River near Tiwai Island Wildlife Sanctuary in Sierra Leone. The interviews and questionnaires addressed human–hippopotamus interactions, local knowledge and awareness of pygmy hippopotamus ecology and behaviour, and public attitudes towards hippopotamus conservation. Overall, 22% of questionnaire respondents acknowledged benefits related to hippopotamus conservation; factors affecting the perception of benefits included age, livestock ownership, distance from Tiwai Island and exposure to conservation programmes. The results of this study could be used to inform the conservation of the pygmy hippopotamus and highlight the critical role of local support in the management of threatened species in biodiversity hotspots.

Ramos VD, Piovezan U, Franco AH, Osava CF, Herrera HM and Szabó MP (2014). Feral pigs as hosts for *Amblyomma sculptum* (Acari: Ixodidae) populations in the Pantanal, Mato Grosso do Sul, Brazil. Exp Appl Acarol; DOI 10.1007/s10493-014-9832-9

The Pantanal in Brazil is the largest floodplain of the world. This ecosystem, rich in wildlife, has a large feral pig population. Such a large host biomass must have a strong influence on the parasite fauna. In this work, we evaluated the role of feral pigs in the maintenance of *Amblyomma sculptum* (formerly *Amblyomma cajennense*), the most prevalent tick species in the Pantanal. Tick infestations were evaluated on 243 feral pigs and their environment. The suitability of domestic pigs, representing their feral relatives, to *A. sculptum* adults and nymphs was assessed experimentally. Tick infestation of feral pigs was strongly associated with that of the environment: 96 and 97 % of the ticks, respectively, were *A. sculptum*. The infestation prevalence on this host species was close to 90 % in the dry season and 100 % in the wet season and mean infestation intensity was above 30 ticks in both seasons. Suitability of pigs as hosts for *A. sculptum* was shown by the high proportion of nymphs and female ticks found engorging on captured feral pigs and adequate biological parameters displayed by ticks from experimental infestations of domestic pigs. Other tick species on feral pigs, albeit in much lower numbers, were Amblyomma parvum and Ornithodorus rostratus. Results show that feral pigs feed a high proportion of the *A. sculptum* adults and nymphs in their territories and should be a target for tick-borne diseases studies. This is particularly relevant to public health because all the main tick species found on feral pigs are aggressive to humans as well.

Nogueira SS, Abreu SA, Peregrino H, Nogueira-Filho SL (2014). The effects of feeding unpredictability and classical conditioning on pre-release training of white-lipped peccary (Mammalia, Tayassuidae). PLoS One. 2014 Jan 27;9(1):e86080.

Some authors have suggested that environmental unpredictability, accompanied by some sort of signal for behavioral conditioning, can boost activity or foster exploratory behavior, which may increase post-release success in re-introduction programs. Thus, using white-lipped peccary (Tayassu pecari), a vulnerable Neotropical species, as a model, we evaluated an unpredictable feeding schedule. Associating this with the effect of classical conditioning on behavioral activities, we assessed the inclusion of this approach in pre-release training protocols. The experimental design comprised predictable feeding phases (control phases: C1, C2 and C3) and unpredictable feeding phases (U1- signaled and U2- non-signaled). The animals explored more during the signaled and non-signaled unpredictable phases and during the second control phase (C2) than during the other two predictable phases (C1 and C3). The peccaries also spent less time feeding during the signaled unpredictable phase (U1) and the following control phase (C2) than during the other phases. Moreover, they spent more time in aggressive encounters during U1 than the other experimental phases. However, the animals did not show differences in the time they spent on affiliative interactions or in the body weight change during the different phases. The signaled unpredictability, besides improving foraging behavior, showing a prolonged effect on the next control phase (C2), also increased the competition for food. The signaled feeding unpredictability schedule, mimicking wild conditions by eliciting the expression of naturalistic behaviors in pre-release training, may be essential to fully prepare them for survival in the wild.

Matthee S, Swanepoel M, van der Mescht L, Leslie AJ and Hoffman LC (2013). Ectoparasites of a Non-Indigenous Warthog Population, *Phacochoerus africanus*, in the Free State Province, South Africa. African Zoology 48(2):259-265

A population of the common warthog, *Phacochoerus africanus*, recently became established on several farms in the Free State Province, South Africa. The aim of the study was to record ectoparasite species that occur on this non-indigenous population and to compare the parasite abundance and prevalence at three different times during 2011. Forty-six warthogs were culled in autumn (15), winter (16) and spring (15). Each individual warthog was screened for ectoparasites for 7–10 minutes by 3–4 persons. Parasites were removed using forceps and stored in 70% ethanol. Ticks were identified by an expert taxonomist, while fleas and lice were identified using published books containing their respective taxonomic keys. A single flea (*Echidnophaga larina*) and louse (*Haematopinus phacocheri*) species and three tick species (*Hyalomma truncatum*, *Rhipicephalus gertrudae* and *Rhipicephalus simus*) were recovered from 46 warthogs. The louse and flea were the most abundant ectoparasitic taxa, while the ticks had lower mean abundances. This is the first record of the tick *R. gertrudae* on warthogs in South Africa. Temporal variation in parasite abundance was observed. The louse was most abundant during spring and summer, while the flea preferred cooler and drier winter conditions. *Hyalomma truncatum* and *R. gertrudae* both preferred warmer spring conditions. In general, parasite species richness in the non-indigenous host population was low, which could support the parasite release hypothesis.

Adjin CK, Lougbegnon TO, Codjia JTC and Mensah GA (2011). Distribution, caractérisation écologique de l'habitat et notes sur le régime alimentaire du phacochère commun, *Phacochoerus africanus* (Gmelin, 1788) au Sud du Bénin. International Journal of Biological and Chemical Sciences; Vol 5, No 5 (2011)

Phacochoerus africanus est le seul suidae du genre *Phacochoerus* présent au Bénin, souvent rencontré en zones soudaniennes et soudano-guinéennes (Nord et Centre). Cette étude fait état de la présence effective de l'espèce dans la partie guinéenne du Bénin et fait ressortir quelques données préliminaires sur sa distribution, la caractérisation de son habitat et son régime alimentaire. L'habitat a été étudié sur la base d'observations directes et des indices de présence, tandis que les entretiens avec 42 chasseurs complétés avec des observations directes de restes d'aliments et d'analyses macroscopiques de crottes ont permis d'appréhender son régime alimentaire. Sur l'ensemble des deux forêts prospectées, *Phacochoerus africanus* se retrouve essentiellement dans la forêt classée de Dogo-Kétou. Il vit dans des gîtes, constitués d'espèces végétales de hauteur moyenne 1,95 ± 0,49 m et de circonférence 16,2 ± 4,58 m. Il fréquente les forêts claires arbustives à *Pterocarpus erinaceus* et *Anogeissus leiocarpus* de recouvrements compris entre 0 et 50%. Dans ces habitats, les sols sont argileux et limoneux avec la présence de cours d'eau et de marigots temporaires qui lui servent de bauges. Son régime alimentaire est constitué de feuilles, d'inflorescences, de fruits, de tiges, de petits mammifères, de poissons et les vers de terre.

Thorp P. (2012). The influence of active bomas on habitat choice of the common warthog (*Phacochoerus africanus*). First cycle, G2E. Skara: SLU, Dept. of Animal Environment and Health

The common warthog (*Phachocoerus africanus*) is a relatively long-legged pig with noticeable curved tusks, a short neck and three pairs of facial warts. It has four recognized subspecies. The common warthog is a non-migratory ungulate living on the African savannah. It is a hindgut fermenter and predominantly dependent on high-quality foods. It prefers open areas for grazing but use bushes for cover. Warthogs prefer former bomas because of the nutrient enrichment that has occurred there and they also distribute their faeces close to their feeding grounds. Warthogs are a pioneer species when it comes to recolonizing abandoned bomas. Warthogs are bearers of several diseases harmful to livestock and are therefore often chased from active bomas. The aim of this study was to investigate how active bomas influence the habitat choice of warthogs. The study was carried out in the Maasai Mara National Reserve and the adjoining Koyake group ranch, in august 2003 and May-June 2004, using well defined study areas; transects. Results showed that warthogs favour the transects farthest away from the bomas. Warthogs probably favour the security of grazing among other species in order to avoid being caught by predators. Other herbivores might also feed on plant species less attractive to warthogs and thereby allowing plant species that warthogs favour to grow.

The IUCN/SSC Wild Pigs, Peccaries and Hippos Specialist Groups (WPSG, PSG and HSG) are three of several Specialist Groups of the Species Survival Commission (SSC) developed by the IUCN to foster conservation, research and dissemination of information for species of conservation concern.

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

The broad aim of the these groups is to promote the long-term conservation of wild pigs, peccaries and hippos and, where pos-sible, the recovery of their populations to viable levels.

Pigs, peccaries and hippopotamuses are non-ruminant ungulates belonging to the Suborder Suiformes of the Order Artiodactyla (the even-toed ungulates).

Within the Suborder Suiformes, pigs belong to the Family Sui-dae, peccaries to the Family Dicotylidae and hippopotamuses to the Family Hippopotamidae.