Suiform Soundings

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Pygmy hog hoglet and mother. Photo: Parag Jyoti Deka

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Editorial

Dear fellow readers,

I hope you are doing well during these strange and challenging times! I am happy to present you with the latest issue of Suiform Soundings.

At the end of October last year, I visited the famous market of Tomohon in the Minahasa Highland in northern Sulawesi, Indonesia. There, I took photos of dead bats, flying foxes, monitor lizards, and snakes on sale for human consumption (see Fig. 1). Later, I sent these photos to friends, who asked if I had tried bats or flying foxes. My answer was that I did not want to become “patient zero” of the next pandemic. Giving this answer, I could not know that a new pandemic, Covid-19, would be on the rise less than three months later.

Due to Covid-19, people all around the world have to bemoan the loss of beloved relatives and friends, face new challenges, and cope with demanding situations they would never have thought of just one year ago. Not only have people to deal with new challenges and problems, but species conservation has changed, and will continue to do so, worldwide. As rangers are forced to stay at home, poaching is on the rise in many protected areas. Meanwhile, the income for local people generated by wildlife tourism has crashed. Many people who were once poachers became tour guides and trackers, and received income by taking tourists to see wildlife. A cornucopia of protected areas generated better lives for nearby local communities due to the job opportunities afforded by hotels, local craft markets and other benefits. Wildlife tourism has provided important income for many countries around the world. What will people do if tourists no longer generate this local prosperity? If there is no money at all, some may turn back to poaching or at least tolerate poaching efforts. The general question underlying this new situation caused by Covid-19 is: How can species and nature conservation work well without the income generated by tourism and with less money from global and local NGOs due to the dramatic reduction in donations they are receiving?

With death tolls in many countries rising every day and poverty increasing worldwide, the global status of species and nature conservation looks bleak! Moreover, on a global scale, it looks as if we have not yet passed the trough of this pandemic. India is one of the countries hit hardest by Covid-19. In fact, while I am writing this editorial, it has become one of the hotspots for this

Editorial

Fig. 1: Dead flying foxes on sale for human consumption at the food market in Tomohon, Sulawesi / Indonesia. Photo: T. Braasch

pandemic and is ranked third in the world after the USA and Brazil (see https://www.worldometers.info/coronavirus/?utm_campaign=homeAdvegas1?%22%20%5Cl%20%22countri). But even during these dark times there is a glimmer of hope: Dr. Parag Jyoti Deka recently sent me this video (https://youtu.be/xsL-Z6nz7Wk) on the release of Pygmy hogs in Manas National Park, entitled 'The homecoming of Pygmy Hogs'. People like Dr. Parag, Dr. Goutam Narayan, and their team provide hope during this bleak pandemic.

In this issue of Suiform Soundings, I am presenting a new section called 'Think Pig'. Think Pig was the motto of the last WPSG workshop about Asian wild pigs, which took place in Cikananga on Java, Indonesia in November 2013. Think Pig will be a section for articles with new ideas, new questions, and new opinions about the conservation of pigs, peccaries, and hippos. The articles of this section do not need to be strictly scientific - it aims to facilitate discussions. The idea of this new section has been around for several years but, in a way, the Covid-19 pandemic has shown that we need new ideas, new questions, and new solutions for species and nature conservation. And we need them sooner rather than later!

I want to thank all the authors for contributing to this issue and the editorial team for all their work!

I hope you will enjoy reading this issue!

With warm regards,

Thiemo Braasch

Chief Editor Suiform Soundings

Symposium

Welcome to the International Symposium on Wild Boar and Other Suids!

The 13th edition of this exciting meeting that takes place every 2 years is held in the Montseny Biosphere Reserve (Catalonia, Spain) from 23th to 26th of March 2021.
The symposium is organised by different research and wildlife management institutions from Catalonia including the Catalan Government, the City Hall of Barcelona and the Autonomous University of Barcelona, among others.
Wild boar is one of the most common mammal species in Europe and in the rest of the world. Their populations are expanding in number and range, colonising any type of temperate and tropical terrestrial habitats and regions, from highest mountains to lowlands and urban areas.
The challenge of controlling wild boar population growth and mitigating the economic and environmental impacts of this species will be the main topic of this Symposium.
Traditional human wild boar conflicts related to the expanding populations of this species will be widely covered such as agricultural damage, traffic accidents or impact on animal or plant biodiversity or the incursion of wild boar in human environments. However, special attention will be also dedicated to new risks such as the expansion of diseases.
The global spread of African Swine Fever requires new approaches to manage and monitor wild boar populations and the potential economic, ecological and social impacts of this disease. Evidence-based management combined with scientific and applied knowledge is now needed more than ever to mitigate human-wild boar conflicts.
The Symposium will include thematic sessions covering wild boar biology and eco-ethology as well as management practice, population control strategies and damage mitigation methods. Other Suids or Tayasuids from all over the world such as Babirusas, Warthogs, Bushpigs, Pygmy hogs, peccaries ands any Suiform species of our planet are also in the scope of the conference and can have their thematic sessions organised if a sufficient number of communications is presented. So we strongly welcome your participation to this event: Everybody interested in wild pigs is welcome to join!

We would like to encourage the active participation of researchers and practitioners working in other suids, with oral presentations and posters. The idea is to make this symposium as diverse and applied as possible, and to highlight the conservation and health of threatened pig species as well as their importance ecological importance as food for other threatened wildlife species and their sociological role as protein source for humans in areas of high biodiversity.
Furthermore, if several WPSG members will join, we would like to grab the opportunity to organise at least an informal meeting of our WPSG, and depending on the situation, some more targeted meetings!
So do not miss this great opportunity to send your abstract, communicate about your results or simply exchange information and expand your network!
The abstract submission deadline has been extended to 15th October 2020 and registrations are now open! All the information can be found in the symposium's website https://wildboarsymposium.com.

If you have questions, please feel free to contact WPSG member Ferran Jori who is part of the organising team (ferran.jori@cirad.fr) or WPSG chair Johanna Rode-Margono (johanna.rode-margono@stiftung-artenschutz.de).

We look forward to meet you there!

The status "Protected" - the end of communication or a success?

Ralf Lohe
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The future will bring new challenges for species conservation and for our work. A less scientific – but quicker – exchange of ideas may be necessary to provide us with the right impetus at the right time. Our chief editor, Thiemo, constructed a new platform “Think Pig” for this knowledge exchange and I am happy to open it by sharing my ideas with you.

Wild animals face different fates: Some populations are stable or increasing, while others are in a steady decline; some species are strictly protected by law, others partly, and some not at all; and some species do very well without any protection, while others have been strictly protected for decades and are dwindling. Even between closely related species or within different populations of a single species, the situation is often completely different. For example, giraffe populations across Africa exhibit the full range between vanishing and thriving, and while some are strictly protected, others are managed with little legal protection. It is remarkable that decades of strict protection have not stopped certain populations from decreasing, while others received little legal protection but strict management over decades, and have increased to a maximum number. It is clear that the status "Protected" does not confer adequate protection in reality. But why are regulations ignored? What goes wrong? Why are protected species still persecuted?

Whilst population declines are often multi-causal and therefore difficult to understand, for some species the causes of decline are clear. Wild pigs are a prime example of this and I will concentrate on their story to illustrate my ideas. For wild pigs, major threats (e.g. international trade in wild pig body parts or live animals) do not exist and habitat loss is mostly overcompensated by new food sources (except in the case of the pygmy hog). However, pigs are heavily persecuted as a source of protein and fat, as crop raiders, or as both. As the majority of persecutions are executed by traditional hunters and local farmers, an in-depth understanding of the motivations behind these persecutions is essential to develop a successful conservation strategy, whilst respecting people’s traditions and needs and ensuring long-term acceptance/cooperation with the program. The key role of local communities for successful conservation is widely recognized; they participate in stakeholder workshops and questionnaire surveys, etc. Fine!
But do we recognize these people as equal partners, on the same level? Are we willing to learn from them?

How do people feel when born into a situation where they must somehow get along with wild animals? Whose parents and grandparents etc. have hunted these animals for food or to protect their crops – necessary for survival and also sustainable for a very, very long time. What will they do when someone from outside decides that this is illegal now?
I have spent quite a while in different countries ‘in the bush’ with local farmers and traditional hunters, many of them illiterates and perceived as primitives in their own country. But I learnt a lot from them about nature, animals, and even life. So, I try to look at these situations from their perspectives:

The traditional hunter

The secret of successful hunting is to predict what an animal will do next. It is obvious that this requires a deep understanding of nature. Some very skilled traditional hunters hunt wild pigs with a simple spear and nothing else - even without dogs! This requires a deep understanding of the species and of nature in general. It is clear that any conservation strategy against the interests of people with such an expertise will fail, but with their support is likely to succeed.

Fig 1: Bearded pigs are a highly favoured prey for indigenious people. Photo: T. Bangun for WWF Germany.

Wild pigs are a perfect target for traditional hunters: They can occur in high densities, are very reproductive, and are large enough to be worth the hunt, yet small enough to be handled easily and can be approached relatively easily. Wild pigs can also withstand a high hunting pressure. In my home country, Germany, wild pigs *Sus scrofa* are thriving in optimal conditions and reproduction rates are maximal. An annual harvest of about 200% of the pre-reproduction population is intended to keep *S. scrofa* under control, but the population is still growing. This is an extreme example, and the reproduction rates of other pig species are lower, but in most cases in a range where a high percentage of the population can be taken out sustainably every year.

When it comes to the protection of an endangered wild pig species, conservationists and hunters have different motivations, but both parties are happy when a population grows. This is the perfect base for a concept, which benefits both sides. However, it should be kept in mind that the success of this concept depends entirely on the acceptance and support of traditional hunters; therefore, the strategy should be discussed openly and concessions should be made on the conservationists' side. There may be a bitter taste when accepting the continued hunting of an endangered species, but if hunters were to focus their efforts on male pigs, for example, leaving females and piglets alive,the population could more than double within two years. This is a good reason for conservationists to smile again. A positive outcome of such a quick success is that the local people become far more open to further cooperation. So, when developing conservation strategies, it may be helpful to start with a species that is important for the people being affected; focus on the bearded pig rather than the orangutan, the Mindoro warty pig rather than the tamaraw - for practical reasons.

I understand it is much easier to raise money for the iconic orangutan compared to the widely unknown bearded pig, but there may be more benefits for the orangutan from a well-reasoned and successful bearded pig project than from a standard orangutan project. In rural communities, wild pigs have the potential to serve as door-openers to the idea of nature conservation - in this context, they are the real flagship species.

The small farmer

Wild pigs are notorious for causing serious agricultural damage and all farmers know that an

increasing population will cause more damage. Farmers are not interested in the success of a pig conservation project. Nevertheless, it has to be recognized that farmers have problems with the damage caused by pigs, not the animals themselves. When pigs do not cause any damage, there is no need for persecution. Therefore, the first step must be to minimize the damage to agricultural fields. The classical strategy is to build a fence around the field. In most cases there will already be a simple construction providing limited protection. But it is important to consider that a real pig-proof fence is expensive, and is a massive construction, which is deeply anchored in the ground, or a modern construction that needs lots of maintenance.
But let's imagine there is enough money for it. What will the pigs do?
They will visit an adjacent crop field until it is also fenced in, and will then move on to the next...
Farmers who have had no previous problems with pigs will be affected now. The strategy sounds good, but it is expensive and, in the long-term, counterproductive. It is much cheaper and more effective to offer the pigs a food source equally attractive as the farmers crops, but in a safe environment. Perhaps there is an old abandoned field some distance from the other fields; a good place to cultivate a varied food supply, preferably trees and bushes, for the pigs. The advantage of trees is that they need to be planted only once, require minimal protection and maintenance, and the fruits grow out of the pigs reach until they fall to the ground. Therefore, wild pigs cannot "finish the table in half an hour", but have to repeatedly return and spend a lot of time in this safe environment; pigs are intelligent and will quickly understand this situation. If there is some eco-touristic project nearby - great! This is the perfect place for tourists to watch pigs - good for the income of local people and consequently good for the pigs.
There will still be problems with pigs in agricultural fields and they will still be persecuted, but on a much smaller scale. However, only a surplus of the population will be affected and there will therefore be no need to criminalize the persecution of pigs. Additionally, when a farmer thinks that it is necessary to protect his crops by killing a pig, it is very likely that he will do so, legally or otherwise. But if persecution is criminalized, a farmer may use less visible methods, such as poison, rather than his dogs and a spear... criminalization is a dangerous tool.

Communication

This is more difficult than it appears, as the "people in the bush" often have a low rank in their society, may do small things that they should not (collecting firewood in the park etc.), and are often intimidated by officials. They may have learned that it is better to tell you what you want to hear, rather than how they truly feel. However, without knowing what these people sincerely think, it is very difficult to create a concept which they will accept and support. That is why it is important to meet them in an atmosphere where they feel comfortable: For example, a relaxed talk at the camp fire - with a school child as an interpreter and without documentation, with no game wardens, no police, and no other important individuals in the background – should provide you with the necessary information. Maybe then there will be no need for an expensive stakeholder workshop or questionnaire survey.

Conservation

For practical conservation, it may be difficult to determine what harvest rate can be tolerated. It has to be sustainable but, for reasons of acceptance, a quick decision is also necessary.
A few camera traps should provide the necessary information in less than four weeks: You need to know the population size and trend over time. Trends are obtained by comparing the number of

Fig. 2: The spreading of oil palm plantations offer superb food conditions for the very reproductive Bearded pig but the populations are in serious decline. Photo: R. Dennis

yearlings to the number of piglets. (Yearlings and piglets are easy to identify. The difference in number is the mortality in the first year of life and that gives you the trend. The mortality rate is highest in this span of life, so you have the trend for the most important year.)

The population size is also easily estimated. Many animals have individual signs that can be used for identification, such as a broken tail or an ear slit. So, for example, if you were to have 100 photographs of pigs and five of them showed the pig with the broken tail, you have a population of around 20 pigs. These methods may appear not very accurate, but it has to be considered that, for most pig species, populations are subject to heavy fluctuations and thus new information has more value than old. To illustrate this, imagine you start with a population of 100 warthogs in an arid region. After three months you could have a population of 200 or just 20; this is the difference between a good and a bad rainy season. I understand the intention to collect accurate data of scientific value, but there are important variables beyond any calculation. For practical conservation, rough but new information is much more valuable than statistically sound estimates based on old data.

Conclusion

Some nature conservation projects run smoothly and effectively, while others are a constant battle with little or no success. Generally speaking, effective projects have local people at the heart of their concept and experience maximal collaboration and integration with these communities. It is hard for me to understand that many projects still neglect or completely ignore the role of the people really affected by these conservation issues in their daily lives. It is predictable that these projects will fail – they are a waste of energy, money, and time. That is why I concentrated on the essential role of those people really affected by these issues in this short article, and do not mention aspects like religious taboos, the hunter/farmer conflict, and dogfights with pigs etc..

These are, no doubt, at least locally important.

In the future we have to expect that there will be less money available for species conservation. Considering this, it is risky to rely on grants. However, for a project that stands on its own, the future looks much brighter.

Our wild pigs have the potential to enable successful conservation!

African Swine Fever's Arrival in India: Our Strategy to Keep the Conservation-Breeding Programme for Pygmy Hogs (*Porcula salvania*) Safe

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Abstract

The last surviving original population of the pygmy hog (*Porcula salvania*) in wild, the population established from the reintroduction into Wildlife Protected Areas (WPA) and the population in captivity all exist only in Assam, a north eastern regional state of India. The pygmy hog is susceptible to pig diseases and pygmy hogs in the captive centres are therefore maintained according to a biosecurity protocol. The arrival of African Swine Fever (ASF) in India through the north east region posed a threat to the wild pygmy hog population of 400 individual and an immediate threat specifically to the 80 captive pygmy hogs. The existing biosecurity of captive centres was assessed to gauge the potential risk of entry of this deadly disease to the captivity. This risk analysis guided us to design an upgraded biosecurity plan for the captive centres. The plan is being implemented to keep the captive pygmy hogs safe from the ASF.

Key Words: African Swine Fever, India, Pygmy Hog, Biosecurity

African Swine Fever has reached India

The first occurrence of ASF in India, in the third week of January, was confirmed in the middle of May 2020 (OIE, 2020). This occurred in the Arunachal Pradesh of north east region (NER) of India. The first outbreak of ASF had been reported in China in August 2018 (OIE, 2018), with the first outbreak reported in Tibet in March 2019 (OIE, 2019) (Fig.1). It subsequently became endemic in Tibet (FAO, 2019). As Arunachal Pradesh borders Tibet, it was suspected that the disease came to Arunachal Pradesh from there (IANS, 2020). There are a number of potential routes of transmission of the disease from Tibet to Arunachal

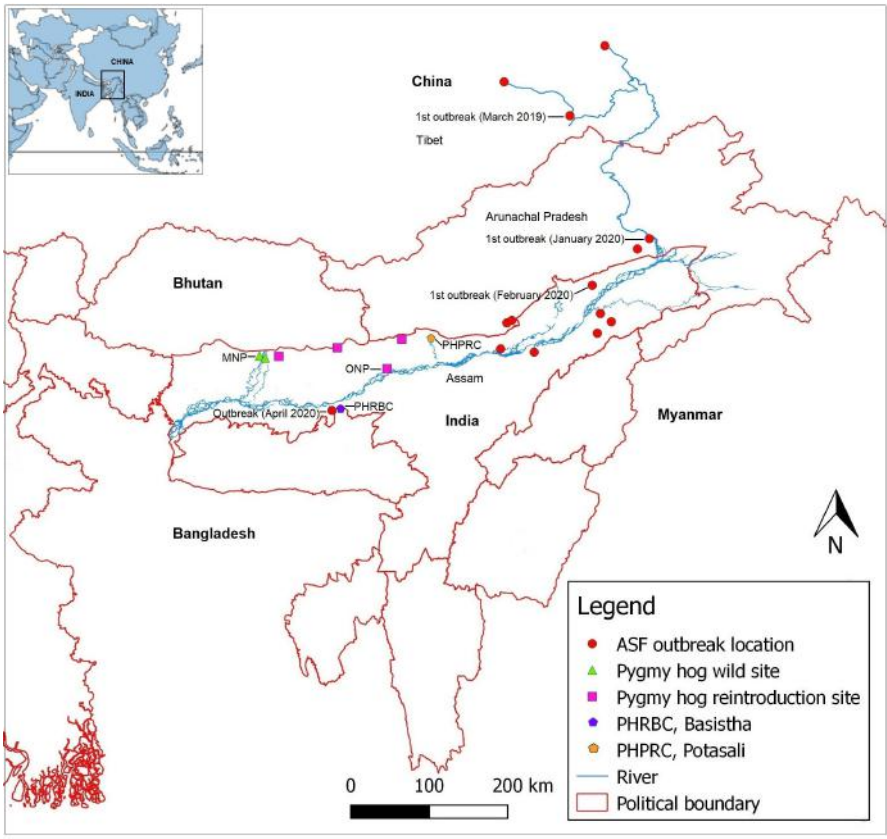

Fig. 1: Regional map showing the progression of ASF outbreaks over time in relation to the pygmy hog breeding centres, the reintroduction sites and the sole wild population of the species.

Fig. 2: Male Pygmy hog. Photo: P.J. Deka

Pradesh. It may come via the movement of live pigs or pork products across the, somewhat porous, border (Central Agricaultural Ministry of Government of India advisory notice of June 2019, cited in Bhattacharyya, 2020). Also, as proper reporting and disposal of pig carcasses was not adopted during the COVID19 pandemic in China (Craymer, 2020) any diseased carcasses disposed of in rivers originating in the Tibet region of China may have been carried downstream into Arunachal Pradesh and then to Assam (Bhattacharyya, 2020). At the same time, deaths of wild boar (*Sus scrofa*) were also reported from along the tributaries of the Brahmaputra River in that region of Arunachal Pradesh (Lepcha, 2020).

Fig. 3: Female Pygmy hog. Photo: P.J. Deka

Outbreak and response scenario in north east region of India

The NER of India is characterized by a high proportion of tribal people for whom pig keeping is integral to their way of life; over a quarter of all India's pigs are in the NER (Deka et al, 2007). There were eleven outbreaks reported in domestic pigs in the NER of India, mainly in Arunachal Pradesh and Assam (OIE, 2020). Except for one isolated outbreak, all were mostly concentrated on either side of the mighty Brahmaputra River on the eastern part of Assam. At the beginning of the outbreak in April, in six districts of Assam, 2260 pigs had died before there had been confirmation of the disease (IANS, 2020).

The Animal Husbandry and Veterinary Departments of all the NER States of India initiated control measures as soon as the outbreak report was confirmed (IANS, 2020). The College of Veterinary Science, Assam Agricultural University also conducted a webinar in June this year which discussed the socio-economic impact of ASF in the region. The Commissioner & Secretary to the Government of Assam, Animal Husbandry & Veterinary Department explained the contingency plan for the State in this webinar. A preliminary standard operating protocol, which included zonation, surveillance, and culling and post-ASF management, was outlined. This detailed how the government conducts disease detection to find any outbreak epicentres and to notify a Containment Zone of one km radius around the epicentre. Culling has been planned to be conducted in July 2020 in all Containment Zones, with proper disposal of carcasses. Surveillance is planned to be conducted within up to a ten km radius of the epicentre, thereby creating a Buffer Zone. The government has prohibited any sale of pork and the transportation of pig in the

containment and the Buffer Zones. Imports of pigs from elsewhere within India to the NER has been banned to reduce the free sale of pork. The Commissioner & Secretary to the Government of Assam has clarified that because the ASF outbreak came to light during the COVID19 pandemic lockdown in Assam there was an initial lag to contain the disease (AAU, 2020).

Fig. 4: Pygmy hog female and newborn hoglets. Photo: P.J. Deka

The Wildlife Division of Forest Department of the Government of Assam also gave various instructions to the managers of WPA to prevent the contact between domestic and wild pigs and to initiate steps to minimise the chance of entry of the virus into the parks via vehicles and the staff residing inside the WPA in the protection camps. A few WPAs have adopted specific measures, including digging deep trenches along the WPA borders to prevent the free movement of wild boar across WPA boundaries and thus minimising their contact with domestic pigs (Bhattacharyya, 2020). The aforementioned Wildlife Division also asked the Pygmy Hog Conservation Programme (PHCP) and the Assam State Zoo to take all necessary steps to keep their captive pygmy hogs safe from ASF. The Animal Husbandry and Veterinary Department of Government of Assam has issued an instruction that, at the request of the Chief Wildlife Warden of Assam, all domestic pigs are to be moved from within one km radius of each pygmy hog captive centre.

African Swine Fever risk to the captive Pygmy Hog

Fig. 5: PHRBC breeding unit. Photo: P.J. Deka

The pygmy hog, the world's rarest and smallest Suid, is currently found only in a few WPA of Assam (Figures 2-4, Narayan and Deka, 2017). It has a wild population of about 400 animals. Two hundred of these, from the original wild population, are found in Manas National Park (MNP). A further population in Orang National Park (ONP), which has grown

from an original 50 reintroduced animals, also numbers some 200 individuals. Once thought to be extinct and rediscovered in 1971 (Tessier-Yandell, 1971), the Durrell Wildlife Conservation Trust initiated the PHCP in 1995. It partnered, initially, with the IUCN/SSC Wild Pig Specialist Group, Assam Forest Department and India's Ministry of Environment, Forest and Climate Change (Mallinson, 1996). The NGOs Ecosystems-India and Aaranyak joined later as local partners. Pygmy hogs were brought into captivity in 1996 to start the recovery programme (Oliver, 1996). Between 2008 and 2020, 130 individuals have been reintroduced into four WPAs in Assam, including the recent release of 14 individuals in MNP. Between 2011 and 2015 animals were reintroduced into ONP, successfully establishing a population there. Currently the captive breeding programme maintains two populations, totalling 80 individuals, in Assam. Two specimens are held for educational purposes on display in the Assam State Zoo.

Pre-ASF Biosecurity Measures at the Two Captive Population Sites

The pygmy hog is susceptible to domestic pig diseases, with some having been recorded in the captive populations (Narayan and Deka, 2017). Thus the pygmy hog centres have always held animals using high levels of biosecurity.

Fig. 6: Open drain passing through the Restricted Zone in the PHRBC, Basistha. Photo: C. Jones

Site: The Pygmy Hog Research and Breeding Centre (PHRBC, Fig. 5), at Basistha, is located in the foothills of the Garbhanga Reserve Forest, on the edge of Guwahati, the capital city of Assam. Occupying nearly one hectare, the perimeter of PHRBC Basistha is secured with a two-meter high chain-link fence. All animal enclosures are enclosed using concrete with weldmesh fencing. Hence, no animal can enter the centre and come close to the hogs. However, a natural stream flows through the centre grounds. This carries wastewater from the people illegally living higher up the hill (Fig. 6). They sometimes keep backyard pigs. This increases the threat of disease transmission to the captive pygmy hogs at Basistha centre. Thus, this narrow stream is channelled through the centre in a channel with concrete sides and base, with no-one permitted to stand in this watercourse.

The Pygmy Hog Pre-release Centre (PHPRC), Potasali, is located at the edge of the Balipara Reserve Forest (Fig. 7). The perimeter of this seven-hectare area is secured with a

Fig. 7: Pygmy hog pre-release facility. Hogs are visiting a feeding corral. Photo: P.J. Deka

seven-strand, one and half meter-high, electric fence. Within this area the Pre-release Unit is fenced with a two-meter-high, chain-link, fence. The Breeding Unit is similarly fenced, with concrete and a chain-link fence. Thus, no animal can come close to the hogs. This centre is also not far from human habitation with the local people similarly keeping backyard pigs.

Visitor entry: As a rule, no visitors are allowed in the PHRBC at Basistha. Exceptions include student groups and forest-staff trainees who come to the centre on occasion, for lectures as part of their studies, as well as visitors with specific objectives. Except for very rare occasions, visitors are not allowed to go close to the hog enclosures. They can observe the hogs from a viewing point. At Potasali PHPRC, people are allowed into the visitor centre and a section of the enclosures, from where they can see the hogs. No visitors are allowed to the Pre-Release Unit where hogs targeted for reintroduction are reared.

Vehicles: The garage for the project cars at PHRBC Basistha is located inside the centre, not far from to the animal facilities. At PHPRC Potasali the car is parked in a garage at the edge of the boundary, away from the animal facilities.

Staff: The project staff directly associated with the captive hogs at PHRBC Basistha live on the premises. Staff involved in animal keeping and maintenance at PHPRC Potasali come from their homes in the neighbourhood, with just two living within the centre.

Animal staff at both the centres must wear uniforms and footwear designated for working with animals. A foot-dip, with a 0.1% fresh solution of potassium permanganate, is placed just in front of all entrances to the enclosures, animal houses and animal kitchens. Footwear used outside these facilities needs to be left outside the entrances, bare feet dipped in the foot-dip and dedicated footwear worn inside.

Veterinary practice: In-house project veterinarians are responsible for the health care of the captive hogs. They are not allowed to provide any veterinary service to any external animal facilities. Only on special occasions veterinary specialists, from the local veterinary institute and from overseas, are invited to provide their services to the captive hogs. Post-mortem examinations of captive hogs are occasionally conducted within the centres. Otherwise these are sent to the local veterinary college. All diagnostic samples are sent to the local veterinary laboratory. Hogs, when essential, are taken (using biosecure precautions) to the local veterinary college for ultrasonography and radiography.

Animal food, bedding and waste: Feed items, bedding materials and other logistical requirements for the hogs are sourced locally for both centres. All food brought from the market is washed before storing. Dried bedding materials are stored directly. Cooking and eating of pork have been prohibited within the centre. All animal kitchen waste, feed waste and animal faeces are buried within the centre in a designated place. However, animal feed waste and faeces from the sick animals is burned immediately.

Stall cleaning: Besides normal cleaning, thorough cleaning of the stalls with concrete floors and walls is carried out twice in a year. Seven steps are involved in this procedure. These include

Fig. 8: Treating bedding material at PHRBC, Basistha. Photo: P.J. Deka

removing all non-fixed items from the house, removing dirt, scrubbing with plain water, soaking with disinfectant (0.1% potassium permanganate solution) and then washing with plain water. After drying the floor is scorched with a blow torch.

Keeping the Captive Pygmy Hogs Safe: A suspected outbreak of ASF in April, some 10 km from our PHRBC Basistha (Fig.1), was followed up by the veterinary authorities of Assam. Our cautious presumption that the case would be positive, and our initiating of changes to biosecurity protocols, was prudent as it was confirmed to be ASF. The existing biosecurity of the pygmy hog captive centres thoroughly reassessed. A specifically-designed checklist was used to evaluate current practice and to determine all possible disease entry routes/risk areas. It was believed that inclusion of a few more elements to the current biosecurity protocol would make it more robust, thus optimising the level of protection and, crucially, reduce the risk of entry of the disease. The resulting process of upgrading was started in late April, as described below, in both captive hog centres.

Site: The entire area of PHRBC, Basistha and PHPRC, Potasali were each divided into three zones: Sanitization Zone, Controlled Zone and Restricted Zone. The captive hogs are located in a core Restricted Zone. Outside this, within the centre, are the Controlled Zones. Near the entrances Sanitization Zones have delineated outside the Controlled Zones. Currently, temporary provisions have been made to demarcate these Zones. Access protocols for movement between the Zones have been drawn. A dress code, including footwear, and shower and hand and feet washing requirements were included in these protocols. Provisions for a foot-dip with a specific disinfectant (see 'List' below), a change of footwear and hand and feet washing were made at all the Zone access points. Additional disinfectants (see 'List' below) and the use of pressure washers were added to the stall cleaning procedures. The covering of the waste-water stream flowing through PHRBC, Basistha with concrete slabs is a high priority, but this has yet to be done due to the monsoon.

Staff: All twenty staff involved in the project at the different sites and at varying levels, including the captive hog centres, field research and community engagement, were evaluated through a scorecard to find out their level of contact with domestic pigs. This score was used to identify the staff who may potentially carry the disease to the captive hogs. A few staff with a high contact level and who are not essential for work in the captive pygmy hog centres were completely banned from visiting the centres. Staff with low contact level now have access to only the Controlled Zones, never to the Restricted Zones. Only staff with no contact with domestic pigs or pig products are allowed to access the Restricted Zones. Different staff were entrusted to each different animal house in both the centres. A few staff with medium contact level were counselled to change their behaviour to limit their domestic pig contact levels. Any external contractors

needing to visit the centres will be similarly evaluated before allowing them to come to the centres.

All staff who need to come to the centres to work were educated about African Swine Fever disease signs and the biosecurity measures to be followed to maintain centre and pygmy hog safety. Staff were also asked to not visit any farm/household keeping pigs nor any pig or pork product selling points.

Visitors, students, trainees are now completely excluded from the centres.

Fig. 9: Temporary shower facility for staff coming from outside at PHPRC.

Photo: P.J. Deka

Animal Food and Bedding Materials: All animal food must be received in the Sanitization Zone. Special provisions have been built in the Sanitization Zone for thorough washing of fruits before taking them into the Controlled Zone for storage. Dry food items (wheat, soybean etc.) are taken to the store in the Controlled Zone. Bedding materials (thatch) are stored in the Sanitization Zone first, then disinfected (see 'List' below) and dried before taking into the Controlled Zone for storage.

Bedding materials, that were collected by the suppliers before the ASF outbreak in Assam and were procured. Now stored, these will last for another four months. All subsequent bedding material will be collected from the places where there is a minimal chance of contact with domestic pigs and wild pigs. There are plans to grow bedding materials in any empty area within the PHPRC premises.

Equipment: In PHRBC, Basistha, the pygmy hogs are housed in three separate enclosures and in PHPRC, Potasali the hogs are housed in two separate facilities. Separate equipment for cleaning and maintenance are used to prevent cross-contamination. No equipment is allowed to be taken out from the premises in any situation.

Vehicles: Vehicles were moved out of the campus at PHRBC, Basistha and a garage will be constructed outside the Sanitization Zone. Project vehicles used in the captive centres are not allowed to drive to any pig farms, markets selling pork products or households keeping pigs. These vehicles are not allowed to carry any person with a high contact level with pigs.

Animal health care

a. Post-mortem examinations and properly disposing of carcass: As part of the upgraded biosecurity protocol, to prevent disease transmission, post-mortem examinations can no longer be conducted on the premises. The programme veterinarian cannot conduct the post-mortem examination themselves in another facility. All carcasses will be sent to the Pathology Department of the local veterinary college in Guwahati for post-mortem. This facility operates only on working

days. Thus, we have decided to build small cold-storage facilities for both centres to isolate and freeze any carcasses safely until the veterinary college is ready to receive them.

b. Veterinary practice: Any veterinarian involved in any form of pig practice shall not be involved any form of healthcare support for captive hogs. Should radiography or ultrasonography be required, hogs will now be taken to a private veterinary hospital dealing only with dogs and cats.

c. ASF monitoring: Monitoring animals for signs of disease and disease response plans for any potential disease situation were always in place. ASF is now specifically included in the disease screening list for pygmy hogs: any dead animals, routine screening of captive populations and for any animals being transported to other facilities. The local veterinarian network in Assam has been requested to pass on any information of large-scale death of pigs and report any suspected outbreaks. Even unconfirmed reports will help us to take any additional precautions as we think appropriate.

Discussion

The COVID19 pandemic lock down in Assam since the last week of March 2020 has restricted any movement in the State. This might have helped in slowing down the transmission of disease, along with the restrictions imposed by the Government of Assam. The monsoon floods in Assam, from June, have also restricted the movement of the pigs and the selling of pigs in certain areas. Conversely, the monsoon flood might have also impeded the implementation of the Government contingency plans. There was suspicion of a few sporadic cases and the news agencies have reported that nearly 20,000 pigs have died since the beginning of the outbreak in the NER of India. The samples from these subsequent deaths have been sent for final diagnosis and disease declaration.

The ongoing works essential to implement the upgraded biosecurity requirements of the centres have needed funding to make permanent some of these temporary provisions. Recently, The Habitats Trust of India has provided emergency relief funding to upgrade the biosecurity. However, the COVID19 pandemic lockdown, in restricting the movement of builders, and the current monsoon season in Assam have impeded constructions. We hope to complete the infrastructure development by the end of October 2020 and, thus, our planned biosecurity measures will be in fully operational at that time.

List of Disinfectants:

1. Foot Dip: PRO-SQR®: Potassium Monopersulphate, Potassium Hydrogen Sulphate and Sodium chloride powder: For 0.5% Sol, 5gm/litre of water.
2. Thatch disinfectant sol.: Virex®

Fig. 9: One week old hoglets suckling. With the help of the security actions the conservation project for Pygmy hogs will continue its success story. Photo: P.J. Deka

II 256: Didecyl dimethyl ammonium chloride and n-alkyl dimethyl benzyl ammonium chloride): 4 ml/litre of water.
3. Food disinfectant Sol.: 0.1% Potassium permanganate solution: Contact time 20 minutes.
4. Animal stall disinfectant: 0.5% Chlorinated solution: Contact time 30 minutes.

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*Information included in this article is up to date as of the end of June 2020.

Pygmy Hogs return to their home in Manas

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[3]EcoSystem India - Rare & Endangered Species Conservation Unit (RESCU)

Fourteen captive-bred pygmy hogs have been released in Manas National Park of Assam by the Pygmy Hog Conservation Programme (PHCP) on 14th and 17th May 2020 (Fig. 1). This is a significant milestone in the effort to save one of the most endangered mammals in the world as the original wild stock for the conservation breeding project was captured from the Park about 24 years ago. The iconic species now returns back to their home where their last original population still survives but has dramatically declined. The loss and degradation of habitat due to unsustainable livestock grazing, extensive grass burning and improper management caused this decline. With this release, the number of pygmy hogs reintroduced into the wild by PHCP has reached 130 (62 males, 68 females). In 1996, six hogs (2 M, 4 F) were captured from Bansbari range of Manas National Park to start the highly successful breeding programme. Later, a young male rescued in 2001, and another male and two females captured in 2013 from the same range joined the captive breeding stock. Reintroduction of captive hogs in the wild began in 2008. Initially, three Protected Areas in their past distribution range in Assam were selected for better protection and restoration of alluvial grasslands. Over the next decade, 35 hogs (18 M, 17 F) were released in Sonai-Rupai Wildlife Sanctuary, 59 (26 M, 33 F) in Orang National Park, and 22 (11 M, 11 F) in Barnadi Wildlife Sanctuary. The reintroductions in Orang has been particularly successful as they have multiplied almost two and a half times in number, and have spread to areas far from release locations. It has been estimated that with the release of these 14 (6 M, 8 F) hogs in Rupahi grasslands in the Bhuyanpara range of Manas National Park, the total number of reintroduced hogs and their progeny may have reached 200 in the four release sites. About 60 hogs will be released over a 5-year period in the Bhuyanpara range from where they had disappeared.

Fig. 1: Hogs in transport crate placed in the releases enclosure. Photo: G. Narayan

The PHCP is a collaborative effort involving the key partners: Durrell Wildlife Conservation Trust, IUCN/SSC Wild Pig Specialist Group, Assam Forest Department, Ministry of Environment Forests and Climate Change, Government of India, EcoSystems-India and Aaranyak. The main aim of the programme incorporates conservation breeding and reintroduction of pygmy hogs after habitat restoration, as well as monitoring existing and potential grassland habitats for the species. To address the main threats to survival of pygmy hog, PHCP is also working towards the recovery of grasslands, designing an efficient model for grassland management and identify the drivers of anthropogenic pressure on grassland habitat and to reduce the same by designing targeted and sustainable livelihood interventions.

Hand-crafted babirusa messages?

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Introduction

In this article the author invites the reader to take a look at the 'overlooked', to travel in both time and space to see hand-crafted artefacts arguably linked to the babirusa (*Babyrousa* spp.) but located in places thousands of kilometres distant from the home range of that pig genus. We are becoming increasingly aware that knowledge and experience of the babirusa extends far beyond the records of the modern written page (Macdonald, 2017). However, it is logical to start this investigation in the home range of the babirusa, on the Indonesian island of Sulawesi, and to explore outwards from there (Figure 1).

Fig. 1: Map of Asia and SE Asia from Panyu to New Ireland. Insert: left lateral view of adult Buru male babirusa (ID_AAM0287, Frankfurt Senckenberg Natural History Museum inventory number 427).

Sulawesi, Indonesia

The evidence of former knowledge may at times be quite enigmatic. Perhaps the best example of this is the group of paintings of the babirusa, hidden for millennia in caves near Maros, Sulawesi (Figure 1); once found and viewed they are seen to be explicit depictions of wild animals in their locality (van Heekeren, 1952, 1972). Careful recent study has enabled them to be dated to at least 35,000 years ago (Aubert et al, 2014). Almost certainly stories about this wild pig have been told on Sulawesi for thousands of years. Sadly, a lot of the information contained in oral legend and spoken histories has never been harvested and put into print. However, sometimes there are

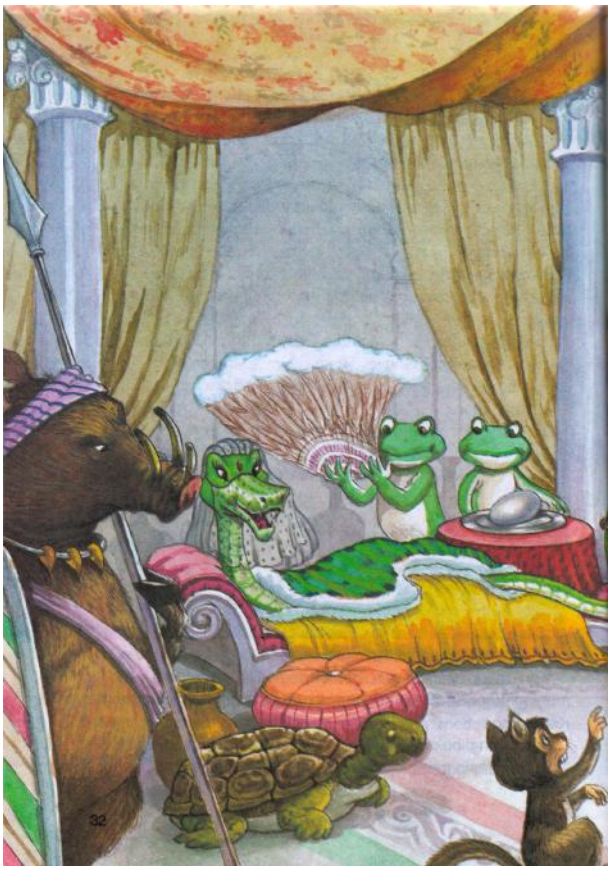

Fig. 2: Illustration from the children's story book 'Rahasia harta yang hilang' [The secret of lost treasure] by Toety Maklis (1991).

times as babirusa were said to be no longer available in those part of eastern Central Sulawesi (Macdonald and Johansson, 2017). Photographs taken in 1920 in Tomata, Central Sulawesi showed that comparable funeral head dresses were being made out of other materials but had retained the shapes of adult male babirusa canine teeth (Kaudern, 1921). Small doll-like figurines were found with the same style of head-dress (Kaudern, 1944).

traces. Anthropologists and linguists have collected stories, or bits of them (e.g. Adriani, 1932). On the islands of Taliabu and Buru various origin tales of the babirusa still circulate in coastal communities (Macdonald and Pattikawa, 2017). Nevertheless, most of the (probably) many old tales have been lost and forgotten (Kruyt, 1938). But creative life goes on. The tradition of storytelling continues. Recent examples may be found in this series of children's books (Figure 2) published on Sulawesi by Maklis (1991, 1992).

Walter Kaudern (1921) discovered during his anthropological investigations in North-east and Central Sulawesi (from 1917-1920), that the canine teeth of the male babirusa were being used in a head dress worn during funeral celebrations. He drew illustrations of these (Figure 3) and painted Tomai Lagongga from Pinapuan, Peleng Island wearing one (Kaudern, 1921; Macdonald and Johansson, 2017). Some of these artefacts had been heirlooms passed down from earlier

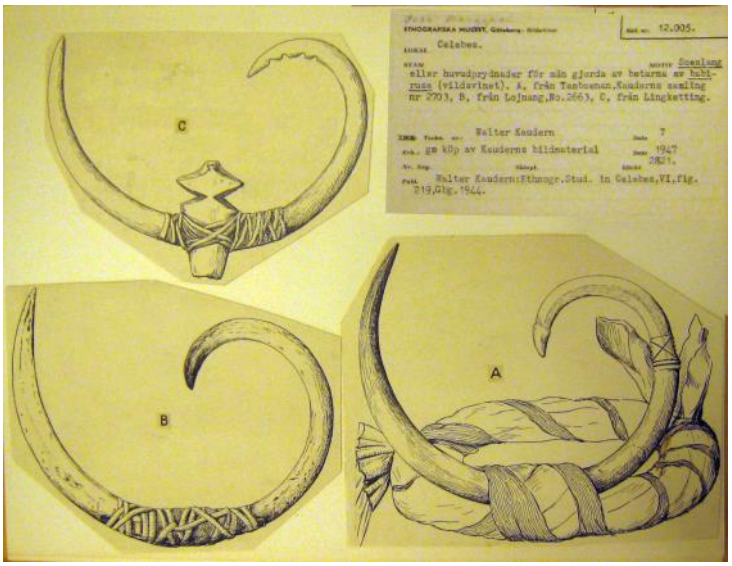

Fig. 3: Illustrations, by W. Kaudern, of babirusa teeth head dress from Tambunan, Loinang and Lingketting in Central Sulawesi.

Finally in this section, but inconclusively, it was reported by Oviedo in the 16th century, that men in Sulawesi 'tattoo themselves with pictures of living creatures to help raise their courage for battle' (Lach, 1965); there were no details given indicating whether the babirusa was so depicted.

Nanyue, Asia

About 3300 km to the north west of Buru lies the Chinese city of Guangzhou, built over the archaeological remains of the city Panyu (Figure 1). There is some evidence that the southern

mainland of China retained evidence of additional 'lost stories' about babirusa (Macdonald, 2017, 2018). But first some explanatory background information from over 2000 years ago. Royal and feudal state 'animal parks' were present in China from the later Zhou period (771 BC to 271 BC); these were largely wildlife reserves for the recreational hunting of geese and deer (Schafer, 1968). They declined somewhat towards the end of that dynasty, but later, during the Western Han dynasty (206 BC to AD 9) there was a revival. The Han capital was at Chang'an (present-day Xi'-an) (Loewe, 2012a), and the imperial park was situated some 50 li, approximately 21 km, from there (Hill, 2015); it was greatly expanded in 138 BC (Schafer, 1968). The animal life husbanded in this park was representative of Asia's creatures; fish, birds, reptiles and mammals. At this time, provincial princes also had wildlife parks, with scholarly suggestions that rare and exotic animals from faraway nations were also to be found in their collections (Schafer, 1968).

It is in this context that we look south to Nanyue, an area of Asia which at that time was not (yet) under the direct control of the Han dynasty. Referred to as Lingnan it was located south of the Ling range of mountains and is currently administered in southeast China as the provinces of Guangdong and Guangxi. Panyu city (Figure 1) was the capital (Loewe, 2012b). Zhao Mo was King of Nanyue from 137 BC until his death in 122 BC. It was in the spectacular tomb of this king that there was evidence in support of a babirusa-linked hypothesis.

During the Han period of Chinese history there developed a funerary tradition of burying emperors, kings and other aristocracy together with small jade sculptures of pigs cut in a stylized and horizontal blocky form (Lyons, 1978). These have been found in pairs, either with holes for sewing onto the sleeve of the dead, or as solid forms to be held in the hands of the deceased (Figure 4). They are known as zhu wo, which translates as 'pig handle' or 'pig grip'. These jade grips represented fortune. Jade was also believed to possess a magical property that helped preserve the body (Lin, 2012). Reputedly, almost every museum with a serious ancient Chinese jade collection displays at least one (Loehr & Huber, 1975; Rawson & Ayers, 1975; Watt, 1990; Forsyth & McElney, 1994). The stylised carving was very fine, and the method used was known as the 'Han 8-cut or Han eight knives' style (Forsyth & McElney, 1994).

Fig. 4: A. Left lateral and B. Dorsal illustration of a jade funeral 'pig handle' (Royal Museum of Scotland inventory number A.1938.387. Image © National Museums Scotland).

The King of Nanyue, Zhao Mo was buried in a silk-edged suit of jade pieces, a privilege usually reserved for the emperor and his immediate relatives, but in this case is unexplained. What is very remarkable is that he did not have a jade 'pig handle' in each hand. Instead, and uniquely, he held two pieces of finely carved jade in his right hand (Figure 5). They have been described as 'two jade xi' of length 7.2 cm and 9.5 cm, carved as two curved dragons each ending in a sharp tip (Li, 2012). Pointed Han pendants such as the smaller of these have been explained as 'knot openers' (Rawson & Ayers, 1975). However, to this author's eye these 'pig grips' closely resemble the mandibular and maxillary canine teeth of a young adult babirusa (Figure 1) from Buru or the Sula Islands (Macdonald and Shaw, 2018). Why might these two pieces of jade have been held instead of the customary 'pig handles'? And why were both in one hand? Could a male babirusa have been brought to Zhao Mo, the King of Nanyue?

Fig. 5: Illustration of jade 'teeth' (154 on page 278 of Lin, 2012) [the photographer is believed to have been Cai Huizhang]

The South China Sea was the gateway to maritime trade in the third century BC (Quan, 2012). Panyu city was ideally placed to control this maritime traffic. Graphic representations of large, ocean-going vessels were found carved into a bronze bucket at the site of the King of Nanyue's tomb (Zhou, 2018). Many additional pieces of archaeological evidence, such as silverware, decorated glass, faience beads, frankincense and African ivory suggested that the Nanyue kingdom had established unusually strong connections with non-Chinese cultures to the south and west (Quan, 2012; Li, 2012). They also provided evidence that Panyu played an important role in the economic and cultural interchange with the coastal regions in the Pacific and Indian Oceans (Quan, 2012). So, could this in some way indicate how a male babirusa was brought to Panyu?

Recent research has revealed more information about the extent and early establishment of maritime trading between island SE Asia and both India and China (Hoogervorst, 2016; Manguin, 2019; Bellina et al, 2019). Southeast Asian sea nomads, with their mastery of the seas and the connections they had established through their complex networks, had the capacity to become intermediaries facilitating trade between small-scale communities over long inter-island distances in Southeast Asia (Hoogervorst, 2016; Hoogervorst and Boivin, 2018; Bellina et al, 2019). Trade in clove, mace and nutmeg to China and to the Han court in the third century BC together with archaeological evidence of South Asian wares along the maritime route from the Straits of Melaka to East Indonesia and the Mollucas during the same period indicate how it might have been done (Manguin, 2019). Young babirusa are easily tamed and can be kept as personal pets (Macdonald and Pattikawa, 2017; Macdonald et al, 2018); there are many

examples described in accounts from more recent centuries (Macdonald, 2018). It is not difficult for those with personal experience of looking after young babirusa in zoos to imagine the appeal of an 'affectionate' and very exotic young male babirusa; a most unusual, rare and special pig. It was not surprising that no written or other archaeological evidence of animal enclosures have been found in Panyu, despite the detailed investigative work carried out in 1983 at the site of the grave of the King of Nanyue, and in 1995 and 1997, a few kilometres southeast, at the 15,000 m^2 area of his palace grounds (Lu, 1990; Lary, 1996; Huang et al, 1998; Allard, 2016; Zeng, 2018). Both archaeological sites lie within the city of Guangzhou – current population 13.3 million. It is highly likely that the King of Nanyue, like other royalty of the Han period, did have appropriate exotic animal facilities nearby. These may yet remain buried elsewhere under Guangzhou city.

Bali, Indonesia

The next examples of 'hand-crafted' intimations of babirusa awareness are found on the Indonesian island of Bali, about 1400 km south of Sulawesi. The Calonarang is a ritualistic dance drama that is performed there and serves to drive away negative powers in a community (Beaman, 2017). The main protagonists are Rangda, a witch who represents destruction and controls harmful witches called Leyaks, and the Barong Ket, a mythical creature who keeps demonic forces in check. China's influence is obvious in the Barong Ket masks and reflects elements of the Lion Dance. The elaborate masks employed in the dance have a long history stretching far back in time (Slattum, 1992). They come in many shapes, depending on the type of animal represented, and may take the form of a boar, bull or deer (Second Face). Barong Ket is often represented as a mythical animal with a red head, covered in white thick fur, and wearing gilded jewellery adorned with pieces of mirrors (Figure 6A). Examples of this mask can be found in museum collections (Mask A; Mask, B; Mask C; Barong ket; Second face). As indicated above, contrary to the beneficent Barong is Rangda, the old crone (Figure 6B). Her mask comprises a

Fig. 6: Balinese masks: A. Barong Ket, and B. Rangda, also known as calonarang, a vexing witch.

sinister, gaping mouth with sharp fangs, a long, protruding tongue, and bloodshot bulging eyes (Mask D). What is particularly noteworthy in the current context is that the masks of both these characters in the drama can also feature small teeth clearly seen arising on each side of the nose (Figure 5). This suggests an (early?) artistic awareness/memory of the growth of the maxillary canine teeth through the skin on each side of the nose of the male babirusa (Macdonald et al, 2016). Recent research conducted in South-east Sulawesi revealed that babirusa there were still being hunted and their skulls being collected to supply canine teeth to satisfy specific aspects of the artistic creation of Rangda masks on Bali (Day and Macdonald, 2016).

New Ireland, Papua New Guinea

Remaining with the topic of carved wooden masks, but moving about 4100 kilometres east of Bali, we come to the area east of New Guinea referred to as Near Oceania (Figure 1). In particular the focus now is on the northern part of the long thin island called New Ireland, on the eastern side of the Bismarck Archipelago. During the second half of the nineteenth century there was a period of intensified contact here with Europeans. Locally made, wooden malangan masks, such as this (Figure 7; Mask 1) were brought back to Europe. A mask of a closely comparable but somewhat different malangan style is present in the Australian Museum in Sidney, Australia (Mask 2; Godin, 1979). Both masks represent humanoid heads, but what made them noteworthy were the long vertical tusks arranged on the front and sides of the face. Their pointed tips were curved caudally. A search of museum collections uncovered another malangan mask collected from the same part of that island in the same time period (see reference Mask 3). It was also stylistically different from the first two and had somewhat thickened teeth-like structures curving over the front of the face. Three additional malangan masks, retaining the basic structure of the brightly coloured humanoid head, had several long, thin, curvilinear structures positioned vertically and rostral to the head (see references Mask 4; Mask 5; Mask 6). In one additional case there were two elongated teeth arising from the 'mandible' and in addition there were what appeared to be two small white teeth protruding from the face, one on each side of the nose (see reference Mask 7).

Two other malangan masks have been found that are quite different from these in that each was based on the head of a suid rather than a humanoid; one is in the Néprajzi Múzeum in Budapest (see reference Mask 8) and the other is in the Ethnologisches Museum der Staatlichen Museen zu Berlin (see reference Mask 9). The former clearly depicts a pig, out of the mouth of which arise what appear to be four pairs of curved teeth, two pair aligned caudally along the side of the face, one transverse-rostrally over the nose, and one short pair arranged rostrally (see reference Mask 8). The other is much more schematically depicted, the pig-like nose apparently being formed from the cauda of a swimming bird (see reference Mask 9). Long, fairly thick, structures reach over the front of the face and curve over and onto the cranium. In one additional malangan mask of a pig (see reference Mask 10), even though the head clearly seems to depict a Sus sp., the arrangement of long, thin, pointed, curvilinear structures attached caudally appear to be consistent with the underlying theme of the preceding nine masks.

These carvings are stylistically distinctive and yet appear to share a common heritage with respect to the pointed, curvilinear teeth-like structures reaching over their faces. The hypothesis arising from this collection of malangan sculpture is this: do they indicate that at some point in time there had been some island-resident's experience of the babirusa?

Paleogeographic reconstruction of Wallacea at 65 thousand calibrated years before present (65

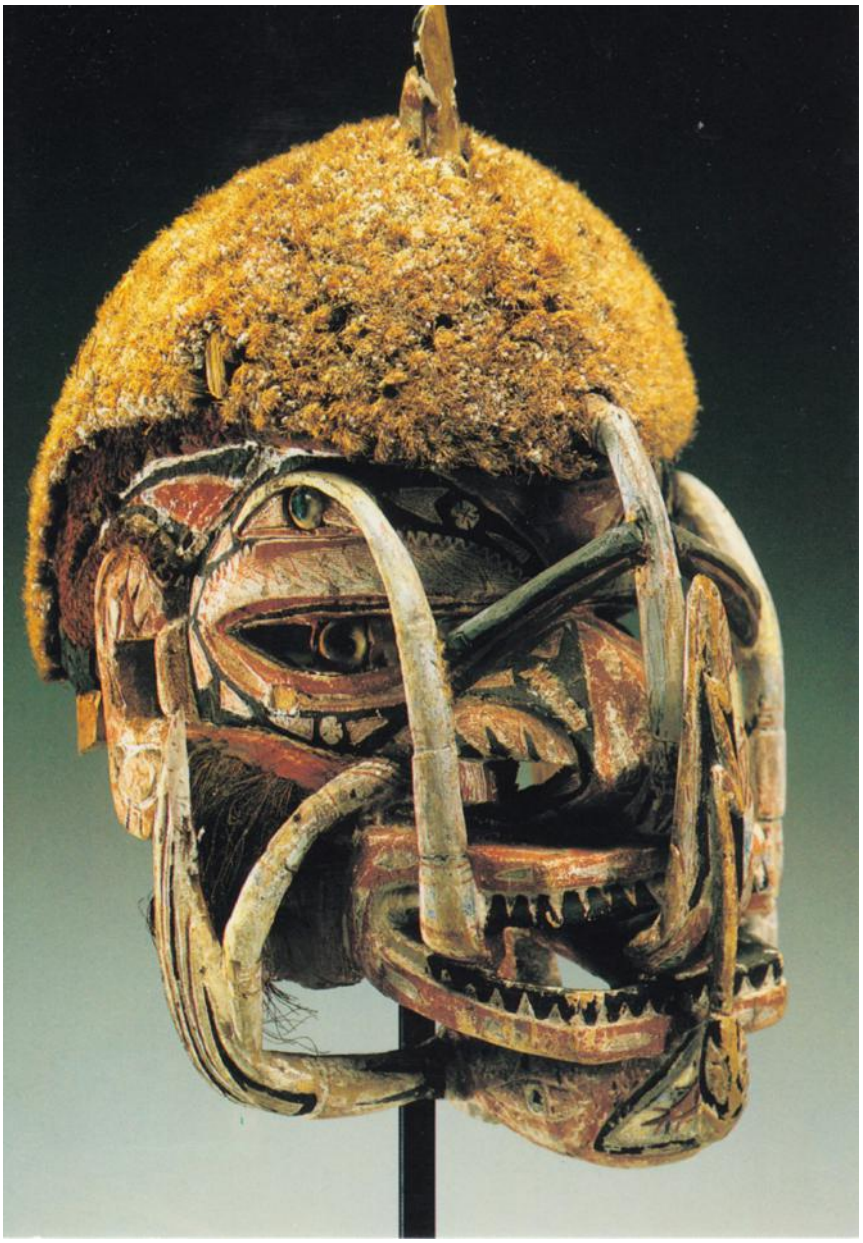

Fig. 7: Malangan mask from northern New Ireland (Wereld Museum, Rotterdam. inventory number WM-57547).

ka cal BP) and the construction of least-cost pathway computer models of early modern human dispersal from mainland Southeast Asia to Australia-New Guinea have indicated an expanded Bornean 'launch-point' for dispersal just east of the present day Balabalagan archipelago onto Sulawesi west of west Sulawesi's provincial capital Mamuju (Keily et al, 2018). The 'highly favourable maritime travel model' examined by Keily et al (2018) suggested human passage east across the South Sulawesi peninsula, then northeast to the East Sulawesi coast opposite the Peleng islands (Figure 1), through these to the Sula Islands of Taliabu and Mangole, and then again east via smaller emergent and enlarged islands such as the Obi and Kofiau Islands, to Misool Island and the Bird's Head Peninsula of New Guinea (Keily et al, 2018). An alternative route from Sanana Island (one of the Sula Islands) to Buru and then via Seram to Misool Island was also envisaged. The current paucity of archaeological sites along this island chain is hampering the detailed study of inter-island movement of these early modern people and their trade goods (Keily et al, 2018). However, the arrival of early modern humans onto the islands of the Bismarck Archipelago (Figure 3) has been estimated at about 40 ka BP (Heinsohn, 2010). There is no archaeological evidence that pigs were brought with them.

Much later in time, about 3300-3200 cal BP, there was a period of prolonged interaction and admixing of Austronesian-speaking (Malayo-polynesian speaking) peoples into the islands of to the Bismarck Archipelago (Anderson and O'Conner, 2008; Donohue and Denham, 2010). The evidence for the introduction of the pig (Sus sp.) into Near Oceania at about this time is currently ambiguous (Donohue and Denham, 2010; Specht et al, 2014; Piper, 2017). Its introduction was perhaps during the early phases of the Lapita Culture development (Denham, 2018) within the Bismarck archipelago. The subsequent Lapita colonists of Remote Oceania were capable sailors;

they maintained long-range contacts across island groups separated by hundreds of kilometres (Irwin, 2008; Pawley, 2017). Although the precise types of watercraft used are unknown (Hoogervorst, 2016), this mobility is best illustrated by their rapid expansion across the Southwest Pacific, with settlement of Vanuatu, New Caledonia, Fiji and Tonga in the period 3100–2850 cal BP (Petchey and Kirch, 2019). There is evidence that these Lapita colonists maintained long-distance trade networks (Sand, 2016; Pawley, 2017). There are also signs of trade along the north coast of Papua New Guinea and between the islands of the Bismarck Archipelago to the east (Lilley, 2016). Evidence indicative of trade links to the west, to the northern Molucca Islands, takes the form of fossil marsupials in archaeological sites on these islands (Flannery et al, 1995, 1998; Heinsohn, 2010; Hull et al, 2019). A proportion of the animal introductions there may have occurred as a result of transport of pets, living-larder food animals, or caged trade stock that escaped captivity on arrival at their destination (Heinsohn, 2010). The archaeological record that is available reinforces the view that there was maritime interaction and regional complexity within and between island southeast Asia and New Guinea before, during and after 3300-3200 cal BP (Denham, 2018).

Malangan carvings of this general 'type' were still being produced in Mangai on the eastern coast of northern New Ireland in 1967 (Billings, 2007). Artistically the style was quite different from that shown in Figure 6. However, the wood carving of the human figure, photographed in Mangai, used coconut husks to represent the pigs' tusks and to supplement the actual tusks used (see Figure 9 in Billings, 2015). As Eruel, the sculptor, was quoted as saying:

The name of this carving, he said, was Vaia. Yes, he had carved it many times. Oh yes, it was always the same, always just like this. Yes, he had made it 'many, many, many, many times' and it was always the same, always just like this. He thought for a minute or two and then said: 'but before only the head. Now Vaia has come out altogether.' … He was using elements of style, I thought, that had been used before, but he had combined them differently than he had before. Yet he felt that whatever he had carved he had carved many times before and always 'just the same'. He viewed himself as part of the group, not as an innovator. And Eruel's [North New Ireland] audience accepted him on those terms: because he 'knew how' (Billings, 2015).

Almost all malangan art objects were created within an art-producing tradition linked to a cultural tradition that enabled the art object to be used as a symbolic object. This Northern New Ireland art tradition includes masks, sculptures and many other objects to be used in malangan cultural traditions. They were the focal points in festivals in memory of distant ancestors and/or the more recently dead (Godin, 1979; Billings, 2007). Research has indicated that different informants in different Northern Ireland places and at different times had different views about them (Gunn and Peltier, 2006; Billings, 2007). In the east coast Cara area in 1965-1967 they were 'just pictures' (Billings, 2007). However, the primary meaning of the malangan carvings to the people is their use in malangan ceremonies, exchange rituals which 'finish' (honour) the dead and their obligations, redistribute their wealth, and organise and reorganise people in groups that continue to work together (Gunn and Peltier, 2006; Billings, 2007). It is the designs, not the objects themselves, that are exchanged and valued. Each type of this malangan art-producing tradition is subject to copyright, owned by sub-clans or individuals, and cannot be sold on the open market (Gunn and Peltier, 2006). Many examples in museums have been traced to particular family traditions on New Ireland. Thus these art-producing traditions are, and have been, quite stable.

The evidence indicates that people brought pigs to New Ireland. The artistic evidence presented here (Figure 7) raises the possibility that at some time during that period of 3300 to 3200 years

the babirusa may also have been brought to New Ireland and/or other islands of the Bismarck Archipelago. They may either have been brought as biological entities or possibly as folk memories. It is not possible to tell from the small amount of evidence that this author has seen. However, it is clear from the accounts of Vargyas (1992) and Gunn and Peltier (2006) that there is a huge resource of research material available for study within the estimated 25,000 New Ireland objects, including masks, in 123 public and 65 private museum or private collections (Gunn and Peltier, 2006). Perhaps it would be possible to uncover how many families and clans owned the style of malangan depicted in masks such as these, and in what way were they biologically related, and the malangan styles conceptually 'related'. Could appropriately adapted techniques of analyses be applied to such family and malangan style relationships and perhaps lead to suggestions of when in time the initial 'babirusa-like inspiration' took place?

Conclusions

This paper sought to bring together a number of examples of artwork that, when first viewed, raised hypotheses of their connection to the babirusa. The examples from Bali were 'grounded' in the findings of recent research. Approximately 5250 km separated the Panyu example from the New Ireland examples. The former was a single unexpected suggestion, the latter group offer future opportunities for further investigation and analyses. There may be additional material awaiting discovery in south China. The artwork from North Ireland lends support to the suggestion that knowledge of babirusa did not stop at Buru. As was once said, 'Look and you will find it - what is unsought will go undetected' (Sophocles, c. 496–406 BC).

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Descripción del encierro de *Tayassu pecari* en la Reserva Ecológica La Otra Opción, Veracruz, México
Description on the confinement of *Tayassu pecari* in the Reserva Ecológica La Otra Opción, Veracruz, México

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Resumen

La información que se presenta en este trabajo describe las características físicas del encierro que habita una piara de pecaríes de labios blancos (*Tayassu pecari*) mantenidos en cautiverio en la Unidad de Manejo para la Conservación de la Vida Silvestre (UMA) "Reserva Ecológica La Otra Opción" en Veracruz, México. La Otra Opción se encuentra sobre laderas de origen volcánico en el predio el Bastonal en el municipio de Catemaco, Veracruz, las cuales presentan fuertes pendientes, y donde la precipitación supera los 4000 mm anuales. Se presentan recomendaciones para instalaciones que se localizan en lugares con climas extremos o relieves accidentados como es el caso de la Reserva Ecológica La Otra Opción; que puede presentar accidentes por deterioro, lluvias, vientos y deslaves. Con este trabajo se pretende sentar una línea base que puede considerarse para documentar el encierro de esta especie en otros lugares con la finalidad de ir construyendo el espacio adecuado para el bienestar de los ejemplares confinados.

Palabras claves: UMA, ladera, encierro, pecarí

Abstract

The information presented in this work describes the physical characteristics of the enclosure that inhabits a herd of white-lipped peccaries (*Tayassu pecari*) kept in captivity at the Management Unit for Wildlife Conservation (UMA) "Reserva Ecológica La Otra Opción" in Veracruz, México. La Otra Opción located on slopes of volcanic origin in the Bastonal estate in the municipality of Catemaco, Veracruz, which have steep slopes, and where rainfall exceedes 4000 mm annually. Recommendations are presented for facilities that are located in places with extreme climates or rough reliefs, such as the Reserva Ecológica La Otra Opción; that can present accidents due to deterioration, rain, winds and landslides. This work aims to establish a baseline that can be considered to document the confinement of this species in other places in order to build the appropriate space for the well being of the confined specimens.

Keywords: UMA, hillside, confinement, peccary

Introducción

La Otra Opción es una reserva ecológica privada y un criadero de especies amenazadas en los

Tuxtlas, Veracruz, México. Por su ubicación se convierte en un sitio privilegiado tanto para los fines de conservación y restauración de ecosistemas que persigue, como para la investigación, educación y generación de conocimientos sobre el bosque mesófilo y la selva tropical (Knopflmacher et al, 2014).

En 2009, la Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) autorizó a la "Reserva Ecológica La Otra Opción" el establecimiento de una Unidad de Manejo para la Conservación de la Vida Silvestre (UMA) con el objetivo de llevar a cabo la reproducción de especies prioritarias nativas como el pecarí de labios blancos (*Tayassu pecari*), especie extirpada en la región desde los años setenta. Con las descripciones de las instalaciones que ocupa la piara, se tendrá información para conocer cómo un encierro con estas características topográficas puede mantener el bienestar para su confinamiento y cuáles posiblemente puedan no beneficiar a los ejemplares. Por lo anterior, el objetivo fue: Describir el diseño de las instalaciones de Tayassu pecari de acuerdo con las características fisiográficas de la "Reserva Ecológica La Otra Opción" en Catemaco, Veracruz, México.

El área de manejo en La Otra Opción tiene una característica como poco de los documentados se encuentra sobre una ladera, y se tienen registros de precipitación superando los 4000 mm anuales (Carrera et al, 2015) lo que hace que presente alteraciones en cuanto a la estructura del encierro y que los pecaríes de labios blancos hayan tenido que adaptarse a este.

Entre los requisitos indispensables que exige la SEMARNAT para autorizar el registro de las UMA, es la presentación de un plan de manejo apropiado para las especies que se van a registrar y para las condiciones físicas del lugar. Este plan es la guía que se debe considerar para mantener adecuadamente a los ejemplares y qué hacer en caso de alguna contingencia. El plan debe contener una descripción detallada del manejo y de las instalaciones para el confinamiento, pero la mayoría de ellos no lo tienen o presentan el tipo de construcción o diseño de instalaciones como por ejemplo los que son utilizados en la producción de animales domésticos como aves, vacas o cerdos.

Las necesidades básicas del pecarí de labios blancos, son espacio, forraje y agua. La mayoría de las veces se adapta exitosamente al cautiverio con poco manejo, incluso se ha observado, que las crías sobreviven pese a las inclemencias del tiempo. Es importante dar al animal un ambiente físico cómodo para la crianza, reproducción, aumentar la población y, por otro lado, un buen saneamiento y control de posibles enfermedades utilizando materiales de la localidad para disminuir costos, facilidad de manejo y seguridad al personal encargado de estos animales (Lindo, 2014). Documentar esta información en las UMA con fines de reproducción y repoblación de la especie de pecari de labios blancos es sin duda una herramienta necesaria para ofrecer una propuesta integral para su confinamiento y bienestar.

Metodología

Zona de estudio

La Reserva Ecológica La Otra Opción, se localiza en la zona de El Bastonal, vecina del ejido Miguel Hidalgo, en el municipio de Catemaco. Limita con la zona núcleo II "Sierra de Santa Marta" de la Reserva de la Biósfera Los Tuxtlas en Veracruz. Se encuentra ubicado entre las coordenadas 18º 22' 50.51" N, 95º 56' 5.33" W y 18º 22'7.60" N, 94º 55' 14.36" W. (Figura 1). La Otra Opción cuenta con una superficie de 136 ha que están en un rango altitudinal de 847 a 1,100 msnm (Carrera et al, 2015). Hasta el 2007, la mayor parte del predio estaba ocupada por pastos ya que era un rancho ganadero, en el 2008 inició un trabajo de restauración con la plantación de 60 mil árboles de 55 especies nativas.

Figura 1: Ubicación de la Reserva Ecológica La Otra Opción. (Tomado de www.laotraopcion.com)

En La Otra Opción, se pueden distinguir tres zonas de vegetación: Bosque Mesófilo de montaña, área de restauración ecológica y sitio de regeneración natural (Carrera et al, 2015). En esta última zona, la más perturbada, es donde se encuentran las instalaciones de pecaríes labios blancos y se realizan las actividades de manejo intensivo.

La zona es una de las más lluviosas de México, en algunas partes la precipitación anual supera los 4,000 mm, de noviembre a febrero los desplazamientos de masas de aire polar se cargan de humedad en el mar y llegan con lluvias y vientos fríos. El mes más seco generalmente es mayo y los más lluviosos van desde julio hasta noviembre (Soto, 2004).

Obtención de la Información

Se recopilo información fisiográfica relacionadas con las condiciones topográficas y geológicas del lugar. Se programaron dos visitas, la primera se llevó en el mes de abril del 2016 en época de estiaje, en el cual se geo-referencio el encierro, se midió y se tomaron fotografías internas y panorámicas de este. Con apoyo del personal de la reserva se recorrió el encierro A con la intención de hacer un reconocimiento de la zona y obtener los datos necesarios para la bitácora de campo, esto se realizó en dos días con tiempos de 6 horas ya que por las condiciones del lugar dificultaba la obtención de datos y fotografías. La segunda visita se llevó a cabo en el mes de agosto del 2017 realizando un monitoreo del encierro B, y detectando zonas que van de los 7 a 24 grados de inclinación dificultando su acceso en el encierro por la topografía que presentaba. Se realizó en época de lluvia retrasando el trabajo por las fuertes bajadas de agua dentro la zona de estudio. Se obtuvo la información en tres días con tiempos de 5 horas, realizando grabaciones y toma de fotografías en un andamio a una altura de 5 metros.

Resultados

El encierro del pecarí de labios blancos se encuentra ubicado entre las coordenadas 18º 22’29.16’’ N y 94º 53’36.43’’ O con una elevación de 1018 msnm. Tiene una superficie de 1.5 ha y se encuentra dividido en dos partes con la finalidad de que la piara la vaya ocupando de manera alterna y dejarlos en reposo para que se vayan recuperando sus suelos y vegetación, el encierro A y el encierro B, ambos a su vez presentan dos zonas que se reportan como baja y alta por su topografía (Figura 2).

Cada encierro cuenta con una zona de alimentación de 50m^2 donde se les proporciona alimento y es utilizado también para exhibición de los animales a los visitantes de la reserva (Figura 3). Ambos encierros están conectados por un pasillo que termina en el área de manejo, que

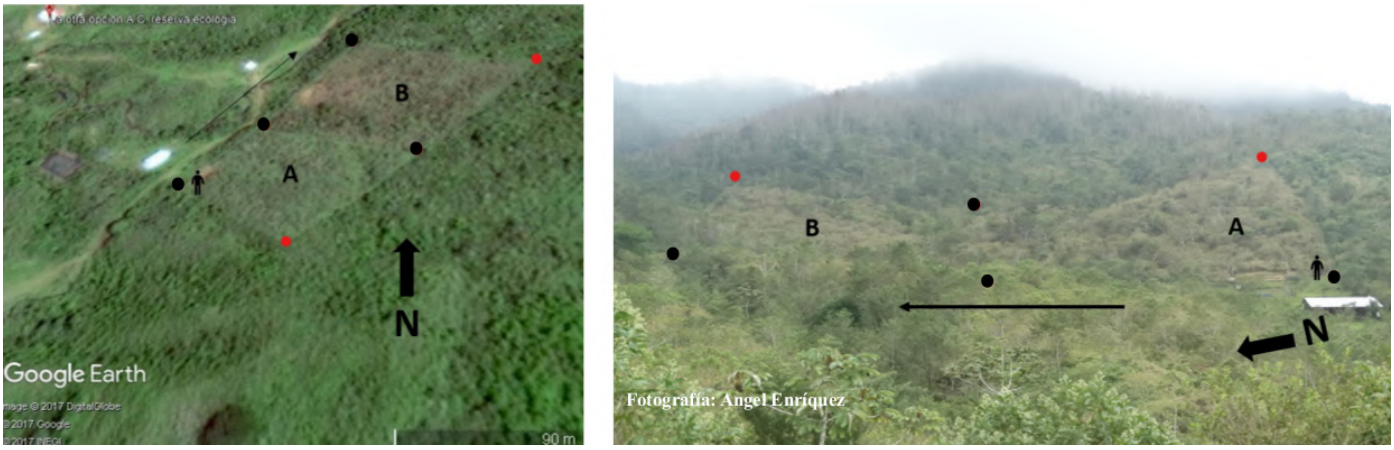


Figura 2: Panorámica de los encierros. Los puntos rojos indican las zonas altas y los negros las zonas bajas, que a su vez son los limites del encierro.

contiene una manga que se usa cuando es necesario capturarlos para sexarlos o cuando se realiza aprovechamiento. El encierro presenta dos arroyos que proporciona agua continuamente a la piara, en la época de lluvias, aparecen innumerables nacimientos que forman escorrentías que son usadas por los pecaríes. Los encierros se encuentran en laderas fuertemente inclinadas con pendientes que registran de 7 a 24 grados de inclinación.

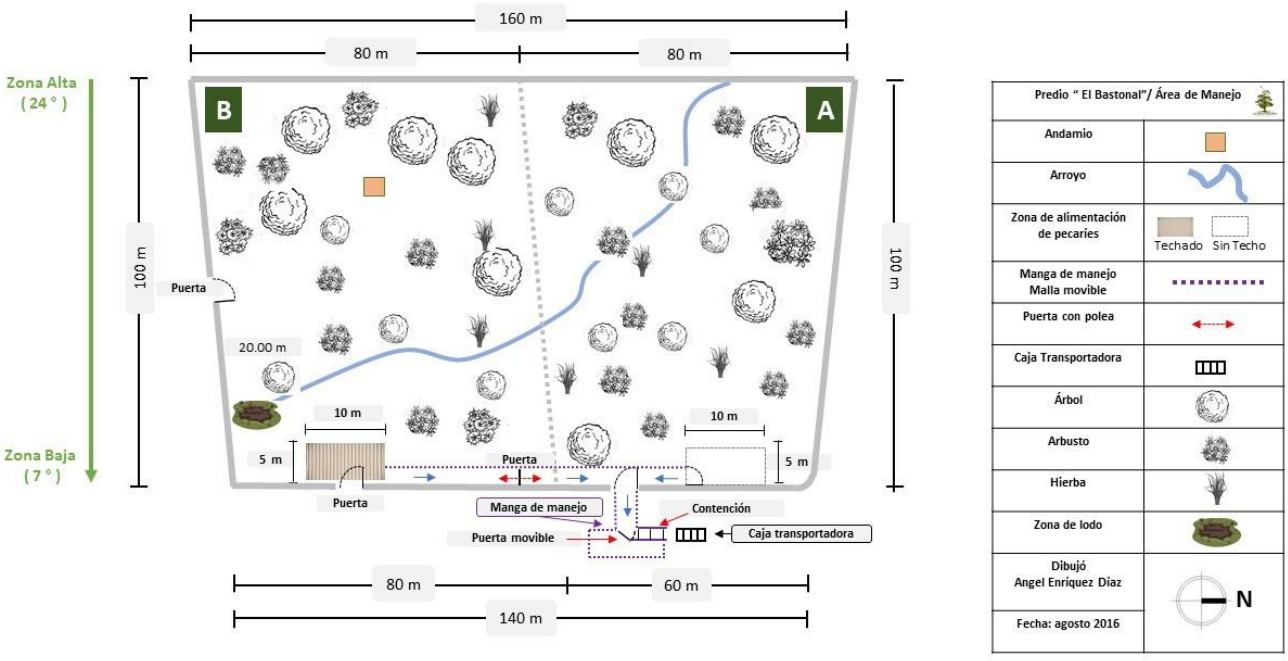


Figura 3: Esquema del encierro de pecaríes de labios blancos

El grupo de pecaríes de La Otra Opción llegó a las instalaciones en mayo de 2010 y estaba formado por 2 machos y 5 hembras adultas (una de ellas con una cría de pocos meses de nacida). Todos los ejemplares provenían de la UMA Bellreguart de Sochiapa (del mismo estado de Veracruz), aunque originalmente, uno de los machos era de un criadero de Chiapas y los otros ejemplares provenían de Guatemala, la cría ya había nacido en la UMA Bellreguart. Unos

meses después, en noviembre, llegaron dos hembras jóvenes más de la UMA mencionada, para completar el pie de cría de La Otra Opción. Durante los primeros años, se tuvo una pérdida considerable de crías debido a que los partos ocurrían en los meses con mucha precipitación y frío de la zona, hasta que llegaron a ser más estacionarios y empezaron a ocurrir en la época de seca (Carrera et al, 2015). Durante el tiempo que duró el estudio, la población llegó a tener 39 animales. Un año después, 2018, los responsables de la UMA firmaron un convenio con la Secretaria de Medio Ambiente e Historia Natural de Chiapas en el cual se comprometieron a donar ejemplares de pecarí de labios blancos durante 5 años consecutivos para formar un grupo reproductor viable con fines de liberación en El Ocote, lo cual comenzó a cumplirse desde ese año y el siguiente con la aprobación del aprovechamiento de ejemplares otorgado por la Dirección General de la Vida Silvestre de la SEMARNAT.

Descripción del encierro

El sitio que ocupa el encierro de los pecaríes se reforestó en el 2008 con especies nativas ya que antes era ocupado para mantener ganado vacuno. Durante el tiempo que duró el estudio fue posible observar algunos ejemplares de la reforestación que han alcanzado más de 7 metros de altura; sin embargo, es interesante notar que la mayoría de la vegetación observada es producto de la regeneración natural, los encargados de la reserva mencionaron que los pecaríes con sus hábitos de levantar el suelo con el hocico, secaron la mayoría de los árboles que se plantaron y de los pocos sobrevivientes están los de la especie Lonchocarpus cruentus localmente conocido como Rosa morada. El encierro se construyó en el 2009 con malla venadera ciclónica de 2.40 m de altura, 40 cm están enterrados, y con soportes de tubo galvanizado de 38 mm. Originalmente tenía una superficie de 2 ha (100 por 200 m) y estaba dividido en dos secciones de una hectárea cada uno, para que la piara lo ocupara alternadamente para dejar un tiempo de recuperación entre cada uso. En el 2012 con las lluvias que dejó el huracán “Ernesto” y por la pendiente del

Figura 4: Área de exhibición del encierro A y B.

sitio el encierro “A” sufrió un deslave, afortunadamente la piara estaba ocupando el encierro “B” por lo que no hubo bajas en la población. A raíz de este percance, se recorrió la línea de malla y se perdió cerca de media hectárea. Actualmente el encierro es de 100 por 140 m y continúa la

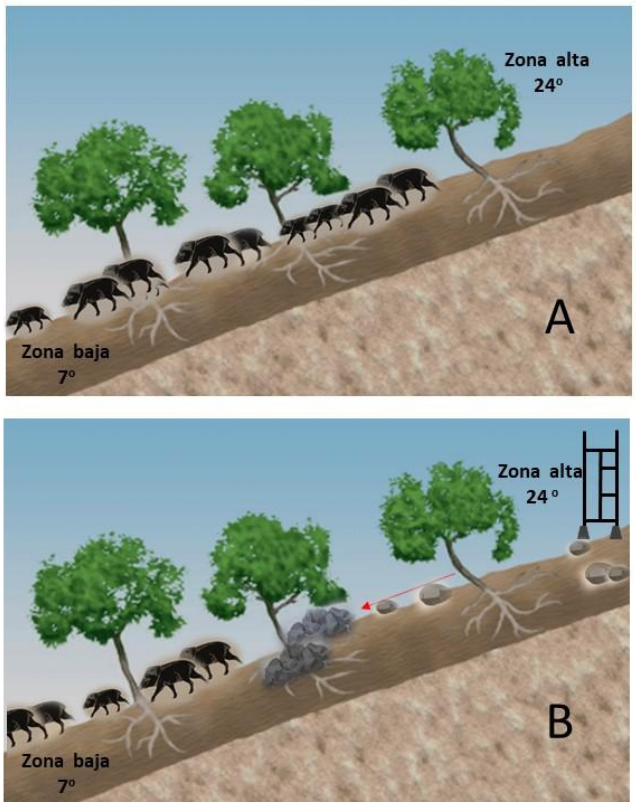
división entre ambos encierros, por lo que uno es más pequeño que el otro. En cada encierro hay una zona de alimentación de 5 por 10 m, construidas con malla ciclón; a una de ellas se le puso techo en el 2014, con lámina acanalada galvanizada sobre una estructura de herrería. Los pisos de estas zonas son de mampostería para protección de las pezuñas de los pecaríes (Figura 4). Es importante que no se utilicen pisos de cemento en el confinamiento de esta especie para evitar que las pezuñas se dañen, hay que tener en cuenta que esta especie se desplaza en manadas de 50 a 300 individuos recorriendo hasta 17 kilómetros al día (Reyna Hurtado et al, 2014).

En la zona de mayor elevación del encierro está colocado un andamio usado como torre de observación, donde fue posible realizar observaciones directas y documentar a la piara mediante fotografías. Gracias a esto, se pudieron registrar los movimientos y conductas del grupo. Fue particularmente interesante notar que, a pesar de ser un grupo confinado exhibe comportamientos de fusión-fisión. Así se pudo detectar la división de la piara en dos grupos, uno formado por los individuos más dominantes, más viejos de mayor número y otro más pequeño formados por los individuos de menor talla. Los individuos están marcados con microchips, por lo que externamente no presentan marcas que los identifiquen, por lo que solo podemos señalar su talla y rango jerárquico en el grupo. Otro aspecto interesante, es que esta conducta de fusión-fisión la realizaron al momento de alimentarse de frutos caídos de un árbol de chicozapote (Manikara zapota), primero accedieron a los frutos los individuos mayores y después los más pequeños. Sin embargo, cuando terminaron de comer, volvieron a juntarse en un solo grupo para desplazarse (Figura 5).

Figura 5: Desplazamiento de la piara en el encierro B

El encierro está construido sobre una ladera (Figura 6) y ésta ha sufrido cambios por las condiciones climáticas. Para el encierro se registraron pendientes de 7º a 24º reportándose como pendientes bajas a moderadas; las pendientes bajas están dentro de (8º - 17º) y las pendientes moderadas de (17º - 28º) En el mes de octubre del año 2017, en el último muestreo que se realizó, la lluvia deslavó prácticamente uno de los sitios de mayor inclinación registrada con (24º) y el arrastre de material se desplazó a la mitad del encierro, deteniéndolo por barreras físicas como rocas, árboles y arbustos que se encuentran en el encierro.

Se deberá tomar en cuenta que en épocas de lluvias se deberá prevenir deslaves afectando los sitios donde se encuentran los animales para alimentación, baño, descanso y exhibición.



Área de manejo	
Corral A	zona baja 7°/ zona alta 24°
Corral B	zona baja 7° / zona alta 24°
Deslave de sitios	Pendiente zona alta 24°
Arrastre de suelo, plantas y rocas	Pendiente zona media y baja 7°
Andamio (5.0 metros de altura)	

Figura 6: Pendiente en los encierros de pecarí de labios blancos

En el periodo de estudio, el encierro en general fue ocupado por 39 pecaríes de labios blancos, a pesar de los deslaves y modificaciones dentro del encierro como la reducción de su área original, mantiene zonas de sombra, agua constante por los arroyos que se encuentran dentro del encierro y plantas frutales como la Manikara zapota (Chico zapote), Quercus skinneri (Encino) y Eugeni capulí (Capulín) que muy probablemente lo utilizan los pecaríes como un alimento extra en su alimentación.

Discusión

Una vez que se obtuvieron los resultados se revisaron reportes de las características fisiográficas de otras regiones similares a la de la zona de estudio con respecto a laderas y algunos autores señalan que zonas que se localizan en este rango de pendiente de (17º - 28º) no se consideran sitios aptos para construcciones o infraestructuras de asentamientos humanos (INIFAP, 2016), sin embargo, se reporta la zona de estudio dentro del rango con pendientes moderadas, aun así, se deberá dar un seguimiento permanente sobre todo en época de lluvia cuando se han registrado percances en esa zona por deslaves años atrás.

No hay estudios que describan los encierros de pecari de labios blancos con respecto a los existentes para pecari de collar que van dirigidos a la venta para consumo y cacería legal, entre otros, sin embargo, en La Otra Opción, al ser una UMA con fines de conservación y reproducción para repoblamiento de áreas protegidas, se privilegia el espacio y confort de los animales.

Conclusión

El encierro de pecaríes de labios blancos de La Reserva Ecológica La Otra Opción, presenta una topografía con inclinaciones de hasta 24º para manejo intensivo y alberga un número importante de ejemplares que están en confinamiento, todo esto sumado puede tener implicaciones en la estructura y diseño del encierro. Estos cambios en la estructura son marcados por temporada sobre todo en época de lluvia que conlleva a vientos, deslaves y escombros que son arrastrados a zonas de alimento, baño o descanso de la piara. Esto puede ocasionar pérdidas económicas por los daños a la infraestructura y hasta de los mismos animales; por tal razón debe hacerse énfasis al constante monitoreo de ambos encierros, bases, techos, puertas, comederos, que como propuesta ayudará a mitigar costos económicos y de vidas de los ejemplares para un óptimo uso y manejo.

Con lo anterior observado, se describen a continuación las siguientes recomendaciones.

Preferentemente usar materiales locales para la construcción, ya que además de estar disponibles, abaratan los costos.

Mantener orden y limpieza al hacer reparaciones para que no queden materiales que puedan provocar lesiones a los pecaríes debido a que la visión de ellos no es muy buena.

Plantar barreras vivas a lo largo de curvas de nivel, a fin de retener rocas y ramas, con lo cual se disminuirán los riesgos de deslave, evitando que el suelo y material arrastrado, se deposite en los comederos y echaderos.

Los pecaríes por lo general se la pasan haciendo surcos y comiendo lo que encuentran, esto podría afectar las barreras vivas, por lo que se podría utilizar otro método de barrera con muros de 30 cm de ancho y de por lo menos 25 cm de alto, hechos de rocas que retarden la corriente y que a su vez sirva para que penetre el agua en el suelo.

Debido al paso del tiempo y a condiciones climáticas de la zona, la malla presenta deterioro en las partes en contacto con el suelo y a las crías se les observó salir por esas cavidades. Por lo que deberá taparse la malla venadera con cinta o madera para evitar el escape de las crías, por lo menos en un periodo corto mientras crecen, son animales muy curiosos todo el tiempo, rascan, muerden, voltean objetos y con esto puede evitarse un accidente.

Colocar comederos más largos, distribuidos con mayor separación entre ellas para evitar confrontaciones derivadas de la jerarquía y dominancia de la especie.

Agradecimientos

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Primeros registros con cámara trampa del Chancho Quimilero (*Parachoerus wagneri*) en el Parque Nacional El Impenetrable, provincia del Chaco, Argentina

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Resumen

El Chancho Quimilero, *Parachoerus wagneri*, es el más grande de los cerdos salvajes nativos o pecaríes de América. En Argentina presenta una distribución limitada en la ecorregión del Chaco Seco, encontrándoselo también en otros países como Paraguay, Bolivia y posiblemente Brasil. A nivel mundial, la Unión Internacional para la Conservación de la Naturaleza (UICN) considera a la especie. En Peligro de Extinción, el mismo estado que le fue asignado en la última categorización de mamíferos de Argentina. El objetivo de este trabajo es comunicar tres (3) registros de esta especie a través de cámaras trampa en el Parque Nacional El Impenetrable, en la provincia del Chaco, Argentina. Esta área protegida, de reciente creación (octubre de 2014), está compuesta por parte de la antigua Estancia La Fidelidad, que mantenía unas 250.000 hectáreas con variada biodiversidad en excelente estado de conservación, entre las provincias de Chaco y Formosa. Sin embargo, hasta que no comenzaron las acciones que desembarcaron en la creación del Parque, la zona estuvo vedada a todo tipo de investigaciones, por lo que las primeras cámaras trampa de la zona se colocaron inicialmente en enero de 2013. Por este motivo consideramos la importancia de poder confirmar fotográficamente la presencia de especies amenazadas o raras en el área.

Abstract

The Chacoan peccary, *Parachoerus wagneri*, is the largest of the native wild pigs or peccaries in America. In Argentina its distribution is limited to the Chaco Seco ecoregion and it is also found in other countries such as Paraguay, Bolivia and possibly Brazil. Worldwide, the International Union for Conservation of Nature (IUCN) considers that the species is Endangered, the same status that was assigned to it in the last mammal classification in Argentina. The purpose of this work is to communicate three (3) records of this species through camera traps in El Impenetrable National Park, in the province of Chaco, Argentina. This recently created protected area (October 2014) is

made up of part of the old Estancia La Fidelidad, which maintained some 250,000 hectares with varied biodiversity in an excellent state of conservation, between the provinces of Chaco and Formosa. However, until the actions that led to the creation of the Park began, the area was closed to all kinds of investigations, so the first camera traps in the area were initially placed in January 2013. For this reason we consider the importance of being able to confirm the presence of threatened or rare species photographically in the area.

Introducción

El Chancho Quimilero, también llamado curé-taguá o taguá, es el mayor de los chanchos silvestres americanos, llegando a pesar hasta 40 kg. Es una especie característica del Chaco Seco, con vegetación xerófila, en zonas con presencia de quebracho colorado santiagueño (*Schinopsis quebracho-colorado*) y quebracho blanco (*Aspidosperma quebracho-blanco*), en áreas donde prospera el cardón (*Cereus coryne*) y el ucle (C. validus), con abundancia de cactáceas rastreras o arbustivas o incluso en los llamados “peladares” (planicies áridas sin vegetación). Debe su nombre de “quimilero” al hábito de mordisquear al quimil (*Opuntia quimilo*), enorme cactácea típica del Chaco Seco si bien algunos autores dudan de esta costumbre y creen que este nombre derivaría de su costumbre de frecuentar los “quimilares” (Chebez, 2008).

La especie fue descrita por primera vez por Rusconi (1930), como un subfósil, y fue redescubierto como una especie existente en Paraguay por Wetzel et al. (1975). Más tarde, la presencia fue confirmada en los departamentos paraguayos de Boquerón, Alto Paraguay y al oeste de Presidente Hayes; en Bolivia (este de Tarija, sudeste de Santa Cruz, y este de Chuquisaca); y en el oeste de Formosa, norte de Chaco, este de Salta y el extremo norte de las provincias de Santiago del Estero en Argentina (Mayer y Wetzel, 1986; Taber et al. 1993; Chebez, 2008; Maffei y col., 2008). Posteriormente, nuevos hallazgos lo han confirmado para el sur de Santiago del Estero, oeste de Córdoba (Torres et al. 2018) y este de La Rioja. Posiblemente también sobreviva en el Mato Grosso brasilero, pero requiere confirmarlo (Chebez, 2008).

El Parque Nacional El Impenetrable se encuentra ubicado en el departamento General Güemes, provincia del Chaco (Fig. 1) y cuenta con una superficie de 128.000 hectáreas que lo convierte en el parque nacional más grande del norte argentino. Esta área protegida está conformada por parte de la antigua Estancia La Fidelidad, que poseía unas 250.000 hectáreas (con amplia biodiversidad en excelente estado de conservación) distribuidas en las provincias de Chaco y Formosa. Hasta que comenzaron las acciones para convertir la porción chaqueña del establecimiento en un Parque Nacional, la presencia en la misma de investigadores ha sido prácticamente nula por lo que nuestros monitoreos de fauna en la zona recién comenzaron en enero de 2013, sin embargo, no fue sino hasta estos registros que se logró confirmar fotográficamente la presencia de esta especie, cuando ya el Parque Nacional estaba constituido.

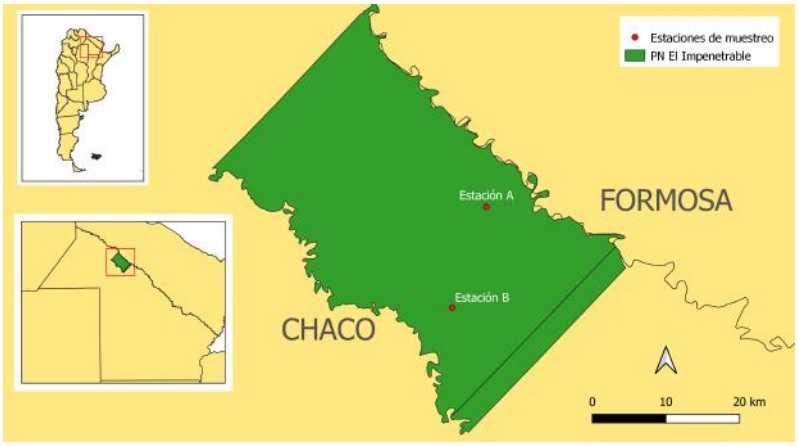

Fig. 1: Estaciones de Muestreo en el PN El Impenetrable donde se registró Chancho Quimilero

Fig. 2: El Chancho Quimilero se distingue de otros pecaríes por su pelaje largo e hirsuto y sus grandes orejas en una prominente cabeza.

Foto: Primer registro en Estación A.

Materiales y métodos

El Parque Nacional El Impenetrable contiene dentro de sus límites una enorme variedad de ambientes de importancia para la conservación de la biodiversidad de la región: montes altos de quebrachos, algarrobales, bosques ribereños en galería, palmares, cardonales, pastizales y uno de los últimos humedales de la zona. Como parte de su Programa de Monitoreo Poblacional de Yaguaretés en la Argentina, la Red Yaguareté inició monitoreos en busca de ese gran felino en lo que era la Estancia La Fidelidad (Chaco) en el año 2013 y continuaron, con una breve interrupción, una vez que éste predio se convirtió en el actual Parque Nacional El Impenetrable hasta el presente.

Dichas cámaras fueron instaladas en diversos ambientes del amplio predio en estaciones de una cámara, ya sea en caminos vehiculares, senderos de vacas, burros o fauna silvestre, aguadas y charcas o bordes de ríos y lagunas. Durante el período estudiado (2013-2020) hubo en total 32 estaciones con cámaras instaladas, para intentar obtener registros de *Panthera onca* dentro del área protegida.

Fig. 3: Esta especie no tiene dimorfismo sexual evidente ni en el tamaño ni en el patrón de coloración, lo que dificulta la identificación a campo de los diferentes sexos.

Foto: Segundo registro en Estación A.

Fig. 4: En concordancia con sus hábitos diurnos: todos nuestros registros han sido durante el día. Foto: Tercer registro en Estación A.

Resultados y discusión

La presente contribución confirma fotográficamente la presencia de *Parachoerus wagneri* en el Parque Nacional El Impenetrable, gracias a cuatro (4) registros diferentes obtenidos a través de imágenes de cámaras trampa, todos en el año 2018.

En la Estación A (-24,998340;-61,005300) se obtuvieron tres registros: el 04/09/2018, a las 14:07 hs. (Fig. 2); el 05/10/2018 a las 10:46 hs. (Fig. 3) y el 06/10/2018 a las 16:18 hs. (Fig. 4). mientras que en la Estación B (-25,121780 -61,052460) se obtuvo un solo registro el día 15/09/2018, a las 13:02 hs (Fig. 5). En todos los registros se fotografió un solo individuo y siempre en horario diurno.

En Argentina, la especie encuentra protección en el Parque Nacional Copo (Santiago del Estero), Parque Nacional Traslasierra (Córdoba), los Parques Provinciales Loro Hablador y Fuerte Esperanza (Chaco), la Reserva Natural Formosa (Formosa), la Reserva Provincial Chancaní (Córdoba) y la Reserva Provincial Los Palmares (Salta) (Heinonen Fortabat y Chebez, 1997, Camino y Torres 2019).

Si bien el Chancho Quimilero ya había sido citado nominalmente para el Parque Nacional El Impenetrable (Camino y Torres, 2019), hasta nuestros registros fotográficos no existía publicación alguna que confirmara su presencia en esta área protegida. Una vez enviado este informe para su publicación, se difundió en una red social alguna foto de esta especie obtenida en el mismo parque, pero de fecha posterior a las que comunicamos aquí. Ello nos lleva a concluir que es necesario un mayor esfuerzo de muestreo, que pueda darnos un panorama más certero de la situación de este amenazado animal en la mayor área protegida del norte de la República Argentina.

Agradecimientos

A Edgardo Garnero, Eduardo E. Musto, Matías “Yaca” Ferroni, Patricio E. Cavallo, Diego G. Satelier, Hugo F. Tolosa, Alfredo R. Gonzalez, Patricia Leiva, Estela Aguiar, Patricio Copper Cowles, Bárbara Gasparri, Sergio Bogan y Juan Manuel Meluso quienes -en distintas campañas- llevaron adelante la instalación y mantenimiento de las estaciones de muestreo así como la planificación y logística para cada campaña. A Inés Ramos Vértiz por la confección del mapa. A Gabriela Palacín por la traducción del resumen.

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Vaya también nuestro agradecimiento para todos los voluntarios y socios de la Red Yaguareté que permiten mantener estas actividades en el tiempo, alentándonos permanentemente a continuar.

Fig. 5: Sobre su coloración general pardo grisácea tiene un collar difuso aunque notable, blancuzco que se extiende desde las quijadas a los hombros.

Foto: Primer registro en Estación B.

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Veterinary, Genetic and Physiological Studies

Seroprevalance of *Trichinella* spp. in Wild Boars (*Sus scrofa*) from Bihor County, Western Romania

Boros, Z., I. Vallee, L. C. Panait, C. M. Gherman, A. Chevillot, P. Boireau, and V. Cozma 2020
Helminthologia 57, no. 3: 235-240

The wild boar (*Sus scrofa*) has a wide geographical distribution and can be an important source of *Trichinella* spp. infection in humans in Romania. The objective of this study was to identify the presence of *Trichinella* spp. in the wild boar population in Bihor County, Romania. Eighty four plasma and diaphragm samples, collected from wild boars, were included in this study. Artifi cial digestion, ELISA and Western blot were performed on these specimens. All diaphragm samples were negative for *Trichinella* larvae in artifi cial digestion, while in ELISA, 54 (64.2 %) plasma samples were positive and 6 (7.1 %) plasma samples were doubtful. Western blot was performed on 26 plasma samples from which only 6 (23.0 %) gave a positive result. Serological evidences indicate the presence of *Trichinella* spp. in wild boars from western Romania. Therefore, human consumers might be at risk to ingest Trichinella larvae, even in low numbers.

Prevalence and Genetic Diversity of Atypical Porcine Pestivirus (Appv) Detected in South Korean Wild Boars

Choe, S., G. N. Park, R. M. Cha, B. H. Hyun, B. K. Park, and D. J. An 2020
Viruses-Basel 12, no. 6

Atypical porcine pestivirus (APPV), currently classified as pestivirus K, causes congenital tremor (CT) type A-II in piglets. Eighteen APPV strains were identified from 2297 South Korean wild boars captured in 2019. Phylogenetic analysis of the structural protein E2 and nonstructural proteins NS3 and Npro classified the APPV viruses, including reference strains, into Clades I, II and III. Clade I was divided into four subclades; however, the strains belonging to the four subclades differed slightly, depending on the tree analysis, the NS3, E2, and Npro genes. The maximum-likelihood method was assigned to South Korean wild boar APPV strains to various subclades within the three trees: subclades I.1 and I.2 in the E2 tree, subclade I.1 in the Npro tree, and subclades I.1 and I.4 in the NS3 ML tree. In conclusion, APPV among South Korean wild boars belonging to Clade I may be circulating at a higher level than among the South Korean domestic pig populations.

Modelling Spatial and Temporal Patterns of African Swine Fever in an Isolated Wild Boar Population to Support Decision-Making

Croft, S., G. Massei, G. C. Smith, D. Fouracre, and J. N. Aegerter 2020
Frontiers in Veterinary Science 7

African swine fever (ASF) is a highly contagious disease affecting all suids including wild boar. As the disease can damage commercial pig production and its circulation can threaten international trade, understanding the risks produced by free-living wild boar (as a wildlife reservoir) is important to ensure proportionate policies to exclude the disease, as well as an effective contingency response. The recent spread of the virus into Western Europe has produced concerns in many stakeholders including pig producers and national governments. Unlike in mainland Europe, where wild boar are widespread, in Britain, free-living populations have only recently re-established, and whilst these are still relatively small and isolated, they may provide a

sufficient reservoir capable of sustaining disease and may thus present a continual source of infection risk to domestic pigs. This study focuses on one component of the risk produced by wild boar, specifically the distribution and persistence of virus in a landscape produced by the natural circulation of disease within wild boar. We used a spatial individual-based model run across a representation of a real landscape to explore the epidemiological consequences of an introduction of ASF into the Forest of Dean, currently hosting the largest population of wild boar in England. We explore various scenarios including variations in the prophylactic management of boar, as well as variations in reactive management (contingency response) following the detection of disease to evaluate their value in reducing this specific risk (presence of ASF virus of wild boar origin in the landscape). The abundance and distribution of wild boar is predicted to increase across our study extent over the next 20 years. Outbreaks of ASF are not predicted to be self-sustaining, with the median time to disease "burn-out" (no new infections) being 14 weeks. Carcass removal, as a tool in a package of reactive management, was of limited value in reducing the duration of outbreaks in this study. We suggest that useful predictions of some of the risks produced by ASF might be possible using only the distribution of the boar, rather than more difficult abundance or density measures.

Wild Boar Deathbed Choice in Relation to Asf: Are There Any Differences between Positive and Negative Carcasses?

Cukor, J., R. Linda, P. Vaclavek, P. Satran, K. Mahlerova, Z. Vacek, T. Kunca, and F. Havranek

2020

Preventive Veterinary Medicine 177

African swine fever (ASF) is a fatal, infectious disease affecting wild boars and domestic pigs, mostly resulting in their deaths. Previous studies showed that carcasses of infected wild boars pose a serious threat for ASF virus transmission and leaving of dead bodies in the environment enables persistence of the disease in the given affected area. Therefore, the prompt finding and removal of the carcasses is crucial for effective ASF control. This study reveals habitat preferences of ASF-positive wild boars for their deathbeds, which could greatly improve the effectivity in the search for infected carcasses. The vast majority (71%) of carcasses were found in forests (although forests occupy only 26.6% of the high-risk area – Zlin region, Czech Republic), especially in young forest stands; 91.3% of infected wild boar carcasses, which were found in forests, were in stands of up to 40 years of age, where infected individuals search for calm and quiet places. The preference of younger forest stands is significantly higher for infected individuals ($p < 0.001$). On meadows, infected individuals preferred a higher herb layer ($p = 0.002$) compared to non-infected individuals. A higher preference of places more distant from roads and forest edges was observed for the infected individuals as well ($p < 0.001$ in both cases). No differences in deathbed habitat preference were observed between selected sex-age categories. The distance between carcasses and water source was observed to be dependent on current mean temperature. Carcasses were found closer to the water sources at higher mean temperature. Because of the comparable character of the landscape, presented models are applicable across Central Europe and have the potential to greatly facilitate the search for infected carcasses.

Estimation of Infection Risk on Pig Farms in Infected Wild Boar Areas-Epidemiological Analysis for the Reemergence of Classical Swine Fever in Japan in 2018
Hayama, Y., Y. Shimizu, Y. Murato, K. Sawai and T. Yamamoto 2020
Preventive Veterinary Medicine 175
In September 2018, classical swine fever (CSF) reemerged in Japan after 26 years' absence. The first case was detected at a pig farm in Gifu Prefecture, in the center of Japan, and the disease spread to both domestic pigs and wild boar (*Sus scrofa*). The spread of CSF in wild boar is extremely difficult to control and is thus a great threat to domestic pig farms, and understanding the transmission risk from wild boar to domestic pigs is essential to implement effective control measures that will prevent domestic pig infection. Therefore, this study elucidates the transmission risk from wild boar to domestic pigs by introducing a transmission kernel that is dependent on the distance between infected wild boar and pig farms, and then estimating the risk area of infection from wild boar by describing the transmission probability. The study used epidemiological data from Gifu Prefecture in the period from September 2018 to March 2019, including a total of 171 1-km grid cells where an infected wild boar was detected and pig farm data from 13 infected and 34 uninfected farms. The estimated infection risk area within 28 days matched well with the observed data. The risk area widened gradually during the epidemic, and at the end of March, the risk area extended over a range of approximately 75 km from east to west and 40 km from north to south (almost 3000 km2). Ten out of the 13 infected farms and four out of the 34 uninfected farms were located within the high-risk area (>60 % infection probability). In contrast, one infected farm and 18 uninfected farms were located within the low-risk area (<5 % infection probability). When several infected grid cells were detected within 5 km of a pig farm, the risk of infection from wild boar within 28 days was more than 5 %. This analysis provides an estimate of the potential spatial range over which CSF virus can spread between wild boar and domestic pig farms, and can be used to inform the early detection of CSF-suspected pigs and the strengthening of biosecurity measures that will effectively prevent and control the disease based on the infection risk level.

Monitoring Relative Abundance Index and Age Ratios of Wild Boar (*Sus scrofa*) in Small Scale Population in Gifu Prefecture, Japan During Classical Swine Fever Outbreak
Ikeda, T., M. Asano, N. Kuninaga, and M. Suzuki 2020
Journal of Veterinary Medical Science 82, no. 6
Although the first cases of classical swine fever were reported in 2018, no studies have explored this impact on wild boar populations in Japan. Comparing the relative abundance indices and age ratios in the wild boar population before and after the outbreak, we investigated the impact of classical swine fever virus on wild boar population dynamics in August 2017–December 2019. Relative abundance indices declined from 2017 to 2019 drastically, while there were no significant differences in age ratios throughout the study period. Consequently, wildlife managers should consider that wild boars continue to contract classical swine fever virus, and they should intensively implement countermeasures in agricultural lands and in pig farms, in addition to wild boar population management

Dynamics of Classical Swine Fever Spread in Wild Boar in 2018-2019, Japan
Isoda, N., K. Baba, S. Ito, M. Ito, Y. Sakoda, and K. Makita. 2020
Pathogens 9, no. 2

The prolongation of the classic swine fever (CSF) outbreak in Japan in 2018 was highly associated with the persistence and widespread of the CSF virus (CSFV) in the wild boar population. To investigate the dynamics of the CSF outbreak in wild boar, spatiotemporal analyses were performed. The positive rate of CSFV in wild boar fluctuated dramatically from March to June 2019, but finally stabilized at approximately 10%. The Euclidean distance from the initial CSF notified farm to the farthest infected wild boar of the day constantly increased over time since the initial outbreak except in the cases reported from Gunma and Saitama prefectures. The two-month-period prevalence, estimated using integrated nested Laplace approximation, reached >80% in half of the infected areas in March–April 2019. The area affected continued to expand despite the period prevalence decreasing up to October 2019. A large difference in the shapes of standard deviational ellipses and in the location of their centroids when including or excluding cases in Gunma and Saitama prefectures indicates that infections there were unlikely to have been caused simply by wild boar activities, and anthropogenic factors were likely involved. The emergence of concurrent space–time clusters in these areas after July 2019 indicated that CSF outbreaks were scattered by this point in time. The results of this epidemiological analysis help explain the dynamics of the spread of CSF and will aid in the implementation of control measures, including bait vaccination.

First Isolation of Foot and Mouth Disease Virus from Wild Boars in the Middle East
Karniely, S., F. Hamed, B. Gelman, R. King, N. Storm, E. Eyngor, and B. E. Tov 2020
Transboundary and Emerging Diseases 67, no. 4: 1725-1729
Domestic pigs are susceptible to foot and mouth disease virus (FMDV) infection and suffer from severe clinical disease. Our knowledge on the clinical manifestations of FMD in and its transmission by wild boars (*Sus scrofa*) is very limited. During an FMD outbreak in the Golan Heights in 2018, wild boars grazing in close proximity to cattle were observed showing lameness. Infectious FMDV was isolated from throat and heart tissues of two young wild boars with FMD clinical signs. This is the first report of wild boars clinically infected with FMDV in the Middle East.

Molecular Detection and Subtyping of Blastocystis Detected in Wild Boars (*Sus scrofa*) in South Korea
Lee, H., M. G. Seo, J. K. Oem, Y. S. Kim, S. Y. Lee, J. Kim, H. Jeong, W. H. Jheong, Y. Kim, W. J. Lee, O. D. Kwon, and D. Kwak 2020
Journal of Wildlife Diseases 56, no. 3: 662-666.
Blastocystis is a genus of parasitic protozoans that live in humans, mammals, and birds and which has been widely studied due to its low host specificity. Limited data are available, however, regarding its presence in wildlife, particularly in South Korea. Contact between wild boars (*Sus scrofa*) and livestock or humans has steadily increased as wild boars venture down from the mountains to farms and residential areas. In this study, we examined the status and subtypes (STs) of Blastocystis in wild boars in South Korea and confirmed its zoonotic potential. From March 2016 to November 2018, we collected 433 fecal samples throughout the country from trapped or road-killed wild boars. The 18S rRNA gene was used for molecular identification and subtyping and the proportion of PCR-positive samples was 10.4%. We then assessed positive samples for associations with sex, region, and seasonal infec-tion; however, no statistical significance was observed for any variable other than season. Phylogenetic analyses revealed that all sequences belonged to subtype 5 and had 99.5–99.9% identity with sequences obtained

from Japanese cattle (Bos taurus) and 97.1% identity with sequences obtained from Chinese. Subtype 5 has been implicated in zoonoses, indicating that Korean wild boars could transmit Blastocystis to humans and other livestock. Our results, in accordance with the One Health concept, strongly support continued interest and efforts by public health and disease control organizations toward transmission prevention.

Characterization of Lactic Acid Bacteria Isolated from the Gastrointestinal Tract of a Wild Boar as Potential Probiotics

Li, M., Y. Wang, H. Y. Cui, Y. F. Li, Y. Sun, and H. J. Qiu 2020

Frontiers in Veterinary Science 7

Lactic acid bacteria (LAB) are major microorganisms used for probiotic purposes and prime parts of the human and mammalian gut microbiota, which exert important health-promoting effects on the host. The present study aimed to evaluate and compare the probiotic potential and safety of LAB strains isolated from the gastrointestinal tract of a wild boar from the Greater Khingan Mountains, China. Amongst all of the isolated LAB strains, five isolates identified as Lactobacillus mucosae, Lactobacillus salivarius, Enterococcus hirae, Enterococcus durans, and Enterococcus faecium, were remarkably resistant to acid and bile salt. The probiotic characteristics (including adhesion capability, antimicrobial activities, autoaggregation, and coaggregation abilities), and safety properties (including hemolytic activity, antibiotic resistance, absence/presence of virulence factors, and in vivo safety) were evaluated. The results showed that all five isolates exhibited high adhesive potential, remarkable aggregation capacity, and antibacterial activities. Upon assessment of the safety, these strains were negative for hemolytic activity and all tested virulence genes. In vivo safety assessment showed no adverse effects of isolated strains supplementation on the body weight gain and organ indices of the treated mice. This study revealed that these LAB isolates, especially L. salivarius M2-71, possess desirable probiotic properties and have great potentials for the development of feed additives for animals to promote health.

Metagenomic Analysis of Acquired Antibiotic Resistance Determinants in the Gut Microbiota of Wild Boars (*Sus scrofa*) - Preliminary Results

Libisch, B., T. Kereszteny, Z. Kerenyi, R. Kocsis, R. Sipos, P. P. Papp, and F. Olasz 2020

Journal of Veterinary Research 64, no. 1: 111-118

INTRODUCTION: Land application of manure that contains antibiotics and resistant bacteria may facilitate the establishment of an environmental reservoir of antibiotic-resistant microbes, promoting their dissemination into agricultural and natural habitats. The main objective of this study was to search for acquired antibiotic resistance determinants in the gut microbiota of wild boar populations living in natural habitats. MATERIAL AND METHODS: Gastrointestinal samples of free-living wild boars were collected in the Zemplén Mountains in Hungary and were characterised by culture-based, metagenomic, and molecular microbiological methods. Bioinformatic analysis of the faecal microbiome of a hunted wild boar from Japan was used for comparative studies. Also, shotgun metagenomic sequencing data of two untreated sewage wastewater samples from North Pest (Hungary) from 2016 were analysed by bioinformatic methods. Minimum spanning tree diagrams for seven-gene MLST profiles of 104 *E. coli* strains isolated in Europe from wild boars and domestic pigs were generated in Enterobase. RESULTS: In the ileum of a diarrhoeic boar, a dominant *E. coli* O112ab:H2 strain with intermediate

resistance to gentamicin, tobramycin, and amikacin was identified, displaying sequence type ST388 and harbouring the EAST1 toxin astA gene. Metagenomic analyses of the colon and rectum digesta revealed the presence of the tetQ, tetW, tetO, and mefA antibiotic resistance genes that were also detected in the gut microbiome of four other wild boars from the mountains. Furthermore, the tetQ and cfxA genes were identified in the faecal microbiome of a hunted wild boar from Japan. CONCLUSION: The gastrointestinal microbiota of the free-living wild boars examined in this study carried acquired antibiotic resistance determinants that are highly prevalent among domestic livestock populations.

Detection of Pseudorabies Virus in Wild Boar Foetus

Pacini, M. I., M. Forzan, G. Cilia, L. Bernardini, F. Marzoli, F. Pedonese, P. Bandecchi, F. Fratini, and M. Mazzei 2020

Animals 10, no. 2

Pseudorabies, or Aujeszky's disease, is a notifiable worldwide infection of domestic and feral swine that causes economic losses for the swine industry. In domestic pigs, the virus is responsible for nervous and/or respiratory symptoms; in pregnant sows, it is one of the major causes of stillbirth, mummification, embryonic death, and infertility (SMEDI). It is known that PRV infection in wild boar is associated with low pathogenicity and attenuated or absent symptomatology, but limited information is available about the ability of the virus to infect the foetuses of infected wild boar pregnant sows. Due to scarce information about the reproductive consequences, we investigate the possible intrauterine vertical transmission of the virus in wild boar pregnant sow living in a highly infected area. A number of 54 hunted wild boar were sampled during 2018–2019, and blood, genital and nasal swabs, placenta, and fetuses were collected for serological and molecular investigations. A seroprevalence of 74% (40/54) was detected, while 1/24 pregnant sow and 1/24 pooled foetuses tested positive by PCR (gene gB). This is the first evidence of viral detection in foetuses from seropositive pregnant wild boar. This finding suggests the possible pathogenetic role of PRV on pregnancy in wild boar and the existence of an additional transmission route.

Spatial Epidemiology of African Swine Fever: Host, Landscape and Anthropogenic Drivers of Disease Occurrence in Wild Boar

Podgorski, T., T. Borowik, M. Lyjak, and G. Wozniakowski 2020

Preventive Veterinary Medicine 177

Host abundance and landscape structure often interact to shape spatial patterns of many wildlife diseases. Emergence, spread, and persistence of African swine fever (ASF) among wild boar in eastern Europe has raised questions on the factors underlying ASF dynamics in this novel host-pathogen system. This work identifies drivers of ASF occurrence in natural wild boar population. We evaluated factors shaping the probability of ASF-postitive wild boar during the first three years (2014-2016) of the ASF epidemic in Poland. We expected to observe positive effects of wild boar density, proportion of forested area, human activity, and proximity to previous infections on ASF case probability. We tested these predictions using the infection status of 830 wild boar samples and generalized mixed-effects models. The probability of ASF case increased from 3 to 20% as population density rose from 0.4 to 2 ind./km2. The positive effect of population density on ASF case probability was stronger at locations near previous ASF incidents. ASF was more likely to occur in forested areas, with the probability of detecting an ASF positive sample rising from 2 to 11% as forest cover around the sample increased from 0.5 to 100%. This pattern was consistent

at both low and high wild boar densities. Indicators of human activity were poor predictors of ASF occurrence. Disease control efforts, such as culling and carcass search, should be focused on high-density populations where chances of detecting and eliminating ASF-positive wild boar are higher. The intensity of control measures should decrease with distance from the infected area to match the observed spatial pattern of ASF case probability. Woodlands represent areas of the highest risk of ASF case occurrence. Distribution and connectivity of suitable habitats over the landscape can be used to prioritize disease-management actions.

Genetic Diversity of Porcine Circovirus Isolated from Korean Wild Boars
Song, S., G. N. Park, S. Choe, R. M. Cha, S. Y. Kim, B. H. Hyun, B. K. Park, and D. J. An 2020
Pathogens 9, no. 6
In Korea, three genotypes of porcine circovirus type 2 (PCV2a, PCV2b, and PCV2d) have been identified on domestic pig farms, while two genotypes (PCV2a and PCV2b) have been identified in wild boar populations. Here, we investigated genotype diversity and genotypic shift in 91 PCV2 isolates from 1340 wild boars captured in South Korea between 2013 and 2017. Phylogenetic analyses based on the complete ORF2 showed that the 91 PCV2 strains were detected as four genotypes by qPCR screening assay: PCV2a (2.2%, 2/91), PCV2b (16.5%, 15/91), PCV2d (80.2%, 73/91), and PCV2h (1.1%, 1/91). Only one intergenotype recombinant event was detected between PCV2 ORF2 in wild boars (PCV2b) and domestic pigs (PCV2a). Amino acid positions 86– 89 within ORF2, which distinguishes the different genotypes, were conserved in all PCV2 genotypes isolated from South Korean wild boars, including TNKI in PCV2a/PCV2h, SNPR in PCV2b, and SNPL in PCV2d. The estimated nucleotide substitution rates in the ORF2 region of viruses from South Korean wild boars and domestic pigs were 5.8145 × 10−4 and 4.5838 × 10−4 substitutions per site per year (s/s/y), respectively. The times to the most recent common ancestor (tMRCA) for South Korean domestic pig PCV2 were 1937 (PCV2a), 1972 (PCV2b), 1999 (PCV2d 1), and 2000 (PCV2d 2). By contrast, the tMRCA for South Korean wild boar PCV2b and PCV2d were 1989 and 2001, respectively. Thus, the PCV2d genotype is prevalent among South Korean wild boars and domestic pigs.

Mrsa Cc398 Recovered from Wild Boar Harboring New Scc Mec Type Iv J3 Variant
Sousa, M., N. Silva, V. Borges, J. P. Gomes, L. Vieira, M. Canica, C. Torres, G. Igrejas, and P. Poeta 2020
Science of the Total Environment 722
A methicillin-resistant Staphylococcus aureus CC398 was recovered from a wild female boar (*Sus scrofa*) in the north of Portugal, in 2013 (Sousa et al. 2017). Whole genome sequencing (WGS) revealed this strain carries a new variant of a mecA-containing staphylococcal chromosomal gene cassette (SCCmec) type IV with an uncommon J3 region. WGS studies can facilitate surveillance and provide more detailed characterization of bacterial clones circulating in the wild, reinforcing the need for a one health perspective to better understand and control antimicrobial resistance.

The Prevalence and Degree of Endoparasitic Infections in Wild Boars Using the Semi-Quantitative Fecal Egg Count Method
Tamara, I., M. Natasa, D. I. Sandal, B. Danical, N. Katarina, G. Bojan, P. Tamas, D. Darko, and B. Zsolt 2020
Acta Parasitologica

Purpose: Breeding of wild boars is a significant part of the hunting economy; however, hogs are associated with zoonotic infection. This study assessed the prevalence and degree of parasitic infections that exist in wild boars from two hunting grounds in the Autonomous Province of Vojvodina, Republic of Serbia. Methods: Parasitological examinations were conducted from 2016 to 2019. In total 220 fecal samples and 13 lungs were collected from wild boars in two hunting grounds (an open and a closed habitat) on the territory of Vojvodina (Serbia). Assessment of the prevalence and degree of the detected endoparasitosis involved a semi-quantitative fecal egg count method. Results: The presence of protozoa - *Eimeria* spp./*Isospora* spp. (76.38%; 32.26%) and *Balantidium coli* (7.08%), nematodes—*Ascaris suum* (29.03%), *Trichuris suis* (31.49%; 19.35%), *Hyostrongylus rubidus*/*Oesophagostomum* spp. (55.12%; 48.39%), *Metastrongylus pudendotectus* (66.14%; 21.51%), *Gnathostoma hispidum* (3.94%; 2.15%) and *Macracanthorhynchus hirudinaceus* (9.45%; 7.53%) and trematodes - *Fasciola hepatica* (5.51%; 4.30%) and *Dicrocoelium dendriticum* (0.78%; 2.30%) were detected as single or mixed infections, via qualitative coprological examination. The total prevalence of the endoparasitosis was 92.91% in hunting ground I (closed habitat) and 73.12% in hunting ground II (open habitat). The most prevalent infection in hunting ground I was coccidiosis (76.38%), and hyostrongylosis/oesophagostomosis (48.39%) in hunting ground II. Adult forms of M. pudendotectus were identified in the lungs of 13 wild hogs with mild to severe bronchopneumonia from hunting ground II. Conclusions: The semi-quantitative fecal egg count method demonstrated clinical and parasitological significance and revealed the risks associated with zoonotic infections in this game species population. Therefore, monitoring the etiology and epizootiology of parasitic infections in wild boars is essential for creating health care programs in hunting ground areas and planning control strategies that protect both the hunting economy and public health.

Wild Boar as a Reservoir of Antimicrobial Resistance

Torres, R. T., J. Fernandes, J. Carvalho, M. V. Cunha, T. Caetano, S. Mendo, E. Serrano and C. Fonseca 2020

Science of the Total Environment 717

Antimicrobial resistance (AMR) has been recognized as an emerging and growing problem worldwide. Knowledge concerning AMR bacteria circulating in wildlife is currently limited, although it could provide important insights into AMR emergence and persistence. Across Europe, wild boar (*Sus scrofa*) populations have dramatically increased their distribution and number over the last decades. In the context of AMR dynamics, wild boar is a perfect model species to unveil the emergence, spread and persistence of AMR at the human-livestock-wildlife interface. Here, we summarize the current knowledge on the importance of wild boar as a reservoir of antimicrobial resistant bacteria, and its possible use as sentinel species for surveillance. Analyses of available data showed a rising interest on this topic in the last years, highlighting the growing concern on wild boar potential role as AMR facilitator and it is foreseen that the importance of antimicrobial resistance research in wild boar will continue to increase in years to come. Available studies have been focused on specific bacterial species, particularly *E. coli*, *Salmonella* spp. and *Enterococcus* spp., bioindicators of AMR, and have been mainly conducted in three countries: Spain, Portugal and Germany. Strikingly, AMR surveillance in wild boar is uneven and still poorly allocated as many wild boar high-density countries do not yet have publications on the topic. Overall, accumulated data showed that wild boar are carriers of antimicrobial resistant bacteria, with variation in the prevalence of bacterial species and the percentage of resistance to different antibiotics. The lack of harmonized sampling and testing

protocols makes it difficult to compare AMR in wild boar. The need for the establishment of standardised protocols keen to provide quantitative comparable data is highlighted. We finally suggest the long-term monitoring of wild boar as a sentinel species for AMR surveillance in order to inform public policies on this topic.

Endosymbionts of *Onchocerca borneensis* Uni, Mat Udin & Takaoka n. sp. (Nematoda: Filarioidea) from the Bornean Bearded Pig *Sus barbatus* Muller (Cetartiodactyla: Suidae) of Sarawak, Malaysia

Uni, S., A. S. M. Udin, T. Agatsuma, K. Junker, W. Saijuntha, N. Bunchom, M. Fukuda, C. Martin, E. Lefoulon, A. Labat, F. A. A. Khan, V. Low, P. L. Cheah, Y. A. L. Lim, R. Ramli, D. M. Belabut, N. A. Zainuri, M. Matsubayashi, H. Omar, S. Bhassu, S. Uga, R. Hashim, H. Takaoka and M. S. Azirun 2020

Description, Molecular Characteristics and Wolbachia Parasites & Vectors 13, no. 1

Background: The genus *Onchocerca* Diesing, 1841 includes species of medical importance, such as *O. volvulus* (Leuckart, 1893), which causes river blindness in the tropics. Recently, zoonotic onchocercosis has been reported in humans worldwide. In Japan, *O. dewittei japonica* Uni, Bain & Takaoka, 2001 from wild boars is a causative agent for this zoonosis. Many filarioid nematodes are infected with *Wolbachia* endosymbionts which exhibit various evolutionary relationships with their hosts. While investigating the filarial fauna of Borneo, we discovered an undescribed *Onchocerca* species in the bearded pig *Sus barbatus* Müller (Cetartiodactyla: Suidae).

Methods: We isolated *Onchocerca* specimens from bearded pigs and examined their morphology. For comparative material, we collected fresh specimens of *O. d. dewittei* Bain, Ramachandran, Petter & Mak, 1977 from banded pigs (*S. scrofa vittatus* Boie) in Peninsular Malaysia. Partial sequences of three different genes (two mitochondrial genes, cox1 and 12S rRNA, and one nuclear ITS region) of these filarioids were analysed. By multi-locus sequence analyses based on six genes (16S rDNA, ftsZ, dnaA, coxA, fbpA and gatB) of *Wolbachia*, we determined the supergroups in the specimens from bearded pigs and those of *O. d. dewittei.*

Results: *Onchocerca borneensis* Uni, Mat Udin & *Takaoka* n. sp. is described on the basis of morphological characteristics and its genetic divergence from congeners. Molecular characteristics of the new species revealed its close evolutionary relationship with *O. d. dewittei*. Calculated p-distance for the cox1 gene sequences between *O. borneensis* n. sp. and *O. d. dewittei* was 5.9%, while that between *O. d. dewittei* and *O. d. japonica* was 7.6%. No intraspecific genetic variation was found for the new species. *Wolbachia* strains identified in the new species and *O. d. dewittei* belonged to supergroup C and are closely related.

Conclusions: Our molecular analyses of filarioids from Asian suids indicate that the new species is sister to *O. d. dewittei*. On the basis of its morphological and molecular characteristics, we propose to elevate *O. d. japonica* to species level as *O. japonica* Uni, Bain & Takaoka, 2001. Coevolutionary relationships exist between the *Wolbachia* strains and their filarial hosts in Borneo and Peninsular Malaysia.

Testicular Biometry and Morphological Characteristics of Wild Boar Spermatozoa in Relation to Age During the Anoestrus Period

Urbsys, A., V. Pileckas, R. Nainiene, and A. Siukscius 2020

Acta Zoologica Bulgarica 72, no. 1: 31-36.

The aim of the present study is to analyse the biometrical parameters of the testes and

morphological characteristics of spermatozoa of different aged wild boars that are hunted outside of the mating season in order to evaluate the expediency of preservation and use of younger males for breeding in the next season. The study indicates that despite obvious biometric differences between the testes of young and mature boars (the weight is 2.6 and the volume is 3.4 times lower in juvenile than in mature specimens) and more effective spermatogenesis of mature boars (the amount of intact spermatozoa is from 2 to 3 times higher), young boars are able to perform reproductive function during the anoestrus period. During this period, the epididymis of both young and mature boars contains 31-35% of spermatozoa with cytoplasmic drops that indirectly indicates comparatively high sexual activity of both groups of boars even during the anoestrous period. Therefore, even the second-year boars can spread, e. g., African swine fever and have to be included into the extermination scheme of the prevention measures.

Risk Factors Associated to a High Mycobacterium Tuberculosis Complex Seroprevalence in Wild Boar (*Sus scrofa*) from a Low Bovine Tuberculosis Prevalence Area

Varela-Castro, L., Alvarez, V., Sevilla, I. A. and M. Barral. 2020

Plos One 15, no. 4

Animal tuberculosis is a worldwide zoonotic disease caused principally by *Mycobacterium bovis*, a member of the *Mycobacterium tuberculosis* complex (MTC). In southern Iberian Peninsula, wild reservoirs such as the wild boar, among other factors, have prevented the eradication of bovine tuberculosis. However, most of the studies have been focused on south-central Spain, where the prevalence of tuberculosis is high among wild ungulates and cattle herds. In northern regions, where wild boar density and bovine tuberculosis prevalence are lower, fewer studies have been carried out and the role of this species is still under debate. The aim of this study was to describe the temporal and spatial distribution of antibodies against MTC in wild boar from the Basque Country, northern Spain. Sera from 1902 animals were collected between 2010 and 2016. The seroprevalence was determined with an in house enzyme-linked immunosorbent assay and the search of risk factors was assessed by Generalized Linear Models. Overall, 17% of wild boars (326/1902; 95%CI, [15.5%–18.9%]) showed antibodies against MTC. Risk factors associated with seropositivity were the year and location of sampling, the number of MTC positive cattle, the distance to positive farms and the percentage of shrub cover. Younger age classes were associated with increased antibody titres among seropositive individuals. The seroprevalence detected was higher than those previously reported in neighbouring regions. Hence, further studies are needed to better understand the role of wild boar in the epidemiology of tuberculosis in low tuberculosis prevalence areas and consequently, its relevance when developing control strategies.

Disease-Mediated Piglet Mortality Prevents Wild Boar Population Growth in Fenced Overabundant Settings

Barasona, J. A., M. A. Risalde, J. A. Ortiz, D. Gonzalez-Barrio, A. Che-Amat, M. Perez-Sancho, L. Vargas-Castillo, A. Xeidakis, E. Jurado-Tarifa and C. Gortazar 2020

European Journal of Wildlife Research 66, no. 2

Assessing Eurasian wild boar (*Sus scrofa*) mortality is a key for understanding population dynamics and adjusting hunting harvest and population management. We used radio-tagging and video-trapping to quantify piglet summer mortality in a managed (i.e. fenced and year-round fed) wild boar population from southern Spain. We used two independent tools to assess wild boar

mortality, i.e. radio-tracking and video footage. A total of 32 wild boar piglets were captured at selective feeders acting as cage-traps, and all the piglets were equipped with ear-tag transmitters including a mortality sensor. Additionally, 20 camera traps were set up in video mode at wild boar feeders. Videos were visualized calculating the proportion of piglets seen per adult as a second indicator of piglet mortality. The survival analysis of radio-tagged individuals indicated an average survival of 48% after 180 days of capturing. Mortality was particularly pronounced in the first 2 months, i.e. during summer. Video footage evidenced a progressive decline in the piglet-to-adult ratio throughout summer. Between June and September, this ratio declined by 80.5%. Dead piglets were in poor body condition, and respiratory lesions compatible with the porcine respiratory disease complex (PRDC) were observed in 86% of them. Porcine circovirus type 2 (PCV2) was the most prevalent pathogen (61%) in this study, and its prevalence showed an increasing trend depending on the lung lesion score. We postulate that high piglet mortality at early age might represent a disease-mediated density-dependent mechanism limiting wild boar population growth in semi-intensive management regimes, characterized by year-round feeding and fencing.

Assessment of Living Conditions in Wild Boars by Analysis of Oxidative Stress Markers
Esposito, L., S. Tafuri, N. Cocchia, R. Fasanelli, N. Piscopo, B. Lamagna, V. Eguren, A. Amici, E. Iorio and F. Ciani 2020
Journal of Applied Animal Welfare Science. https://dx.doi.org/10.1080/10888705.2020.1790365
This study demonstrated that it is possible to differentiate wild boars living in habitats with different animal densities by the measurement of oxidative stress markers. Therefore, reactive oxygen metabolites, the antioxidant barrier, i.e., the biological antioxidant potential and the antioxidative power (OXY-Adsorbent), as well as cortisol were measured in freely ranging wild boars. In two different areas of a State Forest in the Campania Region (Italy), 42 freely ranging, managed wild boars were captured with a corral trap, and blood samples were collected. The wild boars were divided by age (>1 year old and <1 year old) and sex (male and female). Animals in one area showed significantly higher values of oxidative stress parameters than those living in the other area. The annual boar censuses of areas highlighted a higher population density in the first area than in the second one, and this would explain the results obtained. Since the health or nutritional status of animals is reflected by oxidative stress, wild boars in areas with higher animal densities may live under worse conditions than animals in areas with lower densities which becomes evident by measuring oxidative stress markers. As cortisol in blood is only reflecting a short period, the measurement of oxidative stress level may be a better indicator to evaluate the living conditions of wild boars.

To Sample or Not to Sample? Detection of African Swine Fever in Wild Boar Killed in Road Traffic Accidents
Schulz, K., F. J. Conraths, C. Staubach, A. Viltrop, E. Olsevskis, I. Nurmoja, K. Lamberga and C. Sauter-Louis 2020
Transboundary and Emerging Diseases. https://dx.doi.org/10.1111/tbed.13560
African swine fever (ASF) in wild boar remains a threat for the global pig industry. Therefore, surveillance is of utmost importance, not only to control the disease but also to detect new introductions as early as possible. Passive surveillance is regarded as the method of choice for an effective detection of ASF in wild boar populations. However, the relevance of wild boar killed

through road traffic accidents (RTA) for passive surveillance seems to be unclear. Using comprehensive ASF wild boar surveillance data from Estonia and Latvia, the prevalence of ASF infected wild boar was calculated and the probability of infection as measured by PCR compared for animals that were hunted, found dead, shot sick or killed in a RTA. The number of samples originating from wild boar killed in a RTA was low and so was the ASF prevalence in these animals. However, the reasons for this low number of RTA animals remain unknown. Therefore, we recommend to sample wild boar killed in a RTA to a greater extent, also to explore, if this approach can increase the detection probability, and to avoid missing disease introduction.

Exposure of managed red river hogs (*Potamochoerus porcus*) to urine from males stimulates estrous cycling and modulates fecal sex steroid metabolites in males and females

Goblet, C., Lewis, B., Jacobse, V., Jarboe, M., Silva, D., Penfold, L. and A.E. Newell-Fugate 2020
General and comparative endocrinology 285, 113262

For unknown reasons, reproductive success varies among zoos in managed red river hogs. In response to urine exposure from novel conspecifics, we hypothesized that males with low libido would exhibit increased concentrations of testosterone metabolites and that acyclic and/or non-breeding females would be induced to cycle or cycle more regularly. Estrous cycle length and progesterone metabolites in same-sex housed females were compared prior to and following exposure to novel red river hog male urine. Male testosterone metabolites and female progesterone metabolites as well as estrous cycle length were compared among: 1) proven-breeder females and males; 2) non-breeding females newly paired with novel males; 3) non-breeding females and males exposed to urine from novel females and males. Fecal samples were collected 3–5 times per week for eight to 12 months, lyophilized, extracted, and assayed for progesterone and testosterone metabolites with validated enzyme immunoassays. Introduction of female urine resulted in an increased number of estrous cycles per female per month, and decreased luteal and increased follicular progesterone metabolites in females. Introduction of male urine resulted in an increase in testosterone metabolites in males. Average progesterone metabolites for pregnant proven-breeder females were more than double that for pregnant females newly paired to novel males. An interaction between season and treatment group, as well as the acyclicity of females from July through November irrespective of treatment group, suggest that season may confound and warrant judicious interpretation of the results. Additionally, females housed with pregnant females were either acyclic or did not carry their pregnancies to term, indicating that reproductive suppression may occur in females. In conclusion, urine may be a cost-effective and efficient means to manipulate estrous cycling in managed red river hogs. Furthermore, careful consideration of the number of females in a managed herd is recommended to avoid reproductive suppression.

On the true nature of the sphenoidal "pits" in the common warthog, *Phacochoerus africanus* (Artiodactyla, Suidae), and a description of the cranial sinuses

Mader, B. J. and R. B. Hammer 2020
Journal of Mammalogy, Volume 101, Issue 3: 887–899

The peculiar sphenoidal "pits" of the common warthog (*Phacochoerus africanus*) long have been recognized as a feature that distinguishes that species from the closely related desert warthog (*P. aethiopicus*). Authors seem to regard these structures as blind pockets that do not extend beyond

the basicranium. However, these structures actually are openings that lead into a complex system of sinuses (the sphenoidal sinuses) located in the sphenoid and squamosal, and occasionally extending into the occipital and parietal bones. The openings appear to serve as a drain into the nasopharynx. The sphenoidal "pits" of *P. africanus* as currently defined by most authors are, therefore, not homologous with the sphenoidal pits of P*. aethiopicus*. We suggest that the term "sphenoidal apertures" be applied to these openings. The true homologue of the sphenoidal pits of *P. aethiopicus* is the bone that surrounds the sphenoidal apertures in *P. africanus*. This would include the thin bony sheet that forms the floor of the opening and that bears a shallow fossa. We recommend the term "sphenoidal shelf" be employed to describe this part of the true sphenoidal pit of *P. africanus*. In addition to the sphenoidal sinuses, the maxillary and frontal sinuses of *P. africanus* also are described. We report the possibility of mammalian cranial sinuses arising from nasopharyngeal diverticula rather than from diverticula originating from the nasal cavity proper. Previously, such nasopharyngeal pneumatization only has been known to occur in Reptilia. Possible sinus functions are discussed including shock absorption, lightening of the skull, improvement of olfaction, and enhancement of the immune system. In addition to *P.africanus*, sphenoidal apertures also occur in *Babyrousa*, and in an extinct perissodactyl, a brontothere (= titanothere).

EVALUATION OF A PARTIALLY REVERSIBLE IMMOBILIZATION PROTOCOL USING MEDETOMIDINE, BUTORPHANOL, ZOLAZEPAM–TILETAMINE, AND KETAMINE IN FREE-RANGING WARTHOGS (PHACOCHOERUS AFRICANUS) IN KRUGER NATIONAL PARK, SOUTH AFRICA

Hewlett, J., Buss,P., Olea-Popelka, F., Koeppel, K., Neiffer, D., Hausler, G., Rossouw, L., Manamela, T., Stout, E. and M. Miller 2020

Journal of Zoo and Wildlife Medicine 51(1), 80-87

Twenty-one free-ranging warthogs (*Phacochoerus africanus*) in the Kruger National Park, South Africa, were immobilized with a combination of medetomidine (0.07 ± 0.01 mg/kg), butorphanol (0.26 ± 0.04 mg/kg), tiletamine–zolazepam (0.69 ± 0.15 mg/kg), and ketamine (1.43 ± 0.21 mg/kg) administered intramuscularly by dart. Induction, immobilization, and recovery characteristics were evaluated using a standardized scoring system. In the immobilized warthogs, physiological variables were measured every 5 min and arterial blood gases were analyzed at 15-min intervals. At 45 min after initial drug administration, atipamezole (0.34 ± 0.050 mg/kg) and naltrexone (0.53 ± 0.079 mg/kg) were administered intravenously. Overall, induction quality after darting was scored as excellent and the mean time to safe handling was 5.9 ± 2.0 min. Based on muscle relaxation, and loss of palpebral and pedal reflexes, most subjects (17 out of 21) reached a plane of surgical anesthesia by 10 and 15 min; 20 out of 21 warthogs were in this plane for the duration of the monitoring period. In the immobilized warthogs the overall mean heart rate was 65 ± 15.3 beats per minute, mean respiratory rate was 14.7 ± 5.6 breaths per minute, and the mean rectal temperature was 37.9 ± 1.4°C during the 40 min. Arterial blood gas results showed hypoxemia (mean PaO2 62.1 ± 16.2 mmHg), hypercapnia (mean PaCO2 47.1 ± 5.1 mmHg), and acidemia (mean pH = 7.36 ± 0.4). Values for PaO2 and pH improved over the immobilization period. After antagonist 0.5). administration, overall recovery quality from immobilization was scored as good, with animals standing at a mean time of 7.3 ± 4.9 min. The drug combination proved to be effective in the immobilization of free-ranging warthogs with rapid induction, good anesthesia, and limited cardiorespiratory changes. This anesthetic protocol produces effective, safe, and partially reversible immobilization in warthogs.

Genome Sequences of Three African Swine Fever Viruses of Genotypes IV and XX from Zaire and South Africa, Isolated from a Domestic Pig (*Sus scrofa domesticus*), a Warthog (*Phacochoerus africanus*), and a European Wild Boar (*Sus scrofa*)

S. Ndlovu, S., Williamson, A.-L., Heath, L. and O. Carulei 2020

Scientific Reports 10(1), 1-11

We report here the genome sequences of three African swine fever virus isolates obtained from a domestic pig (Zaire [Zaire]), a warthog (RSA/W1/1999 [South Africa]), and a European wild boar (RSA/2/2004 [South Africa]) belonging to genotypes IV, XX, and XX, respectively. This report increases the number of genotype XX, wild boar, and warthog reference sequences available.

Substitution of warthog NF-κB motifs into RELA of domestic pigs is not sufficient to confer resilience to African swine fever virus

McCleary, S., Strong,R., McCarthy, R.R., Edwards, J.C., Howes, E.L., Stevens, L.M., Sánchez-Cordón, P. J., Núñez, A., Watson, S., Mileham, A. J., Lillico, S.G., Tait-Burkard, C., Proudfoot, C., Ballantyne, M., Bruce, C., Whitelaw, A., Steinbach, F., and H. R. Crooke 2020

Scientific Reports 10(1), 1-11.

African swine fever virus (ASFV) causes a lethal, haemorrhagic disease in domestic swine that threatens pig production across the globe. Unlike domestic pigs, warthogs, which are wildlife hosts of the virus, do not succumb to the lethal effects of infection. There are three amino acid differences between the sequence of the warthog and domestic pig RELA protein; a subunit of the NF-κB transcription factor that plays a key role in regulating the immune response to infections. Domestic pigs with all 3 or 2 of the amino acids from the warthog RELA orthologue have been generated by gene editing. To assess if these variations confer resilience to ASF we established an intranasal challenge model with a moderately virulent ASFV. No difference in clinical, virological or pathological parameters were observed in domestic pigs with the 2 amino acid substitution. Domestic pigs with all 3 amino acids found in warthog RELA were not resilient to ASF but a delay in onset of clinical signs and less viral DNA in blood samples and nasal secretions was observed in some animals. Inclusion of these and additional warthog genetic traits into domestic pigs may be one way to assist in combating the devastating impact of ASFV.

Distribution of intestinal parasites of baboons (*Papio anubis*) and warthogs (*Phacochoerus aethiopicus*) at the Mole National Park, Ghana

Larbi, J. A., Akyeampong, S., Addo, S. O., Dakwa, K. B., Boampong, K., and B. Opoku Nketiah 2020

Veterinary Medicine and Science, https://doi.org/10.1002/vms3.335

The identification of intestinal parasite of baboons (*Papio anubis*) and warthogs (*Phacochoerus aethiopicus*) was undertaken at the Mole National Park, Ghana. The main objective of the study was to determine the types and prevalence of intestinal parasites in baboons and warthogs in the Mole National Park. A total of nineteen (19) and twenty three (23) samples were collected from the baboons and warthogs, respectively, and examined using the direct saline smear and formol ether concentration technique for the identification of cysts, eggs and larvae of parasites. The survey showed that 94.74% of the baboon samples examined was infected with at least one parasite, whereas that of the warthogs showed 95.65% prevalence. A total of seven (7) and eight (8) different parasites were identified in baboon and warthog faecal samples, respectively. *Strongyloides* sp. had the highest prevalence in baboons (84.21%) and warthogs (78.26%). The

second prevalent parasite identified was *Ascaris* sp. in the baboons (31.58%) and warthogs (30.43%). The results showed a high level of multiparasitism in these wild animals and an increased risk of zoonotic transmission which may result from interaction with inhabitants of the park community.

Serological survey of bovine viral diarrhea (BVDV-1), brucellosis, and leptospirosis in captive white-lipped peccaries (*Tayassu pecari*) from the Midwest region in Brazil
Gatto, I.H.R., Di Santo, L.G., Storino, G.Y., Sanfilippo, L.F., Ribeiro, M. G., Mathias, L.A., Carciofi, A.C.and L. G. De Oliveira 2020
Austral Journal of Veterinary Sciences Vol. 52 no. 1
The present study was conducted to assess the occurrence of anti-Brucella sp., anti-BVDV-1, and anti-Leptospira spp. antibodies from captive white-lipped peccary (*Tayassu pecari*). A cross-sectional survey was performed testing 100 serum samples collected in a commercial breeding herd. All samples were submitted to the acidified antigen test (AAT), virus neutralization test (VNT) and microscopic agglutination test (MAT) with live antigens. None of the samples tested agglutinated in the AAT screening test. In the VNT, 28 samples presented a cytotoxic effect and were excluded from the evaluation. For BVDV-1, only one sample (1/72; 1.38%) was positive, with antibody titers of 40. For leptospirosis, 9% (9/100) of the samples reacted to at least one of the 24 serovars tested, with 8% (8/100) positive for serovar Patoc and 1% (1/100) for serovar Grippotyphosa. The maximum titer observed was 100. The identification of antibodies against the serovars Patoc and Grippotyphosa suggests that the sampled individuals have been exposed to the pathogen at some point during their lifetime. Regarding BVDV-1, this may be the first serological survey to describe seropositive samples in tayassuids.

STANDARD ELECTROCARDIOGRAPHIC DATA OF PECCARIES (*TAYASSU TAJACU*)
de Souza, A. B., de Sá Rodrigues, R. P., Pessoa, G. T., da Silva, A. B. S., da Silva Moura, L., Souza, F. D. C. A., ... and F. D. C. A. Alves 2020
Acta Scientiae Veterinariae, 48(1).
Background: Peccaries (*Tayassu tajacu*, Linnaeus, 1758) are wild suiformes that belong to the Tayassuidae family. Electrocardiography is an important technique for cardiovascular evaluation. Analysis of various intervals, segments, complexes and waveforms of electrocardiographic (ECG) traces aids in the diagnosis of cardiac alterations and in the differentiation of congenital and acquired heart diseases from physiological cases. However, in wild animal medicine, the various patterns of normality and the evaluation of electrical traces associated with heart disease have not yet been sufficiently elucidated. The purpose of this study was to characterize the electrocardiographic (ECG) traces of peccaries sedated using ketamine and xylazine. Materials, Methods & Results: Fourteen healthy adult animals that were subjected to digital ECG examination were used. Animals with evidence of systemic diseases, cardiovascular abnormalities (murmurs or arrhythmias), or any degree of valve insufficiency observed on echocardiogram and animals that exhibited excessive stress during the examination were excluded from the study. All animals presented with a normal sinus rhythm. A combination of 15 mg/kg of ketamine hydrochloride and 3 mg/kg of midazolam maleate was applied intramuscularly for chemical immobilization. The animals were manipulated after 15 min, when the onset of the anaesthetic effect was verified, for a duration of 45 min, and no reinforcement dose was necessary to complete the electrocardiographic examination. No significant differences were

observed in the P-wave duration, PR interval and QT interval between genders (P > 0.05). No significant differences were found between the amplitudes of the P and R waves between males and females (P > 0.05). The observed P waves were small, monophasic and positive. The QRS complex was positive in the DI, DII, DIII, aVF, V4 and V10 derivations and negative in the aVR, aVL, V1 and V2 derivations. In 71% of the animals, the T wave showed negative polarity in the DI, DII, DIII, aVL, aVF, and V10 derivations and positive polarity in the aVR, V1, V2 and V4 derivations. The ST segment was isoelectric in 100% of the animals. GraphPad Prism 7 (La Jolla, CA, USA) software was used to analyze the data, with non-parametric tests used to test for differences in the variables between the sexes. In these tests, a P-value of 0.05 was considered to indicate statistical significance. Discussion: Although studies on the cardiac electrophysiology of wild animals have previously shown good results for several species, this is the first study concerning the standardization ECG traces for peccaries. However, due to the wild nature of these animals, their manipulation for handling and data collection purposes is only feasible under chemical containment, although other studies have used non-anaesthetized agoutis. It is not known to what extent these results may have been influenced by the effects of stress. Drugs used for this function may have direct effects on cardiac function. Therefore, the presumed normal ECG values, as well as the recognition of changes due to drug or iatrogenic interactions, are of fundamental importance. This protocol provided high-quality anaesthetized peccary ECG traces, allowing reliable measurements of waves and intervals and assessment of the cardiac rhythm and heart rate. The surface registry digital ECG recording technique used with chemical containment allowed good monitoring and rapid acquisition and was well tolerated by the animals.

Composition of semen and foreskin mucosa aerobic microbiota and its impact on sperm parameters of captive collared peccaries (*Pecari tajacu*)

Santos, C. S., Silva, A. M., Maia, K. M.. Rodrigues, G. S. O. Feijó, F. M. C., Alves, N. D. Oliveira, M. F. and A.R. Silva 2020

Journal of Applied Microbiology Volume 129, Issue 3, Pages 521-531

Aim To evaluate the bacterial composition of collared peccary semen and foreskin mucosa, and to verify the sensitivity of isolates to antimicrobials used in semen conservation and to Aloe vera gel, which is an alternative external cryoprotectant. Methods and Results Nine foreskin mucosa and ejaculate samples from adult animals were used. Sperm characteristics and bacterial load were evaluated in fresh semen. The preputial mucosa and semen bacterial isolates were identified and tested against five concentrations of each antimicrobial (streptomycin–penicillin and gentamicin) and A. vera gel. *Corynebacterium* sp. and *Staphylococcus* sp. were isolated in greater numbers than others in both semen (64·10 and 20·51%, respectively) and the foreskin mucosa (60·60 and 24·25%, respectively), and ranged from 0·4 to 21 × 105 colony-forming units (CFU) per ml. The average load of *Corynebacterium* sp. was negatively correlated (P < 0·05) with the sperm membrane integrity (r = −0·73055) and curvilinear velocity (r = −0·69048). Streptomycin–penicillin and gentamicin inhibited most micro-organisms, and A. vera showed lower antimicrobial activity. Conclusion Several Gram-positive bacteria are present in semen and foreskin mucosa of collared peccary, and the benefits of using primarily penicillin–streptomycin and gentamicin antimicrobials in the bacterial control of diluted semen of these animals are strongly indicated. Significance and Impact of the Study This study provides insight into the reproductive microbiota of captive male-collared peccary. This work provides a theoretical basis to assist reproductive biotechnologies for ex situ conservation of the species.

Production of collared peccary (*Pecari tajacu* Linnaeus, 1758) parthenogenic embryos following different oocyte chemical activation and in vitro maturation conditions

Borges, A. A., De Oliveira Santos, M., V., Nascimento, L. E., De Oliveira Lira, G. P., Praxedes, E. A., De Oliveira, M. F., Silva, A. R. and A. F. Pereira 2020

Theriogenology Volume 142, 320-327

To optimize the protocols for assisted reproductive techniques (ARTs) in collared peccary (*Pecari tajacu* Linnaeus, 1758), we evaluated various conditions for oocyte in vitro maturation (IVM) and chemical activation. Initially, we assessed the IVM rates, cumulus-oocyte complex (COC) quality, and oocyte morphometry in the absence or presence of epidermal growth factor (EGF). There was no difference between the COCs matured in absence or presence of EGF for the expansion of cumulus cells (97.6% ± 1.2 vs. 100% ± 0.0), presence of first polar body (65.9% ± 1.2 vs. 70.5% ± 1.8), nuclear status in second metaphase (62.5% ± 11.6 vs. 68.4% ± 4.9), cytoplasmic maturation (100.0% ± 0.7 vs. 75.0% ± 0.7), reactive oxygen species levels (0.5 ± 0.2 vs. 0.3 ± 0.1), and mitochondrial membrane potential (1.1 ± 0.2 vs. 1.1 ± 0.1). However, the zona pellucida thickness of matured COCs was reduced in the presence of EGF. Thus, the EGF group was used for further experiments. The oocytes were artificially activated with ionomycin and four secondary activator combinations [6-dimethylaminopurine (6D), 6D and cytochalasin B (6D + CB), cycloheximide (CHX), and CHX and CB (CHX + CB)]. The effect of immature COCs based on cumulus cell layers and cytoplasm homogeneity (GI and GII or GIII COCs) on embryonic development and quality was evaluated. There was no difference in the cleavage rates among the groups of secondary activators. The cleavage rates of embryos derived from GI/GII and GIII COCs were greater than 72.2% and 25.0%, respectively. Moreover, treatment with CHX showed a reduction in the cleavage rate of embryos derived from GIII COCs when compared to the cleavage rate of embryos derived from GI/GII COCs ($P < 0.05$). Nevertheless, higher rates of blastocyst/total GI and GII COCs were observed in the 6D group (27.6% ± 0.3) compared to CHX group (6.9% ± 0.3). Additionally, only 6D treatment resulted in the production of embryos derived from GIII COCs (25.0% ± 0.2). The percentage of the ICM/total cell ratio was also greater in blastocysts derived from 6D (42.5% ± 19.0), 6D + CB (37.9% ± 21.9), and CHX + CB (43.8% ± 19.6) groups when compared to CHX (3.6% ± 0.1) group. Thus, the combination of ionomycin and 6D could produce collared peccary embryos by activation of both GI/GII COCs and GIII COCs. These optimized IVM conditions using EGF and chemical activation using ionomycin and 6D in collared peccaries form the first steps for establishing ARTs to conserve this species.

Structural and ultrastructural characteristics of the tongue of the Collared Peccary (*Pecari tajacu*, Linnaeus, 1758)

Barbosa, G. K., Dos Santos Jacob, C., Neto, J. P., De Oliveira, M. F., Rici, R. E. G., Watanabe, I.-S. and A. P. Ciena 2020

Anatomía, Histología, Embryologia Volume 49, Issue 4, Pages 532-540

The tongue is an important organ in species due to its feeding functions, and its structure is influenced by the habitat and diet. The Collared Peccary (*Pecari tajacu*, Linnaeus, 1758) is a terrestrial mammal that is distributed on the American continents and has an omnivorous diet. This study aimed to describe the morphological characteristics of the tongue, lingual papillae and the connective tissue cores (CTCs) of the Collared Peccary. Eight tongues were collected from the Wild Animals Multiplication Center. The samples (n=6) were processed for three-dimensional analysis of their dorsal epithelium, and their CTCs by scanning electron microscopy and the other

samples (n=2) were used to observe ultrastructural characteristics by transmission electron microscopy. Filiform papillae were observed in the lingual apex and body with their conical CTC demonstrating ripples in their extent. Two types of fungiform papillae were observed, the first in the apex and body with a dome shaped CTC and the second forming a dorsolateral line with a radial pattern CTC. The vallate papillae were bilateral in the caudal region with the CTCs, characterised by numerous projections, and foliate papilla were not observed. We found a new type of papilla anteriorly to the vallate papilla with an irregular groove and a CTC formed by triangular shaped projections with a duct opening at the top. We concluded that the lingual papillae of the Collared Peccary resemble those papillae of other mammals, however, were revealed another form of their CTCs and a new lingual papillae morphological description.

BMP-15 activity on in vitro development of collared peccary (*Pecari tajacu* Linnaeus, 1758) preantral follicles

Gomes, H. A. N., Campos, L. B., Praxedes, E. C. G., Oliveira, M. F., Pereira, A. F., Silva, A. R. and M. V. A. Saraiva

Reproduction in Domestic Animals Volume 5, Issue 8, Pages 958-964

This study investigated the effects of BMP-15 on the in vitro development of preantral follicles of collared peccaries. Ovarian fragments were cultured for 1 or 6 days in Tissue Culture Medium 199 (TCM199+) supplemented with BMP-15 at rates of 0, 1, 25 or 50 ng/ml. The fragments were analysed histologically by evaluating follicular morphology, activation and growth as well as the potential for proliferation of granulosa cells. Our results show the addition of 25 ng/ml BMP 15 in the medium provided the greatest percentage of normal follicles (79.67% ± 0.69) when compared to other treatments ($p < .05$); however, this result is similar to 1 ng/ml BMP-15 (74.00% ± 1.90, $p > .05$). Moreover, 25 and 50 ng/ml of BMP-15 promoted follicular activation. BMP-15 supplements did not affect oocyte and follicular growth. All concentrations of BMP-15 increased the number of nucleolus organizer regions (NORs) after 1 day of culture when compared to fresh fragments or the control samples ($p < .05$). However, at the end of the experiment, the number of NORs in follicles cultured in all treatments was higher than that observed in the fresh control (sample taken prior to culturing) ($p > .05$). In summary, the addition of 25 ng/ml BMP 15 to the culture medium of collared peccary preantral follicles maintained a high number of morphologically healthy follicles and stimulated the activation of primordial follicles after 6 days in culture.

Cardiorespiratory and sedation evaluation of the combination of dexmedetomidine-butorphanol-midazolam or detomidine butorphanol-midazolam in collared peccaries (*Pecari tajacu*)

Silva, R. A, Pimenta, E. M. L., Rassy, F. B., Mattoso, C. R. S., Lima, M. P. A., D'Elia, M. L. and S. L. Beier 2020

Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 2020, vol. 72, no 2, p. 452-460.

The study compared the cardiorespiratory, hemogasometric and sedative effects of the combination of midazolam (0.41 mg/kg) and butorphanol (0.31 mg/kg) plus detomidine (157 µg/kg) (DTMB) or dexmedetomidine (36 µg/kg) (DXMB) in collared peccaries. Collared peccaries (n=20) were divided into two groups, either DTMB or DXMB. The variables (FC, f, PAM, SpO2, EtCO2 and TR) were evaluated after application of the drugs. Sedation was assessed by visual analogue scale, muscle relaxation, posture and auditory response. ANOVA followed by paired t-test (parametric) and Mann Whitney Rank Sum Test (non-parametric) with $P < 0.05$ were

performed. No statistical difference was observed for the latency period. A significant increase was observed between groups for the variables f, PAM and SpO2 with higher values for DTMB and EtCO2 with higher values for DXMB. The two groups presented a reduction in HR and lactate concentration, and an increase in bicarbonate concentration. SpO2 remained below 90% throughout the experiment in both groups. The animals of the two groups presented deep sedation and maximum muscle relaxation. It is concluded that the two protocols tested provided adequate sedation and could be indicated for chemical containment of collared peccaries.

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Looking the River Horse in the Mouth: New Insights on Incisors, Canine Curvatures and Mulling the Molars

Naples, V. and M. Haji-Sheikh 2020

The FASEB Journal, https://doi.org/10.1096/fasebj.2020.34.s1.05413

Tooth numbers, types, eruption patterns, occlusion, and timing of tooth replacement in the living hippopotamus species, *Hippopotamus amphibius* (common or Nile hippo) and *Choeropsis liberiensis* (pygmy hippo), were examined. We discovered inaccuracies in the published dental formula of *H. amphibius*, and present the corrected dental formula in this study. By examining crania and mandibles ranging in chronological age from late fetal or neonatal to aged adult hippos, we also identified the relative timing of tooth eruption and growth rates for both deciduous and permanent dentitions. Living hippos have ever-growing incisors and canines that shape the anterior rostrum for foraging and intraspecific competition. Despite their highly differential use of the canines, with *H. amphibius* using these teeth for intraspecific aggression and display while pygmy hippos use them in foraging, the canine teeth of both living taxa are greatly enlarged in comparison to other components of the dentitions. In fact, *Hippopotamus amphibius* has some of the largest canine teeth among mammals. In addition to thegosis, or wear caused by tooth-tooth contact, foraging behavior and tongue wear cause incisor attrition, albeit deriving from different

species-specific tooth usage. As individuals of *H. amphibius* grow, the erupting canines show lateral displacement, which correlates with anterior rostral elongation. This dramatic change in both length and width of the face in *H. amphibius* allows the roots of the enlarging canine teeth to occupy increased space in the maxilla and mandible. Despite facial elongation, enlargement of the recurved roots of the ever-growing canines drastically reduces space for the alveolus of the first and sometimes the second premolar. In some cases this results in the elimination of one or more premolars from the adult dentition. These losses may not be symmetrical in either maxilla or mandible. In other cases, all deciduous premolars may be retained into adulthood, resulting in the published conclusion that the number of premolars in *H. amphibius* is variable, a phenomenon that is rare among mammals. In contrast, in *C. liberiensis* the canines enlarge to a relatively lesser degree and do not displace the deciduous premolars; therefore pygmy hippos retain the full premolar complement, explaining the dichotomy in dental formulae between the two species. This study also expands a previous rubric for chronological age determination in *H. amphibius*, mandibles were divided into twenty stages to include characterization of the dentitions of the correlated skulls (N = 34). The crania examined represented thirteen of twenty *H. amphibius* age classes. These specimens are housed in the osteological collections of the Smithsonian Institution (USNM) and the Field Museum of Natural History (FMNH). This chronological aging method was also adapted to provide a relative age of skulls and mandibles (N = 15) representing ten of the twenty age classes of *C. liberiensis* from the same collections. Observations reveal that an increased time interval between successive molar eruptions in *H. amphibius* may reflect adaptation to a lifespan of up to sixty years, a phenomenon not seen in *C. liberiensis*.

Taxonomic, Biogeographic and Evolutionary Studies

Spatial Genetic Structure and Historical Demography of East Asian Wild Boar
Hu, C., T. Pan, Y. Wu, C. Zhang, W. Chen, and Q. Chang 2020
Animal Genetics 51, no. 4: 557-567
Pleistocene climatic fluctuations may have had a profound impact on the evolutionary history of many species. The geographical pattern of European wild boar (*Sus scrofa*) is clearly studied, and it was greatly influenced by ancient climatic events, especially the Last Glacial Maximum. Previous research on genetic variation has mainly focused on the origin and distribution histories of domestic pigs. However, some questions have not been answered, including those concerning the genetic diversity, geographical pattern and possible historic influence of climate on East Asian wild boar (EAWB). Employing the control region of mtDNA (511 bp), we investigated the contributions of historic climate, which possibly shaped the genetic pattern of wild boar. Given that the level of genetic diversity of wild boars is higher in East Asia than in Europe, 172 haplotypes were detected from 680 individuals. Phylogenetic analysis demonstrated the complex phylogeographic structure of EAWB. Mismatch analysis, neutrality tests and the Bayesian Skyline Plot results all retrieved signals of a rapid population expansion, which might have played an important role in driving the formation of complex spatial genetic structure. Genetic data and species distribution modelling showed that the Last Glacial Maximum had weak effect on the distribution of the EAWB. We suggest that, in shaping spatial genetic structure in East Asian, long term gene flow and population history played more important roles than Pleistocene climate fluctuations.

Intra-tooth stable isotope profiles in warthog canines and third molars: Implications for paleoenvironmental reconstructions

Yang, D., Uno, K.T., Souron, A., McGrath, K., Pubert, E. and T. E. Cerling 2020
Chemical Geology p. 119799.

Intra-tooth stable isotope variations have been used to interpret seasonality and aridity in paleoenvironmental reconstructions of paleontological and archeological sites. However, most intra-tooth datasets only permit qualitative interpretations of seasonality, because the measured signal is attenuated due to the duration of enamel mineralization process and sampling geometry. The common warthog (*Phacochoerus africanus*) is an ideal organism to investigate stable isotope variation in enamel. Their canines grow continuously through the life of the individual and are therefore excellent candidates for mathematical modeling of seasonal signals and of signal attenuation; further, their isotope profiles (a series of isotope measurements) can be compared to isotope profiles of third molars (M3) to provide insights into environmental reconstructions. We first obtained paired intra-tooth enamel samples from ever-growing canines and hypsodont M3s of two extant common warthog specimens from Laikipia, Kenya. Second, from a different set of specimens, we collected data on enamel growth patterns and geometry using histological thin sections and transmitted light microscopy, and enamel mineralization parameters using micro-CT scans in each tooth type. Third, we reconstructed the timeline of unattenuated seasonal δ18O signal from canine enamel using growth rate estimates and the inverse model of Passey et al. (2005). Our results demonstrate that canines, which capture ~1.5 years of time, exhibit near-constant growth rates and simple enamel maturation geometry, whereas M3s, which also represent ~1.5 years of time, exhibit linearly decreasing growth rates and more complex maturation patterns. We compare the timelines of unattenuated seasonal δ18O signal and measured M3 profiles and find an average signal reduction of ~50% in the M3s, providing interpretations of the duration of seasonal cycles that are consistent 75% of the time. We conclude that warthog canines are well suited for the inverse model approach, and we established the model parameters for the forward and inverse methods. Timeline reconstructions based on M3 histology are promising for investigating the pattern of rainfall seasonality in the past. Finally, we found an unexpected carbon isotopic spacing of ~2‰ between canine and M3 enamel, which suggests caution in interpreting δ13C results from suid canine or molar enamel alone.

Primer registro de pecaríes fósiles (Artiodactyla, Tayassuidae) para el Mioceno Superior (Hh3: Hemphilliano tardío) de Costa Rica, América Central

Valerio, A. L. and C. L. Laurito 2020
Revista Geológica de América Central Núm. 62

Por primera vez se tiene el registro fósil de la familia Tayassuidae en el Cenozoico de Costa Rica. Dos especies de pecaríes *Prosthennops serus* (Cope, 1878) y *Protherohyus brachydontus* Mooser y Dalquest (1980) son descritos para la localidad fosilífera de San Gerardo de Limoncito en el sur de Costa Rica. La distribución simpátrica de ambas especies es confirmada por primera vez para el Hemisferio Norte.

***Muknalia minima* from the Yucatán of Mexico is synonymous with the collared peccary, *Pecari tajacu* (Artiodactyla: Tayassuidae)**

Schubert, B. W. Samuels, J. X., Chatters, J. C. and J Arroyo-Cabrales

Open Quaternary, 2020, vol. 6, no 1.
Ongoing investigation of peccary remains from fossiliferous deposits in the Yucatán resulted in re-examination of previously identified tayassuid fossils from the region. This included the recently described new genus and species of peccary, *Muknalia minima*, which is based on a dentary from Muknal Cave near Tulum, Quintana Roo, Mexico. Diagnostic characters of this taxon include a concave notch along the caudal edge of the ascending ramus and a ventrally directed angular process. Our assessment of the holotype indicates that these characteristics are not a reflection of the original morphology, but are instead the result of breakage and polishing of the posterior aspect of the dentary. Measurements and intact morphological features indicate the Muknal Cave specimen belongs to the extant collared peccary, *Pecari tajacu*.

Disruption of thermogenic UCP1 predated the divergence of pigs and peccaries
Fyda, T. J., Spencer, C., Jastroch, M., and M. J. Gaudry
Journal of Experimental Biology 223(15).
Uncoupling protein 1 (UCP1) governs non-shivering thermogenesis in brown adipose tissue. It has been estimated that pigs lost UCP1 20 million years ago (MYA), dictating cold intolerance among piglets. Our current understanding of the root causes of UCP1 loss are, however, incomplete. Thus, examination of additional species can shed light on these fundamental evolutionary questions. Here, we investigated UCP1 in the Chacoan peccary (Catagonus wagneri), a member of the Tayassuid lineage that diverged from pigs during the late Eocene–mid Oligocene. Exons 1 and 2 have been deleted in peccary UCP1 and the remaining exons display additional inactivating mutations. A common nonsense mutation in exon 6 revealed that UCP1 was pseudogenized in a shared ancestor of pigs and peccaries. Our selection pressure analyses indicate that the inactivation occurred 36.2–44.3 MYA during the mid–late Eocene, which is much earlier than previously thought. Importantly, pseudogenized UCP1 provides the molecular rationale for cold sensitivity and current tropical biogeography of extant peccaries.

INVESTIGATING ECOLOGICAL AND PHYLOGENETIC CONSTRAINTS IN HIPPOPOTAMIDAE SKULL SHAPE
PANDOLFI, L., MARTINO, R., ROOK, L. and P. PIRAS 2020
Rivista Italiana Di Paleontologia e Stratigrafia 126(1)
Hippopotamidae are a group of large-sized mammals of interest for testing evolutionary traits in time and space. Variation in skull shape within Hippopotamidae is here investigated by means of shape analysis (Geometric Morphometrics) and modern statistical approaches. Two-dimensional shape analysis is applied to dorsal and lateral views of extant and extinct Hippopotamidae species sufficiently preserved to allow their morphology to be captured by landmark and semi-landmark digitization. The results show that *Hippopotamus gorgops* and *H. antiquus* display similar shapes, while *Hexaprotodon palaeindicus* falls within the morphospace occupied by *H. amphibius*, suggesting similar morphology. The cranial shape of the Sicilian hippopotamus (*H. pentlandi*) still resembles that of *H. amphibius* in lateral view, suggesting that adaptation to the insular domain was yet not fully attained. Madagascan hippopotamuses (*H. madagascariensis* and *H. lemerlei*) are close to the pygmy hippo, *Choeropsis liberiensis*, in PC1 values; nevertheless, the cranial shape of the Madagascan hippos seems not to be closely related to the cranial shape of *C. liberiensis*. Despite the morphological convergences within the group, while cranial shape in Hippopotamidae is phylogenetically structured, this does not hold for size.

Although further investigations are needed to test the influence of ecological and palaeoecological parameters on the general shape to provide additional information for understanding Hippopotamidae evolution and adaptation, the present study provides an insight into the evolutionary framework of Hippopotamidae.

Gross anatomy, histological, and histochemical analysis of the eyelids and orbital glands of the neonate pygmy hippopotamus (Suina: *Choeropsis liberiensis* or *Hexaprotodon liberiensis*, Morton 1849) with reference to its habitat

Klećkowska-Nawrot, J. E, Goździewska-Harłajczuk, K. and W. Paszta 2020

The Anatomical Record, https://doi.org/10.1002/ar.24459

The pygmy hippopotamus is phylogenetically related to members of both the Suidae and Cetacea. However, differences in their habitats may have resulted in variation in the anatomy and physiology of the ocular adnexa between these species. Therefore, this study focuses on the identification of accessory organs of the eye, which are typical for the pygmy hippopotamus and are comparable to organs present in mammals related to it. Moreover, the secretions produced by the superficial gland of the third eyelid, the deep gland of the third eyelid and the lacrimal gland were examined, as they ensure eyeball protection. In the upper and lower eyelids, numerous serous glands where identified, which were typical for the pygmy hippopotamus and similar as in the Cetacea. This study enabled to identify additional folds in the eyelids of the pygmy hippopotamus. Lymphoid follicles and diffuse lymphocytes were not found in the lymphoid region in the upper or lower eyelids and the third eyelid, which was most likely caused by the age of the studied hippopotamuses. An accurate histochemical analysis revealed that the secretions of the pygmy hippopotamus are very similar to the Sus scrofa. The structural differences between the pygmy hippopotamus and representatives of Cetacea are most likely caused by the fact that most of Cetacea live in saltwater and are exposed to more frequent fluctuations in water temperature compared to the pygmy hippopotamus, which lives in fresh water and does not lead a migratory lifestyle like the Cetacea.

Ecological, Behavioural and Conservation Studies

Accounting for Detection Unveils the Intricacy of Wild Boar and Rabbit Co-Occurrence Patterns in a Mediterranean Landscape

Barros, A. L., G. Curveira-Santos, T. A. Marques, and M. Santos-Reis 2020

Scientific Reports 10, no. 1

The patterns of species co-occurrence have long served as a primary approach to explore concepts of interspecific interaction. However, the interpretation of such patterns is difficult as they can result from several complex ecological processes, in a scale-dependent manner. Here, we aim to investigate the co-occurrence pattern between European rabbit and wild boar in an estate in Central Portugal, using two-species occupancy modelling. With this framework, we tested species interaction for occupancy and detection, but also the interdependencies between both parameters. According to our results, the wild boar and European rabbit occurred independently in the study area. However, model averaging of the detection parameters revealed a potential positive effect of wild boar's presence on rabbit's detection probability. Upon further analysis of the parameter interdependencies, our results suggested that failing to account for a positive effect on rabbit's detection could lead to potentially biased interpretations of the co-occurrence pattern. Our study, in spite of preliminary, highlights the need to understand these different pathways of species interaction to avoid erroneous inferences.

Vegetation Recovery after 11 Years of Wild Boar Exclusion in the Monte Desert, Argentina
Cuevas, M. F., C. M. Campos, R. A. Ojeda, and F. M. Jaksic 2020
Biological Invasions 22, no. 5: 1607-1621
The wild boar (*Sus scrofa*) is considered an ecosystem engineer. It roots up the ground looking for forage, generating patches of different sizes and without vegetation. Studies of wild boar's impact on vegetation can be addressed in two contrasting ways: short-term effects (immediately after boar's disturbance) and long-term effects. Short-term studies in the Monte Desert of Argentina showed that wild boar rooting modifies soil properties, reduces plant cover, and decreases plant richness and diversity. The objective of this study was to analyse the vegetation response in a desert ecosystem after 11 yr of wild boar disturbance establishing a replicated experiment of medium and large-sized animal's exclusion. In this long-span study, time was the most important variable to predict the cover of different plant life forms and richness in disturbed soils. Herb cover was higher in disturbed soils, with grasses and woody species showing the opposite. Over the long-term, wild boar positively affect alpha diversity and richness, while the species turnover (rate of species replacement) was only influenced by the replacement of herbs. Disturbed soils were mainly dominated by annual species with a relatively high (60%) extent of species turnover. These vegetation changes throughout time are influenced by the occurrence of unexpectedly high rainy episodes, and probably by the system's own fragility of Monte Desert.

Who's Afraid of the Big Bad Boar? Assessing the Effect of Wild Boar Presence on the Occurrence and Activity Patterns of Other Mammals
de Oliveira, E. S., M. L. F. Rodrigues, M. M. Severo, T. G. dos Santos, and C. B. Kasper 2020
Plos One 15, no. 7
Wild boar are considered one the world's worst invasive species and linked to biodiversity loss, competition for resources, predation of native species, and habitat modifications. In this study, we use camera traps to evaluate whether the invasive wild boar had an effect on the medium-sized mammal community of a protected area in southern Brazil. Based on photographic records, we evaluated whether the presence and relative abundance of wild boar was associated with a decrease in diversity or change in activity of medium-sized mammals. All comparisons were made between samples where wild boar were present or absent. The records of each camera during a season were considered a sample. The wild boar was the fourth most common species in the study area being present in 7.8% of the photographic records. The species richness of mammals was not negatively affected by the occurrence of wild boar and most common species did not exhibit changes in the daily activity pattern. However, we recorded an increase in the time elapsed between an observation of wild boar and the record of the next species relative to the average latency period observed among other mammalian species. This average latency period was similar to that observed in the case of large predators such as Puma, and its increase could be reflective partly of the avoidance of native species to wild boar. Nevertheless, our results show that the effect of invasive wild boar on the mammal community is not large as expected.

Estimating Wild Boar Density and Rooting Activity in a Mediterranean Protected Area
Fattorini, N. and F. Ferretti 2020
Mammalian Biology 100, no. 3: 241-251
The mitigation of ecological/economic impacts of wild boar *Sus scrofa* is one of the most

challenging issues in wildlife management worldwide. Monitoring population density and impact of wild boar is crucial to plan appropriate management actions to reduce its density, environmental impact and epidemiological risk, as well as to evaluate control effectiveness. In 2018–2019, we used plot-based faeces counts, coupled with specific estimates of daily defecation rates, to estimate wild boar density and rooting activity in natural/semi-natural habitats, in a Mediterranean protected area. Daily defecation rate was 6.7 faeces/individual, much lower than that of ruminants. We obtained estimates of 70.0–70.5 faeces/km2, corresponding to wild boar densities of c. 10.5 individuals/km2 (relative standard error: 18%) in both years. Low daily defecation rates and skewed distribution frequencies of wild boar faeces should be considered to plan surveys with an adequate sampling design and intensity. Faeces abundance and rooting activity peaked in ecotones, i.e. open areas at the interface of wood patches, whereas they did not differ between other habitat types, suggesting a fine-scale concordance between the two indicators. Long-term monitoring is needed to assess relationships between indicators of impact and abundance at a broad scale. Our work shows how to undertake simultaneously wild boar density estimates and impact assessment in natural environments, which is particularly important for protected areas and/or habitats of conservation concern across the globally distributed Mediterranean biome.

Synthesizing Remote Sensing and Biophysical Measures to Evaluate Human-Wildlife Conflicts: The Case of Wild Boar Crop Raiding in Rural China

Giefer, M., and L. An 2020

Remote Sensing 12, no. 4

Crop raiding by wild boars is a growing problem worldwide with potentially damaging consequences for rural dwellers' cooperation with conservation policies. Still, limited resources inhibit continuous monitoring, and there is uncertainty about the relationship between the biophysical realities of crop raiding and humans' perceptions and responses. By integrating data from camera traps, remote sensors, and household surveys, this study establishes an empirical model of wild boar population density that can be applied to multiple years to estimate changes in distribution over time. It also correlates historical estimates of boar population distribution with human-reported trends to support the model's validity and assess local perceptions of crop raiding. Although the model proved useful in coniferous and bamboo forests, it is less useful in mixed broadleaf, evergreen broadleaf, and deciduous forests. Results also show alignment between perceptions of crop raiding and actual boar populations, corroborating farmers' perceptions which are increasingly dismissed as a less reliable source of information in human–wildlife conflict research. The modeling techniques demonstrated here may provide conservation practitioners with a cost-effective way to maintain up-to-date estimates of the spatial distribution of wild boar and resultant crop raiding.

Wild Boar Grubbing Causes Organic Carbon Loss from Both Top- and Sub-Soil in an Oak Forest in Central China

Liu, Y. C., X. J. Liu, Z. L. Yang, G. Y. Li, and S. R. Liu 2020

Forest Ecology and Management 464, https://dx.doi.org/10.1016/j.foreco.2020.118059

Soil disturbances by large animals are known to affect soil carbon (C) storage and thus have the potential to change ecosystem functioning in forests. However, little is known about the effects of wild boar grubbing on soil CO2 emission in forest ecosystems. Here we investigated soil respiration and soil physico-chemical properties of top- (0–10 cm) and sub-soil (10–20 cm) on the

paired grubbed and non-grubbed plots in an oak forest for a 2-year period. Wild boar grubbing substantially increased soil respiration by 69.5% in 2015 and 32.9% in 2016, respectively. Wild boar disturbance considerably elevated soil basal respiration but showed no effect on its temperature sensitivity. In addition, we found that the grubbing-induced increases in soil organic carbon and microbial biomass activity from both top- and sub-soil contributed to the stimulated soil respiration after the disturbance. Our 2-year experiment indicates that soil bioturbation could lead to a strong positive effect on soil CO2 emission in oak forest ecosystems, but the stimulation tends to reduce with recovery time. The finding also highlights the importance of soil depth and time effect while quantifying the effect of wild boar grubbing on soil C storage in forest ecosystems.

Effect of Age and Sex on the Quality of Offal and Meat of the Wild Boar (*Sus scrofa*)
Ludwiczak, A., J. Skladanowska-Baryza, and M. Stanisz 2020
Animals 10, no. 4
The goal of the study was to examine the effect of age and sex on the quality of wild boar offal and meat. A number of 32 hunt-harvested animals was assigned to groups according to age (juveniles and sub-adults) and sex. The quality of offal (liver, kidneys, heart and tongue) and m. semimembranosus was examined. The pH value of m. semimembranosus ranged from 5.45 to 5.88. The highest pH was recorded in the kidney and the liver (6.32–6.54 and 6.12–6.31). The meat in the group of juveniles was brighter ($p = 0.042$), yellower ($p = 0.039$), showed a greater drip loss ($p = 0.007$), cooking loss ($p = 0.039$), and plasticity ($p = 0.028$), compared to the sub-adults. The extractable fat content in the m. semimembranosus and offal ($p = 0.004$), and water to crude protein ratio ($p = 0.033$), also differed between age groups. The results of the study show different quality attributes of offal and meat of wild boars from two age groups. The obtained quality measures suggest that the culinary and technological usefulness of offal and meat from the wild boars may differ according to the age of hunted animals.

Impact of Wild Boar Rooting on Small Forest-Dwelling Rodents
Mori, E., F. Ferretti, A. Lagrotteria, L. La Greca, E. Solano, and N. Fattorini 2020
Ecological Research 35, no. 4: 675-681
Assessing impacts of wild boar on ecosystems is a research priority worldwide, with applied implications for environmental management. We evaluated whether rooting intensity by wild boar affected a rodent community in Central Italy. Rooting intensity was measured within trap transects and all around them, following standard procedures. We live trapped rodents in coppiced forests with a gradient of rooting intensity (including a fenced, boar proof, area) and evaluated relationships between abundance and rooting for two arboreal and five ground dwelling species. Among those, the most abundant ones were the bank vole *Myodes glareolus* and the yellow necked wood mouse *Apodemus flavicollis*. Rooting within and outside transects correlated to each other, as well as with the local passage rate of the wild boar, assessed through camera trapping. We found a negative relationship between rooting intensity and abundance of bank voles, that is, the main food resources of some predators of conservation concern. Rooting activity may trigger effects on ground dwelling rodents at the population level.

Ecological Drivers of African Swine Fever Virus Persistence in Wild Boar Populations: Insight for Control
Pepin, K. M., A. J. Golnar, Z. Abdo, and T. Podgorski 2020

Ecology and Evolution 10, no. 6: 2846-2859

Environmental sources of infection can play a primary role in shaping epidemiological dynamics; however, the relative impact of environmental transmission on host-pathogen systems is rarely estimated. We developed and fit a spatially explicit model of African swine fever virus (ASFV) in wild boar to estimate what proportion of carcass-based transmission is contributing to the low-level persistence of ASFV in Eastern European wild boar. Our model was developed based on ecological insight and data from field studies of ASFV and wild boar in Eastern Poland. We predicted that carcass-based transmission would play a substantial role in persistence, especially in low-density host populations where contact rates are low. By fitting the model to outbreak data using approximate Bayesian computation, we inferred that between 53% and 66% of transmission events were carcass-based that is, transmitted through contact of a live host with a contaminated carcass. Model fitting and sensitivity analyses showed that the frequency of carcass-based transmission increased with decreasing host density, suggesting that management policies should emphasize the removal of carcasses and consider how reductions in host densities may drive carcass-based transmission. Sensitivity analyses also demonstrated that carcass-based transmission is necessary for the autonomous persistence of ASFV under realistic parameters. Autonomous persistence
through direct transmission alone required high host densities; otherwise re-introduction of virus periodically was required for persistence when direct transmission probabilities were moderately high. We quantify the relative role of different persistence mechanisms for a low prevalence disease using readily collected ecological data and viral surveillance data. Understanding how the frequency of different transmission mechanisms vary across host densities can help identify optimal management strategies across changing ecological conditions.

The Potential Role of Scavengers in Spreading African Swine Fever among Wild Boar

Probst, C., J. Gethmann, S. Amler, A. Globig, B. Knoll, and F. J. Conraths 2020

Scientific Reports 10, no. 1

Understanding the transmission patterns of African swine fever (ASF) among wild boar (*Sus scrofa*) is an issue of major interest, especially in the wake of the current ASF epidemic. Given the high stability of ASF-virus, there is concern about scavengers spreading infectious carcass material in the environment. Here, we describe scavenging activities on 32 wild boar carcasses in their natural habitat in Germany. Using digital cameras, we detected 22 vertebrates at the study sites, thereof two mammal and three bird species scavenging. The most frequently detected species was the raccoon dog *Nyctereutes procyonoides* (44% of all visits). Raccoon dogs, red foxes (*Vulpes vulpes*), and buzzards (*Buteo buteo*) scavenged in the warm and the cold season, while ravens (*Corvus corax*) and white-tailed eagles (*Haliaeetus albicilla*) scavenged only in the cold season. In summer, however, insects removed most of the carcass biomass. Although most of the material was consumed on the spot, foxes, raccoon dogs and ravens left the study sites in rare cases with a small piece of meat in their mouths or beaks. We conclude that scavengers represent a minor risk factor for spreading ASF, but may contribute to reducing local virus persistence by metabolizing infected
carcasses.

Cross-Specific Markers Reveal Retention of Genetic Diversity in Captive-Bred Pygmy Hog, a Critically Endangered Suid

Purohit, D., M. S. Ram, V. K. Pandey, S. Pravalika, P. J. Deka, G. Narayan, and G. Umapathy 2020

Conservation Genetics Resources 12, no. 2: 269-273

As part of the species recovery plan for the critically endangered pygmy hog (*Porcula salvania*), a conservation-breeding program was initiated, to bolster its wild population. For successful conservation-breeding, it is essential to maintain 90% of the founder genetic diversity over time. Therefore, in the present study, we assessed the genetic diversity of a captive population of pygmy hog across generations using a set of ten, cross-specific microsatellite markers. Our results indicated a genetically heterozygous captive population (HE = 0.603), with stable expected heterozygosities across generations. However, the most recent generation showed a significant decrease in individual heterozygosities, implying possible genetic inbreeding. The current findings warrant a need for genetic evaluation to inform future conservation-breeding decisions. In addition, we also designed and tested primers for PCR-based species and sex-identification in the pygmy hog. The markers standardised in the present study would also help in evaluating the survival and ecology of the reintroduced populations.

How Does Increasing Mast Seeding Frequency Affect Population Dynamics of Seed Consumers? Wild Boar as a Case Study

Touzot, L., E. Schermer, S. Venner, S. Delzon, C. Rousset, E. Baubet, J. M. Gaillard and M. Gamelon 2020

Ecological Applications. https://dx.doi.org/10.1002/eap.2134

Mast seeding in temperate oak populations shapes the dynamics of seed consumers and numerous communities. Mast seeding responds positively to warm spring temperatures and is therefore expected to increase under global warming. We investigated the potential effects of changes in oak mast seeding on wild boar population dynamics, a widespread and abundant consumer species. Using long-term monitoring data, we showed that abundant acorn production enhances the proportion of breeding females. With a body mass structured population model and a fixed hunting rate of 0.424, we showed that high acorn production over time would lead to an average wild boar population growth rate of 1.197 whereas non acorn production would lead to a stable population. Finally, using climate projections and a mechanistic model linking weather data to oak reproduction, we predicted that mast seeding frequency might increase over the next century, which would lead to increase in both wild boar population size and the magnitude of its temporal variation. Our study provides rare evidence that some species could greatly benefit from global warming thanks to higher food availability and therefore highlights the importance of investigating the cascading effects of changing weather conditions on the dynamics of wild animal populations to reliably assess the effects of climate change.

Grow Fast at No Cost: No Evidence for a Mortality Cost for Fast Early-Life Growth in a Hunted Wild Boar Population

Veylit, L., B. E. Saether, J. M. Gaillard, E. Baubet, and M. Gamelon 2020

Oecologia 192, no. 4: 999-1012

From current theories on life-history evolution, fast early-life growth to reach early reproduction in heavily hunted populations should be favored despite the possible occurrence of mortality costs

later on. However, fast growth may also be associated with better individual quality and thereby lower mortality, obscuring a clear trade-of between early-life growth and survival. Moreover, fast early-life growth can be associated with sex-specifc mortality costs related to resource acquisition and allocation throughout an individual's lifetime. In this study, we explore how individual growth early in life afects age-specifc mortality of both sexes in a heavily hunted population. Using longitudinal data from an intensively hunted population of wild boar (*Sus scrofa*), and capture–mark–recapture–recovery models, we frst estimated age-specifc overall mortality and expressed it as a function of early-life growth rate. Overall mortality models showed that faster-growing males experienced lower mortality at all ages. Female overall mortality was not strongly related to early-life growth rate. We then split overall mortality into its two components (i.e., non-hunting mortality vs. hunting mortality) to explore the relationship between growth early in life and mortality from each cause. Faster-growing males experienced lower non-hunting mortality as subadults and lower hunting mortality marginal on age. Females of all age classes did not display a strong association between their early-life growth rate and either mortality type. Our study does not provide evidence for a clear trade-of between early-life growth and mortality.

Genome Wide Assessment of Genetic Variation and Population Distinctiveness of the Pig Family in South Africa

Hlongwane, N. L., Hadebe, K., Soma, P., Dzomba, E. F. and F.C. Muchadeyi 2020

Frontiers in Genetics 11, 344

Genetic diversity is of great importance and a prerequisite for genetic improvement and conservation programs in pigs and other livestock populations. The present study provides a genome wide analysis of the genetic variability and population structure of pig populations from different production systems in South Africa relative to global populations. A total of 234 pigs sampled in South Africa and consisting of village (n = 91), commercial (n = 60), indigenous (n = 40), Asian (n = 5) and wild (n = 38) populations were genotyped using Porcine SNP60K BeadChip. In addition, 389 genotypes representing village and commercial pigs from America, Europe, and Asia were accessed from a previous study and used to compare population clustering and relationships of South African pigs with global populations. Moderate heterozygosity levels, ranging from 0.204 for Warthogs to 0.371 for village pigs sampled from Capricorn municipality in Eastern Cape province of South Africa were observed. Principal Component Analysis of the South African pigs resulted in four distinct clusters of (i) Duroc; (ii) Vietnamese; (iii) Bush pig and Warthog and (iv) a cluster with the rest of the commercial (SA Large White and Landrace), village, Wild Boar and indigenous breeds of Koelbroek and Windsnyer. The clustering demonstrated alignment with genetic similarities, geographic location and production systems. The PCA with the global populations also resulted in four clusters that where populated with (i) all the village populations, wild boars, SA indigenous and the large white and landraces; (ii) Durocs (iii) Chinese and Vietnamese pigs and (iv) Warthog and Bush pig. K = 10 (The number of population units) was the most probable ADMIXTURE based clustering, which grouped animals according to their populations with the exception of the village pigs that showed presence of admixture. AMOVA reported 19.92%–98.62% of the genetic variation to be within populations. Sub structuring was observed between South African commercial populations as well as between Indigenous and commercial breeds. Population pairwise FST analysis showed genetic differentiation ($P \leq 0.05$) between the village, commercial and wild populations. A per marker per population pairwise FST analysis revealed SNPs associated with QTLs for traits such

as meat quality, cytoskeletal and muscle development, glucose metabolism processes and growth factors between both domestic populations as well as between wild and domestic breeds. Overall, the study provided a baseline understanding of porcine diversity and an important foundation for porcine genomics of South African populations.

Antagonistic interactions between predator and prey: mobbing of jaguars (*Panthera onca*) by white-lipped peccaries (*Tayassu pecari*)
Rampim, L. E., Sartorello, L.R., Fragoso, C.E., Haberfeld, M. and A. L. Devlin 2020
Acta Ethologica p. 1-4
Ambush predators rely on stealth to successfully secure prey. Mobbing is a rarely observed anti-predation strategy used by groupliving prey species whereby several individuals distract or harass a predator until it either ends the pursuit or leaves the area. Herein, we present three unique cases of white-lipped peccaries (*Tayassu pecari*) mobbing jaguars (*Panthera onca*) in the wild. White-lipped peccaries and jaguars co-occur within the study area, a large-scale ecotourism and working cattle ranch in the Brazilian Pantanal. Two cases of mobbing were recorded by video camera trap during routine surveys, and a third case was directly observed by one of the authors during telemetry triangulation of a GPS-collared individual jaguar. Our observations provide direct empirical evidence of antagonistic behavioral interactions between jaguars and white-lipped peccaries that have previously been limited to anecdotes within academic literature. We discuss the implications of this behavioral interaction for the proximate and ultimate fitness of both predator and prey.

El registro del pecarí labiado *Tayassu pecari* (Link, 1795) (Cetartiodactyla, Tayassuidae) en el Delta del Paraná (República Argentina)
Loponte, D. M., Acosta, A., Monsalvo, E.S., De Santis, L. J. M., and M. De Santis 2020
Notas sobre Mamíferos Sudamericanos (Sociedad Argentina para el Estudio de Mamíferos)
Versión on-line ISSN 2618-4788
En este trabajo se da a conocer un registro de pecarí labiado *Tayassu pecari* en el sitio arqueológico Islas Lechiguanas 1, localizado en el Delta del Paraná, sur de la provincia de Entre Ríos, República Argentina. El material identificado corresponde a dientes recuperados del nivel II, fechado en 408 ± 30 años 14C AP. Este registro confirma la presencia de esta especie de manera contemporánea con el inicio del período histórico en la región, extendiendo su distribución meridional con anterioridad a los cambios ambientales producidos por la invasión biológica del siglo XVI.

Impactos causados en suelos por pecaríes de labios blancos en cautiverio en la Reserva Ecológica "La Otra Opción" en Catemaco, México
Enríquez-Díaz, A.-A., Vela-Correa, G., González-Rebeles-Islas C., and E. Carrera-Sánchez 2020
Revista Latinomaericana de Recursos Naturales 16 (2), 68-78
En la Reserva Ecológica "La Otra Opción", se trabaja en la re-introducción de pecarí labios blancos (*Tayassu pecari*), con fines de reproducción y conservación, como una alternativa, al manejo extensivo del pastoreo de ganado vacuno el cual es frecuente en las áreas que se han deforestado para habilitarlas como potreros en la región. Por lo anterior el objetivo de este trabajo fue determinar los impactos causados durante un año por los pecaríes de labios blancos en los suelos de la Reserva Ecológica La Otra Opción en Veracruz, México, para lo cual, se

trabajó en los encierros donde tienen cautivos a una piara de 39 animales. Se tienen destinados dos corrales, se trazaron cuatro cuadrantes de 20 x 10 m cada uno, y se tomaron muestras de suelo a una profundidad de 0 - 20 cm. Posteriormente, a cada muestra se le determinó: la humedad, densidad aparente y real, porosidad, textura, pH, CIC, MO, Corg, Ca2+, Mg2+, Na+ y K+. Entre los resultados, se tiene que los impactos causados por los pecaríes en los suelos, muestran un incremento en la porosidad, contrário a los potreros con ganado vacuno. También hubo un ligero aumento en MO, Corg., así como de Ca2+, Mg2+, Na+ y K+, estos últimos se estima provenientes de los alimentos balanceados con que son alimentados los pecaríes. En conclusión, la re-introducción de *Tayassu pecari* tuvo un impacto positivo en los suelos, particularmente en ocho de las propiedades químicas, más que en las físicas, donde solo la porosidad se incrementó. Se considera que la re-introducción de esta especie, puede ser una alternativa para la recuperación de los ecosistemas, siempre y cuando se rediseñe el tamaño de los encierros y permita tener mejores condiciones a los pecaríes.

Peccaries and their relationship with water availability and their predators in Calakmul, México

Sanchez-Pinzón, K., Reyna-Hurtado, R., Naranjo, E. J. and A. Keuroghlian 2020

Therya (2020) Vol. 11, núm. 2, p. 212.

A reduction in the frequency of rainfall and an increase in drought periods, as a consequence of climatic change, has caused the desiccation of water ponds (locally known as “aguadas”) in the Calakmul region. The objective of this study was to determine if the abundance and distribution of the white-lipped peccary, *Tayassu pecari*, and the collared peccary, *Pecari tajacu*, in the ponds of the Calakmul Biosphere Reserve, a tropical forest in Southern México, are related to water availability and to the presence of their predators throughout five years of study. Using photo-trapping technique, 12 aguadas were monitored. The index of abundance of photographic records and the activity patterns were estimated, and the presence of both species of peccaries was related through linear and logarithmic regressions with the availability of water and their predators (pumas and jaguars). The abundance and presence of the white-lipped peccary and the jaguar were directly related to decreasing water availability, while water was not a determining factor for the presence of the collared peccary and the puma. The decrease in the availability of water in the aguadas of the reserve has become a serious threat to the white-lipped peccary, one that, when coupled with other threats such as hunting and fragmentation of their habitat in the communities surrounding the reserve, will increase the risk of extinction of these populations, that at least for the white-lipped peccary, is the most important in Mesoamerica.

Precipitous decline of white-lipped peccary populations in Mesoamerica

Thornton, D., Reyna, R., Perera-Romero, L., Radachowsky, J., Hidalgo-Mihart, M. G., Garcia, McNab, R., … and J. Polisar 2020

Biological Conservation (2020) Vol. 242

Large mammalian herbivores are experiencing population reductions and range declines. However, we lac regional knowledge of population status for many herbivores, particularly in developing countries. Addressing this knowledge gap is key to implementing tailored conservation strategies for species whose population declines are highly variable across their range. White-lipped peccaries (*Tayassu pecari*) are important ecosystem engineers in Neotropical forests and are highly sensitive to human disturbance. Despite maintaining a wide distributional range, white-lipped peccaries are experiencing substantial population declines in some portions

of their range. We examined the regional distribution and population status of the species in Mesoamerica. We used a combination of techniques, including expert-based mapping and assessment of population status, and data driven distribution modelling techniques to determine the status and range limits of white-lipped peccaries. Our analysis revealed declining and highly isolated populations of peccaries across Mesoamerica, with a range reduction of 87% from historic distribution and 63% from current IUCN range estimates for the region. White-lipped peccary distribution is affected by indices of human influence and forest cover, and more restricted than other sympatric large herbivores, with their largest populations confined to transboundary reserves. To conserve white-lipped peccaries in Mesoamerica, transboundary efforts will be needed that focus on both forest conservation and hunting management, increased cross-border coordination, and reconsideration of country and regional conservation priorities. Our methodology to detail regional white-lipped peccary status could be employed on other poorly-known large mammals.

Primeros registros de pecarí de collar *Pecari tajacu* (Mammalia, Artiodactyla) para Monte de Sierras y Bolsones y en la provincia de Catamarca, República Argentina
De Bustos S. and E. Alderete 2020
Notas sobre Mamíferos Sudamericanos (Sociedad Argentina para el Estudio de Mamíferos)
Versión on-line ISSN 2618-4788
Se presentan los primeros registros confirmados de pecarí de collar (*Pecari tajacu*) en la ecorregión de Monte de Sierras y Bolsones y se agrega en su distribución a la provincia de Catamarca, a 1.890 m de altitud. Los registros consisten en imágenes y huellas obtenidas en las inmediaciones del río Vis Vis (Departamento de Belén), en marzo de 2017 y mayo de 2018. Dichos registros constituyen una clara evidencia de la presencia de esta especie en la región.

Confirmación de la presencia de pecarí de collar (*Pecari tajacu*) en el Parque Provincial Ischigualasto (San Juan, República Argentina)
Ontiveros, Y., Cappa, F. M., Campos C. M. and S. M. Giannoni 2020
Notas sobre Mamíferos Sudamericanos (Sociedad Argentina para el Estudio de Mamíferos)
Versión on-line ISSN 2618-4788
Si bien el pecarí de collar presenta una amplia distribución, la especie en Argentina está categorizada como vulnerable debido a la disminución de sus poblaciones. En este trabajo se confirma la presencia de pecarí de collar en el Parque Provincial Ischigualasto (PPI). Los registros fueron de un grupo compuesto por siete individuos mediante observación directa, y de dos individuos distintos con trampas cámara. Estos registros aumentan la lista de especies del PPI así como el número de las áreas protegidas donde está registrada la especie.

Spatial patterns of the first groups of collared peccaries (*Pecari tajacu*) reintroduced in South America
Hurtado, C. M., Beck, H., Thebpanya, P. and M. Altrichter 2020
Tropical Ecology p. 1-12
The collared peccary (*Pecari tajacu*) is distributed from southwestern USA to northern Argentina; however, in some Argentinean localities it went extinct over 50 years ago. As part of a rewilding project, two peccary groups (one captive-bred family group and one mixed group formed by not genetically related individuals) were reintroduced to the Ibera National Park. Following the

release, we monitored the movements of 16 individuals to obtain GPS locations every 100 min, for 6 months. We evaluated the individual's spatial patterns by assessing site fidelity, home range changes, and habitat selection. Most members of the family group survived and established a home range whereas almost all members of the mixed group dispersed and did not survive. Using the Autocorrelated Kernel Density Estimator, the groups' home range was 8.9 ± 1.7 km2 for the entire study period. In addition, individuals showed high fidelity to release site and a stable home range a few months after release. At larger scales (second order of selection), peccaries selected forested habitat and proximity to release site while at a smaller scale (third order of selection), they avoided grasslands. We highlight the importance of familiarity of individuals prior to release and provide recommendations for future reintroductions. Three years later, by September 2019, nine groups were established in the Ibera National Park and the abundance was over 45 individuals. This is the first post-release assessment of the movement patterns of collared peccaries in South America.

Relaciones ecológicas entre pecaríes de collar y cerdos asilvestrados en el sur de México: ¿evidencia de la división de nicho?

Hernández-Pérez, E. L., Castillo-Vela, G., García-Marmolejo, G., Hidalgo-Mihart, M., Contreras-Moreno, F. M., De la Cruz, A. J., Juárez-López, R. and R. Reyna-Hurtado

Revista Mexicana de Biodiversidad, 2020, vol. 91.

Se ha registrado la presencia de pecaríes de collar (*Pecari tajacu*) y cerdos asilvestrados (*Sus scrofa*) en el suroeste de Campeche. A pesar de esta coexistencia, la división de nicho entre estas especies no había sido estudiada en México. Los objetivos de este trabajo fueron: evaluar el uso y selección de hábitat, identificar variables que determinan la presencia de ambas especies; así como analizar el patrón de actividad de pecaríes de collar en presencia y ausencia de cerdos asilvestrados. Se recolectaron registros directos e indirectos mediante cámaras-trampa y transectos, entre enero y junio de 2018. Se obtuvo un alto grado de traslape en el uso de hábitat entre especies, sin embargo, a escala más fina, los pecaríes seleccionaron áreas de selva baja inundable y los cerdos seleccionaron cultivos de palma de aceite y popales/tulares. Las variables antrópicas influyeron positivamente en la presencia de los cerdos y negativamente en la de los pecaríes. Los patrones de actividad de pecaríes se alteraron en presencia de los cerdos. Es posible que en la región de laguna de Términos, donde la configuración del paisaje compuesta por áreas altamente antropizadas y ligadas a fragmentos conservados, se esté permitiendo la distribución de recursos, y por consiguiente, la segregación espacio-temporal de ambas especies.

La crianza de cerdos en vida libre y pecaríes silvestres en zonas de transición de áreas protegidas del sureste de México

Sanvicente, L. M., Vargas, L.S., Bustamante, G.A. and V.J.L. Jaramillo 2020

Archivos de zootecnia vol. 69, no 266, p. 216-224.

El estudio analizó los sistemas de producción de cerdos domésticos en vida libre y pecaríes silvestres para determinar los beneficios sociales, económicos y ambientales en comunidades ubicadas en la zona de transición de la Reserva de la Biósfera Calakmul, México. La información se obtuvo de 169 campesinos criadores de suinos, de un censo realizado en 13 comunidades. La información de la unidad de producción, los criadores, la piara de cerdos, la alimentación, los parámetros productivos y reproductivos, la comercialización, los costos e ingresos se registraron

en un cuestionario. Los datos se analizaron con frecuencias, análisis de varianza, clúster, factorial y componentes principales con el paquete estadístico SAS. Se identificaron tres sistemas de crianza de cerdos domésticos en vida libre: traspatio (23,1%), itinerancia estacional (21,9%) e itinerante (55%). Los tres sistemas tuvieron pecarí de collar (*Pecarí tajacu*) como una forma de reproducción en cautiverio de esta especie silvestre. El sistema de crianza en traspatio fue el más intensivo en uso de mano de obra, forraje de corte, grano de maíz y la compra de alimento. El sistema de itinerancia estacional fue intermedio en el uso de recursos e insumos. La crianza itinerante tuvo mayor convivencia con el pecarí en cautiverio, con el uso de los ecosistemas naturales y una menor orientación al mercado. La crianza en traspatio y la itinerancia estacional se clasificaron como de transición a la producción en confinamiento, con una disminución de la crianza en libertad y se incrementó el uso de insumos para la alimentación.

Individual differences in behavior affect total tract fiber digestibility: the example of collared peccary

Borges, R. M., Nogueira-Filho, S. L. G., Cairo, P. L. G., Nogueira, S. S. C., Mendes, A., Aldrigui, L. G., ... and J. Bindelle 2020

Animal 1-10

Differences in how individuals cope with stressful conditions (e.g. novel/unfamiliar environment, social isolation and increases in human contact) can explain the variability in data collection from nutrient digestibility trials. We used the collared peccary (*Pecari tajacu*), which is under process of domestication and shows high individual behavioral distinctiveness in reactions toward humans, to test the hypothesis that behavioral differences play a role in nutrient digestibility. We assessed the individual behavioral traits of 24 adult male collared peccaries using both the 'behavioral coding' and the 'subjective ratings' approaches. For the behavioral coding assessment, we recorded the hourly frequency of behaviors potentially indicative of stress during the 30-day habituation period to the experimental housing conditions. The subjective ratings were performed based on the individuals' reactions to three short-term challenge tests (novel environment, novel object and threat from a capture net) over a period of 56 days. During the last 26 days, the collared peccaries were fed diets either high (n = 12) or low (n = 12) in dietary fiber levels, and we determined the total tract apparent digestibility of nutrients. The individual subjective ratings showed consistency in the correlated measures of 'relaxedness', 'quietness' and 'satisfaction' across the three challenge tests, which were combined to produce z score ratings of one derived variable ('calmness'). Individual frequency of BPIS/h and calmness scores were negatively correlated and both predicted the total tract digestibility of acid detergent fiber (ADF), which ranged from 0.41 to 0.79. The greater the calmness z scores (i.e. calmer individuals), the greater the total tract digestibility of ADF. In contrast, the higher the frequency of BPIS/h, the lower the total tract digestibility of ADF. Therefore, our results provide evidence that by selecting calmer collared peccaries, there will be an increase in their capacity to digest dietary fiber.

Captive-born collared peccaries learning about their predators: Lessons learnt but not remembered

de Faria, C. M., de Souza Sá, F., Costa, D. D. L., da Silva, M. M., da Silva, B. C., Young, R. J. And C. S. de Azevedo

Behavioural Processes 171, 104031.

Captive-born animals frequently lose their anti-predatory abilities due to the absence of encounters with their predators, but these abilities can be regained through specific training. Anti-predator training can, thus, enhance the success of reintroduction programs with predator naïve animals. In addition, a good memory is important to guarantee the effects of the anti-predator training and increase survival rate after release into the wild. In the present study, anti-predator training sessions were applied to 11 captive-born collared peccaries (Pecari tajacu), followed by memory tests at 30, 60 and 90 days after the end of the training sessions. The collared peccaries responded appropriately to training against predators, showing alert, escape and predator avoidance behaviors after anti-predator training; however, the animals maintained these acquired behaviors for only 30 days after the end of the anti-predator training. After 60 days, peccaries responded to the predator in a 'relaxed' manner, exhibiting no anti-predator behaviors. For the trained collared peccaries to be released into the wild, reinforcement in the anti-predator training would be required at least 30 days prior to release.

A review of some aspects of the ecology, population trends, threats and conservation strategies for the common hippopotamus, *Hippopotamus amphibius* L, in Zimbabwe
Utete, B. 2020
African Zoology, https://doi.org/10.1080/15627020.2020.1779613
This review explores some ecological aspects of the common hippopotamus (hippo), *Hippopotamus amphibius* L, threats to its population and contextual peculiarities affecting its conservation in selected water systems in Zimbabwe. Scoping surveys of literature and thematisation of common issues related to hippo ecology, human-hippo conflict and conservation were used for data collection. Hippos play integral ecological roles, such as habitat engineering through track creation in water systems, nutrient recycling by swirl spread of highly organic faeces, harbouring commensal water birds, parasites and leeches. Regardless, the hippo population is not well documented for the country with indications of sharp declines in freshwater systems during the period 1982 to 1992 and gradual recovery thereafter. Habitat degradation, water pollution, climate change, drought-induced extreme water level fluctuation, poaching and deliberate culling, as part of problem-hippo control (PHC), are key drivers of hippo population declines. However, it appears much of the attention is on human-hippo conflict and its consequences, resulting in negative perceptions among human communities. Commercial breeding of hippos for non-consumptive tourism, and export-orientated meat, and ethnomedical mimics of hippo sweat and milk products are new, potentially viable, but unexplored options for conserving and increasing the population of the species in Zimbabwe. Currently, it appears more anti-hippo poaching patrols and awareness campaigns especially in water systems outside protected areas may be key to sustaining the current hippo population. For the future, it is essential to increase the scope for hippo census data to include water systems inside and outside protected areas for sustainable conservation of the species in the country.

Fatty acid analyses provide novel insights on hippo defecation and consequences for aquatic food webs
Dawson, J., Pillay, D., Perissinotto, R. and N. B. Richoux 2020
Scientific Reports 10
By defecating grasses into aquatic systems at massive scales and intensities, hippos can initiate complex changes to aquatic ecosystems. However, consequent effects on food webs are not well

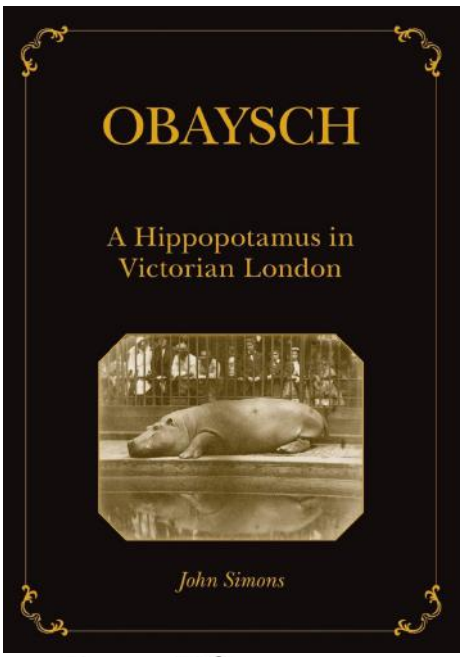
understood, particularly regarding shifts in basal resource contributions to consumer diets and their physiological condition. Here, we use fatty acid analysis to show that dense hippo aggregations and high dung loading are associated with (1) alterations to basal resource pools, (2) reduced quality of sediment organic matter and (3) increases in terrestrial and bacterial biomarker levels, but declines in those of diatoms in estuarine secondary consumers. While hippo defecation can increase boundary permeability between terrestrial and aquatic systems, our findings indicate that this may lead to a shift from a microphytobenthic food web base to one with increasing bacterial contributions to higher consumers. Our findings expand understanding of the mechanisms by which an iconic African megaherbivore indirectly structures aquatic ecosystems.

Activity and Pool Use in Relation to Temperature and Water Changes in Zoo Hippopotamuses (*Hippopotamus amphibious*)
Fernandez, E. J., Ramirez M. and N. C. Hawkes 2020
Animals 10(6)
In the wild, hippopotamuses spend much of their daily activity in the water. In zoos, it is less clear the extent to which hippos spend time in the water. We examined how much time Woodland Park Zoo's three hippos spent in their outdoor pool, based on: (a) temperature of the pool water, and (b) when the pool water was changed (approximately three times a week). Several digital temperature data loggers collected water and air temperature readings once every hour for six months. We correlated the water temperature readings with several behaviors the hippos could engage in, where the hippos were on exhibit (pool vs. land), and how many days it had been since a dump (0, 1, or 2 days). The results indicated that water changes had little effect on pool usage, while increasing water temperatures resulted in both increased activity and pool use. The results are discussed in terms of how these findings relate to wild hippo activity, current knowledge of zoo-housed hippo welfare, and future directions for zoo-housed hippo welfare and research.

Common hippopotamus in Nigeria: New census data and literature review confirm the conservation importance of sites outside protected areas
Baker, L. R., Che, J., Teneke, V. N., Kadala, E., Uba, M. S., Geoffrey, N. and C. Haskainu 2020
Aquatic Conservation, https://doi.org/10.1002/aqc.3397
1. Once abundant across Africa, the common hippopotamus is threatened owing to habitat degradation and loss, hunting, and negative human–wildlife interactions. West African populations are notably small and fragmented and therefore at greatest risk.
2. In Nigeria, Africa's most populous nation, the IUCN estimates that only 100 hippos remain. They occur in protected areas, such as national parks and game reserves, and outside protected areas in estuarine habitats, inland rivers, lakes, and reservoirs. However, the status of hippos in most sites is poorly known. Reliable data are needed to better ascertain the status of this species in Nigeria.
3. Over five days in December 2018 and May 2019, motorized boats were used to conduct a census of the hippo population in Kiri Dam reservoir, a large-dam reservoir along the Gongola River, a major tributary of the Benue River, in north-eastern Nigeria. These findings were compared with data on hippo abundance from several sites across Nigeria and the Benue River basin in North Cameroon.
4. A minimum of 56 hippos (51 adults and 5 calves) were recorded, predominantly in the

transitional zone of the reservoir. Based on available data, hippos in Kiri reservoir currently represent the largest recorded population in Nigeria, exceeding individual populations in official protected areas.
5. Research and conservation efforts for hippos in Nigeria should focus on assessing their status and improving protection in key sites and increasing connectivity among populations. Special attention should be paid to populations within the Benue River basin, which is emerging as critical for hippopotamus conservation in west-central Africa.

Ecosystem effects of the world's largest invasive animal
Shurin, J. B., Aranguren-Riaño, N., Negro, D.D., Lopez, D.E., Jones, N.J., Laverde-R, O., Neu, A. and A. P. Ramos 2020
Ecology 101(5)
The keystone roles of mega-fauna in many terrestrial ecosystems have been lost to defaunation. Large predators and herbivores often play keystone roles in their native ranges, and some have established invasive populations in new biogeographic regions. However, few empirical examples are available to guide expectations about how mega fauna affect ecosystems in novel environmental and evolutionary contexts. We examined the impacts on aquatic ecosystems of an emerging population of hippopotamus (Hippopotamus amphibus) that has been growing in Colombia over the last 25 yr. Hippos in Africa fertilize lakes and rivers by grazing on land and excreting wastes in the water. Stable isotopes indicate that terrestrial sources contribute more carbon in Colombian lakes containing hippo populations, and daily dissolved oxygen cycles suggest that their presence stimulates ecosystem metabolism. Phytoplankton communities were more dominated by cyanobacteria in lakes with hippos, and bacteria, zooplankton, and benthic invertebrate communities were similar regardless of hippo presence. Our results suggest that hippos recapitulate their role as ecosystem engineers in Colombia, importing terrestrial organic matter and nutrients with detectable impacts on ecosystem metabolism and community structure in the early stages of invasion. Ongoing range expansion may pose a threat to water resources.



If you read articles in the news about zoo animals from time to time you may notice that some of them become famous or even iconic. In Germany-speaking countries the polar bear Knut from Berlin Zoo was such a famous animal in the first decade of this century. Going back in history Obaysch a Common hippopotamus was the very first animal kept in a zoo that became such a star. John Simmons has written a monograph about this first hippo that arrived in Europe since the Roman Empire and the first hippo in Britain since prehistoric times. Simmons has studied the historic sources deeply. First, he presents his reasons for writing a book about the hippo Obaysch in Victorian London and discusses why Obaysch is definitely the first live hippo that lived in modern Europe. Simmons also writes about the technique Obaysch was captured in Egypt and how he was transported to London. Furthermore he explains the reasons for the foundations of modern zoological gardens. Then Simmons

tells about Obaysch's life. Doing this he also describes human perceptions of wild animals in the Victorian age citing Charles Dickens, articles from Punch satire magazine and other sources. Simmons tells about the second hippo Adhela, a female that arrived later London Zoo and the two hippos' offspring that created together. Only the third of their offspring survived and it was ironically named Guy Fawkes (after the famous unsuccessful assassin). Simmons also tries to take Obaysch's point of view and how this hippo might have perceived its live. After the first huge public interest created by Obaysch the “hippomania” faded away but Obaysch remained the most famous animal kept in London Zoo. The following chapters of Simmon's book deal with the several meanings of hippos and with other hippos kept in European and American zoos that became famous such as Coco or Bichette in French zoos in the 19th century or the hippo Knautschke in Berlin Zoo that was born in 1943 during the Second World War and survived the bombing of the zoo as one of very few animals there.
John Simmons has written a very interesting book not only about the first zoo animal that became famous but also about the way exotic animals were treated in the Victorian age and how scientific explorations, commercial ambitions and imperial expansions influenced the perceptions of exotic animals during this age. 28 black and white plates illustrate this highly recommended book.

Obaysch – A Hippopotamus in Victorian London
By John Simmons
226 pages
2019, Sidney University Press

Reviewed by Thiemo Braasch

German farmers face possible pig culls as African swine fever discovered

https://www.theguardian.com/environment/2020/sep/10/german-farmers-face-possible-pig-culls-as-african-swine-fever-discovered
Kate Connolly, The Guardian, Thu 10 Sep 2020

Discovery of deadly virus in wild boar cadaver leads to crisis measures including hunting, harvesting and leisure bans
German farmers have been ordered to enact a series of crisis measures after the discovery of the country’s first case of African swine fever (ASF). The arrival of the highly infectious disease, found in the cadaver of a wild boar close to the German border with Poland in the state of Brandenburg, is a devastating blow to farmers who have been at pains for several years to keep it at bay. While ASF poses no immediate danger to humans, it can be spread quickly by animals and humans and is usually fatal in farm pigs and wild boars.A danger zone will now be declared for several kilometres around the area where the find was made and will include land in neighbouring Poland. The nearest large pig farm is just 7km away. An area of at least 3km around where the cadaver was found is expected to be fenced off. A strict hunting ban in the area of the Spree-Neisse district as well as a ban on harvesting corn in a radius of 15km has also been ordered. Agricultural events and folk festivals involving pigs are to be cancelled and dog walkers are banned from walking their dogs in the area. Farmers face the prospect of a ban on exports of

pork to non-EU countries. Asia is a huge market for German pig farmers, worth billions of euros. A spread of ASF to Germany was considered to only be a matter of time, after the discovery in March of the virus in western Poland, around 10km from the German border. As a result, Brandenburg authorities erected a 120km-long electric pasture fence in an attempt to prevent wild boars from crossing the river there. Ursula Nonnemacher, consumer affairs minister for the state of Brandenburg, said it was unclear how the dead boar had become infected. “We cannot say … whether it came over the border from Poland, or became infected by discarded sausage meat,” she said. “We must now make every effort to stop it from spreading.” Germany’s agriculture minister, Julia Klöckner, appeared to play down the find after the federal research laboratory had confirmed the infection on Thursday. “One wild boar has been found in one district,” she told reporters in Berlin. No decision has yet been made over whether pigs will now have to be slaughtered. Germans have been urged to desist from feeding wild boars, which have become an ever frequent presence throughout states like Brandenburg and Thuringia as well as in and around the German capital. Travellers are also banned from bringing animal products into Germany from Belgium, Bulgaria, Romania, Poland or the Czech Republic, where ASF is well-established. Picnickers are being urged to take remains of meat products home rather than throw them into bins which are often emptied by scavenging animals and birds. Undercooked or raw meat products such as dry-cured ham and salami are a main source of the infection. But vehicles, humans and dogs can also spread the virus.

Threat to kill wild boar that stole nude bather's laptop prompts outcry

https://www.theguardian.com/world/2020/aug/17/threat-to-kill-wild-boar-that-stole-nude-bathers-laptop-prompts-outcry-berlin
Kate Connolly, The Guardian, Mon 17 Aug 2020

‘When he returned from the forest, everyone applauded him.’ The nudist chased the boar - and a yellow bag containing his laptop - into undergrowth near Berlin’s Teufelssee. Photograph: Adele Landauer/@adelelandauer_lifecoach/AFP/Getty Images

Berlin officials say Elsa and her piglets pose a danger and may have to be ‘withdrawn’

A wild boar that has become a frequent visitor at a lakeside bathing resort in Berlin is attracting a growing band of supporters following authorities’ suggestion that it could have to be killed. The animal, nicknamed Elsa, has earned something akin to celebrity status after a series of photos of it and its piglets stealing a nude bather’s laptop at Teufelssee lake in west Berlin went viral this month. The owner of the laptop was captured in bare-bottomed pursuit of the boar, which later abandoned its booty, presumably having discovered it was not edible. Subsequent sightings of the creatures rifling through bathers’ picnic baskets and rucksacks and apparently showing no timidity have prompted

Berlin foresters to label them a danger to humans. “This wild sow and her two young is a frequent visitor at Teufelssee,” Katja Kammer, the head of the forestry office in the district of Grunewald told the broadcaster RBB. “They phlegmatically forage in broad daylight over the grass looking for food wherever there are bathers. They have lost all sense of shyness.” As a result, she said, they would have to be “withdrawn as a matter of priority” – a bureaucratic euphemism for killing them. Kammer’s remarks prompted the campaign group Action Fair Play to call a demonstration to save the beast. Around a dozen protesters gathered at the forestry office on Sunday. “A few days ago pictures appeared in the media of a man in the nudist section of Teufelssee chasing a female wild boar which had run off with his laptop in a bag,” the organisers said in a statement. “These pictures delighted people around the world. Only the forestry office appeared to get no pleasure from them, deciding instead to shoot the sow and her young.” The group said the animals had done no harm “and the owner even got his laptop back”. It said there was no need to kill the wild boar. A petition on Change.org calling for the rescue of the “cheeky but peaceful sow from Teufelssee” had collected more than 5,300 signatures by Monday afternoon. Its organisers said that in contrast to other wild boar, which can pose considerable danger to humans and dogs, this female had built a reputation “over years” of being friendly towards bathers. “There has been absolutely no account taken for the fact that this sow has peacefully shared her living space with bathers for years,” they said, adding that the creature’s very friendliness was in danger of leading to its downfall. “This wild boar has earned the right to live,” they said. Marc Franusch, a spokesman for Berlin’s forestry commission, said it remained uncertain whether and when the wild boar would be shot. “It is the wrong time of year,” he told local media. “Due to the age of young, it is forbidden to shoot them right now.”

Hog Apocalypse- African Swine Flu in Assam can be ravaging for KNP

https://www.sentinelassam.com/assam-news/hog-apocalypse-african-swine-flu-in-assam-can-be-ravaging-for-knp-470571
Sentinel Digital Desk , 4 May 2020

NUMALIGARH: More than 2,500 sudden deaths in pigs were reported in several districts of Assam since the last few days. After testing and verifying all the samples, the National Institute of High Security Animal Diseases (NIHSAD), Bhopal has confirmed very recently that the cause of this Hog Apocalypse is none other than the African Swine Fever (ASF). ASF is a severe viral disease of pigs that can spread very rapidly. ASF is a highly contagious disease of domestic pigs and wild boars. It is caused by a virus and it causes severe haemorrhage. It is different from the Classical Swine Fever which we have known for a long time.

Now, disposal of the carcasses of the dead pigs into the river and other open places may definitely prove catastrophic. Kaziranga National Park Director P. Shivakumar told The Sentinel that a lot of pig carcasses had been recovered in the Brahmaputra River inside the national park. "Recently we detected a total of 21 carcasses of pig which were floating on the River Brahmaputra. All the carcasses were disposed off with help of the Veterinary Department of Biswanath. A meeting was also held with civil, police and NGOs in this regard, which was chaired by Chief Wildlife Warden at Kohora," said KNP Director P. Shivakumar.

After recovery of the pig carcasses, the forest department is on high alert. Patrolling has been

intensified along the riverside and other areas. The forest department has also issued a departmental advisory lately to take all precautionary measures against any possible transmission of the disease to the protected areas. "ASF has a very high fatality rate in pigs from 80 per cent to 90 per cent, but luckily it is not zoonotic, which means that it doesn't affect humans. This kind of contagious infectious disease in NE States is a major threat to swine population under domestication but we cannot ignore the fact that if disposal of carcass of infected swine is not done in scientific way then it may spread to the wild counterparts as this virus enters sylvatic cycle too," said zoonotic disease expert Dr Samsul Ali.

According to the World Organization for Animal Health (OIE), this disease can be transmitted through direct contact. So, if a healthy pig comes in contact with a sick pig, the disease can spread. This is direct transmission. Indirect transmission takes place when infected bedding material, feed and carcasses of diseased animals or garbage come in contact with healthy pigs. Ornithodoros ticks also act as biological vectors for the spread of the disease. There is no vaccine for ASF and it can spread through non-biological objects like shoes and clothing.

Corbett Foundation deputy director and veterinarian Dr Naveen Pandey said, "If the carcasses of diseased animals are disposed near wetlands or thrown in rivers, it poses a greater risk for the population down the stream. In a floodplain like Kaziranga, it is a very scary situation. The wild boars in Kaziranga and pigmy hogs in Manas National Park are vulnerable. Hundreds of wild boars have perished in Europe due to ASF. The Corbett Foundation is launching an awareness programme for the villages around Kaziranga National Park where individual contacts are being made with farmers, mainly through mobile phones to inform about the symptoms of the disease and disposal of the carcass if this disease is seen. After easing of the lockdown, there is a programme to reach to villages and explain how farmers can take precautions and how they should dispose off the carcasses in case of death." Wildlife experts and other stakeholders are also asking for appropriate measures and action to be taken by the civil administration and Veterinary department to save the wildlife of KNP and other protected areas from the African swine fever.

Huge feral hogs invading Canada, building 'pigloos' as they go

https://www.nationalgeographic.com/animals/2020/03/huge-feral-hogs-swine-spreading-through-north-canada/?utm_campaign=website&utm_source=sendgrid.com&utm_medium=email
Andrea Anderson, April 3 2020

In the late 1980s and early 1990s, some Canadian farmers imported wild boars from Europe to raise for meat. But as wild boars are wont to do, some of them escaped, either digging under fences or barreling through them. Others were set free once the boar meat market cooled. At first, it didn't seem like a big problem; many thought they couldn't survive Canada's long winters. But the boars proved hardier than some researchers expected, and now they're causing havoc across wide swaths of Canada. The descendants of these wild boars have interbred with domestic pigs to varying degrees, and are now found throughout western and central Canada, from British Columbia to Manitoba and beyond. As they spread, they sow environmental destruction, plowing through crops and grasslands, causing erosion, displacing wildlife, harassing livestock, and eating just about anything. These feral fugitives can weigh up to 600 pounds or more, and sport sharp tusks and bristly coats over thick, warm fur. They are reproducing rapidly and their range is

expanding. Their combination of wild traits and domestic ones—including their high tolerance for cold and ability to birth large litters—may have led to “super pigs,” says Ryan Brook, a wildlife researcher with the University of Saskatchewan. The creatures even have been known to build above-ground shelters that researchers have dubbed “pigloos.” “We should be worried, because we know the biology,” Brook says. “They're called an ecological train wreck for a reason.”

Got pigs?

The hog explosion is a new problem, and until recently, “no one even knew where they were,” says Ruth Aschim, a doctoral candidate at the University of Saskatchewan. She and her advisor Brook spent three years mapping their distribution using trail camera images, GPS collar data, and interviews with local landowners, farmers, and hunters. For three months of the project, Aschim lived out of her tent and her car, meeting with local biologists and conservation officers across western Canada. The results, published in a paper in Scientific Reports in May 2019, reveal wild pigs have spread extensively over the past three decades, with sightings emanating outward from former boar farms. They’re continuing to move into new territory, far beyond where they were once raised.

Porcine pests

Canadian feral hogs often eat crops such as wheat, barley, and canola as they range through prairies and farm lands and into the edges of forests and wetlands. They will make a meal out of most anything that fits into their mouths, including plants, small reptiles or mammals, ground-nesting birds, and eggs. Beyond the damage they can do to field crops, grain bins and storage containers, the pigs can plow through large patches of farmland in search of invertebrates, roots, and other edibles. “The rooting is really something to see. It's almost like a small backhoe has gone through some of these pastures,” says Perry Abramenko, an inspector and pest program specialist with Alberta Agriculture and Forestry. Wild pigs also wallow in stream beds, causing erosion and water contamination, Abramenko says. And given their close relationship to domestic pigs, experts have raised concerns about potential infectious diseases that could be passed back and forth between the animals. Canada’s pig problem is relatively new, however, and many impacts have yet to be fully felt. Crop insurance claims attributed to wild pigs in Saskatchewan, for example, are still far outpaced by damage from other wildlife, according to the Saskatchewan Crop Insurance Corporation.Moreover, pigs are elusive; even though seen on trail cameras, residents might not know they’re around. Even so, economic and ecological problems associated with pigs—including risks posed to motorists—are expected to grow alongside the mushrooming pig population. That has people like Brook concerned about the lack of a comprehensive plan to reduce their numbers in Canada, despite some initial efforts and meetings—lots of meetings. Without concrete action, time may be running out to turn back the wild pig tide. “Meetings don't eradicate wild pigs,” he says. Prior to such research, a Canadian feral pig scourge was hard to fathom. In the United States, the animals are best known in the south and warmer coastal areas, such as Florida, Texas, and California, where Spanish explorers introduced pigs as far back as the 1500s. In western Canada, though, “we have the exact opposite,” Brook says. “The coldest spots—Manitoba, Saskatchewan, and Alberta, sort of north-central—is where we have, by far, the most pigs." Why? The answer may lay partly in their history and heritage.

Swine on the move

Most taxonomists agree that domestic pigs and European wild boars are the same species, Sus scrofa, though different subspecies. They readily interbreed if given the chance. Wild boars are native to Eurasia, ranging from North Africa to Scandinavia and east to Siberia. They are not native to the Americas, though pig-like peccaries range throughout Latin America.

Humans have been raising domestic pigs, descendants of European wild boars, for around 10,000 years. The domestic variety has less hair and has been bred to be large and meaty, while reproducing quickly, particularly since the advent of commercial pig farming. The descendants of escaped pigs can take on characteristics of their boar ancestors, including longer coats, though these “feral pigs” or “wild hogs” may harbor distinct color patterns and other remnants of domesticity. Many feral pigs in the U.S. have strong domestic ancestry. A February 2020 study in Molecular Ecology of genetic data taken from 6,500 feral animals across the U.S. found that most descend from a mix of heritage breed domestic pigs—the kind raised as livestock prior to industrialized agriculture—and wild boar.

Wild boars provide archaeologists with clues to early domestication

https://www.sciencedaily.com/releases/2020/03/200303204500.htm
CNRS, March 3, 2020

Until now, archaeozoologists have been unable to reconstruct the earliest stages of domestication: the process of placing wild animals in captivity remained beyond their methodological reach. Using the wild boar as an experimental model, a multidisciplinary team made up of scientists from the CNRS and the French National Museum of Natural History have shown that a life spent in captivity has an identifiable effect on the shape of the calcaneus, a tarsal bone that plays a propulsive role in locomotion. Being relatively compact, this bone is well preserved in archaeological contexts, which makes it possible to obtain information about the earliest placing of wild animals in captivity. This modification is caused by changes in the animal's lifestyle, since the bone is reshaped as a result of its movement, the terrain, and muscle stress. The scientists observed that the shape of the calcaneus was mainly modified in the area of muscle insertions: contrary to what might be expected, captive wild boars displayed greater muscle force than wild boars in their natural environment. It appears that a captive lifestyle turned them from "long-distance runners" into "bodybuilders"'. As well as providing archaeologists with a new methodology, these findings show the speed with which morphological changes can occur when an animal is taken out of its natural environment by humans, and could prove useful in programmes reintroducing captive-bred animals into the wild. These results are published in the journal Royal Society Open Science dated March 4, 2020.
Journal Reference:
Hugo Harbers, Dimitri Neaux, Katia Ortiz, Barbara Blanc, Flavie Laurens, Isabelle Baly, Cécile Callou, Renate Schafberg, Ashleigh Haruda, François Lecompte, François Casabianca, Jacqueline Studer, Sabrina Renaud, Raphael Cornette, Yann Locatelli, Jean-Denis Vigne, Anthony Herrel, Thomas Cucchi. The mark of captivity: plastic responses in the ankle bone of a wild ungulate (*Sus scrofa*). Royal Society Open Science, 2020; 7 (3): 192039 DOI: 10.1098/rsos.192039

Shift in West African wildmeat trade suggests erosion of cultural taboos

https://www.sciencedaily.com/releases/2020/09/200918083712.htm
University of Kent, September 18, 2020

New research by the University of Kent's Durrell Institute of Conservation and Ecology (DICE) has demonstrated a clear fluctuation in the trade of wildmeat in and around the High Niger National Park in Guinea, West Africa. Conservationists found a significant increase in the trading of species that forage on crops including the green monkey (*Chlorocebus sabaeus*) and warthog (*Phacochoerus africanus*), in comparison with earlier data, in spite of religious taboos against the killing and consumption of monkeys and wild pigs by Muslims in the region. These species are increasingly being killed to protect crops and farmers can gain economically from their sale, providing an additional incentive for killing. The consumption of wild pigs is prohibited by Islam, yet a marked increase in the number of carcasses recorded in rural areas from 2011 to 2017 has suggested an erosion in the religious taboo. The research team led by Dr Tatyana Humle (DICE) alongside colleagues from Beijing Forestry University, China, and the Higher Institute of Agronomy and Veterinary of Faranah, Guinea, drew conclusions after examining the wildmeat trade in three rural markets in the Park and in the nearest urban centre, Faranah, by collecting market survey data during August-November 2017, and comparing it with data from the same period in the 1990's, 2001 and 2011. Mammals, most notably small sized species, now dominate the wildmeat trade around High Niger National Park. Further findings indicate a marked increase in the number of carcasses and biomass offered for sale from 2001 onwards in rural areas, whereas in Faranah there were no notable differences with data gathered in 1994. Therefore, urban demand does not appear to be driving the wildmeat trade in this region. Instead, the wildmeat trade in rural areas could perhaps be linked to an increase in human population and limited access to alternative sources of animal protein. Dr Humle said: 'This study highlights that despite the local reduction in urban demand for wildmeat, pressures on wildlife in the Park remain. The prominence of crop-protection is increasingly being recognised for driving the wildmeat trade across rural West Africa, yet there is a need to better understand the motivations behind hunting and supply and demand dynamics. There is wider scope to investigate and improve the balance between local farmers' livelihoods and biodiversity conservation.'
Journal Reference:
Lucie Duonamou, Alexandre Konate, Jiliang Xu, Tatyana Humle. Temporal evolution of bushmeat traded in High Niger National Park, Guinea, West Africa. Oryx, 2020; 1 DOI: 10.1017/S0030605319001443

500 years of species loss: Humans drive defaunation across Neotropics

https://news.mongabay.com/2020/09/500-years-of-species-loss-humans-drive-defaunation-across-neotropics/
Elizabeth Claire Alberts on 15 September 2020

A new study indicates that human activities, such as overhunting, habitat loss, and fires, have contributed to a more than 56% decline in species in mammal assemblages in the American tropics.The study drew on animal inventories at more than 1,000 Neotropical study sites, from studies published in the past 30 to 40 years, but with data going back to the time of European colonization of the American tropics. The Amazon and Pantanal wetland regions are considered to be relatively “faunally intact,” according to the study, but the current fires in these regions would be adversely affecting wildlife and their habitats. The researchers say they hope their findings can inform effective conservation policies, such as better management and policing of existing protected areas, and efforts to stop illegal hunting, deforestation and fires.

A new study provides an in-depth look at the detrimental impacts of human activities on wildlife in the Neotropical region of the Americas over the past 500 years.

The study, published Sept. 15 in Nature Scientific Reports, found that more than 56% of species in mammal assemblages, or groups of coexisting species, living in the Neotropics, have died out since 1500, about the time that European colonization began. The biggest losses were seen in ungulate species, such as the lowland tapir (*Tapirus terrestris*) and the white-lipped peccary (*Tayassu pecari*). Humans are largely responsible for this extensive loss of wildlife, or defaunation, the study found, with overhunting, habitat loss, intentional or accidental fires, and the introduction of invasive species and disease all playing a part. While wildlife and habitat have steadily declined since the 16th century, losses have become even more pronounced in the past 50 years, according to co-author Carlos Peres, professor of tropical conservation ecology at the University of East Anglia (UEA) in the U.K.

"We've had a big hike in habitat loss, which more or less coincides with the first big road that reaches the Amazon from the rest of Brazil," Peres told Mongabay. "As you know, the Amazon was isolated from the rest of Brazil until 1971, and so that's a big landmark in terms of tropical deforestation." The study, led by researchers from UEA and the University of São Paulo (USP), Brazil, used animal inventories at 1,029 Neotropical study sites across 23 countries, from Mexico to Chile and Argentina. These inventories were mostly published in the past 30 to 40 years, but the data go back to the time of European colonization. What the researchers ultimately found was that anthropogenic pressures, such as habitat loss and overhunting, were the primary cause of local species extinction and "assemblage downsizing," which refers to the reduction of body size within each mammal assemblage. "Any given species removed from an assemblage will open up an ecological space and consequently a failure in ecosystem functioning," lead author Juliano Bogoni, a postdoctoral researcher at UEA, told Mongabay in an email. "For example, the loss of a large-bodied frugivorous species will compromise the seed dispersal process, forest regeneration, and changes in phytodemographic dynamics (i.e., the forestry composition dynamics and trees dominance). The loss of an apex-predator will alter the top-down control of their prey or promote failures in the control of disease reservoirs. With a local species extinction, the ecosystem also loses their genetic variability and their ecological roles (that is, the functional diversity)." Peres, who has been researching subsistence and commercial hunting in the American tropics for the past 40 years, said the findings ultimately surprised him."I've been to more sites in the Brazilian Amazon, doing wildlife studies, than any other biologist who has ever lived, both people who are alive today and dead," Peres said. "But I'm used to seeing places where only the very large-bodied species are lost. What our paper is showing is that there are a lot of local extinctions of even medium-bodied species." The researchers say they hope this study can help inform conservation efforts in the Neotropics, particularly in the Amazon region and the Pantanal wetlands, which are still considered "faunally intact." Conversely, regions such as the Brazilian Atlantic Forest and the Caatinga have become so degraded that they are now considered to be "empty ecosystems," according to the study.

Bogoni says future conservation efforts should include "effective implementation and law enforcement in existing protected areas, and curbing political pressures to either downgrade or downsize these areas." Additionally, he says action needs to be taken to stop illegal hunting, deforestation and human-caused fires. While conservation work can help protect the intact biomes of the Amazon and Pantanal regions, the fires currently burning throughout these areas would be having a devastating effect on wildlife and their habitats, Peres said. The Pantanal

region is getting hit particularly hard since it's "not really meant to burn," he said. "The Pantanal hasn't burned properly for many, many years," Peres said. "So there's a lot of biomass, a lot of fuel to burn. What people are reporting are … huge numbers of carcasses and huge levels of mortality. The Pantanal fires are really really severe … and they're not done yet. People are talking about rain next week, but we don't know if the rains are going to come." While the findings of the study clearly indicate that humans have contributed to the widespread defaunation of the Neotropics, the paper ends with a call to action — and offers a nugget of hope. "Hominins and other mammals have coexisted since the earliest Paleolithic hunters wielding stone tools some 3-4 million years ago," the authors write. "Over this long timescale biodiversity losses have only recently accelerated to breakneck speeds since the industrial revolution. Let us make sure that most of this impoverishment is behind rather than ahead of us, or else the prospects for Neotropical mammals will look increasingly bleak."

Citation:

Bogoni, J. A., Peres, C. A., & Ferraz, K. M. (2020). Extent, intensity and drivers of mammal defaunation: A continental-scale analysis across the Neotropics. Scientific Reports, 10(1). doi:10.1038/s41598-020-72010-w

Keystone mammal plunges 87% in Mesoamerica

https://news.mongabay.com/2020/07/keystone-mammal-plunges-87-in-mesoamerica/
Francesca Edralin on 17 July 2020

White-lipped peccaries, the pig-like mammals that range from Mexico to Argentina, are in "precipitous decline" in their Mesoamerican range, according to a new study. Their numbers in this region may have dropped by as much as 90% over the past 40 years, sparking a push for a new conservation assessment.The main threat to the species is the destruction of its rainforest habitat, largely attributed to the expansion of agriculture and cattle pasture. Conservationists say the loss of peccaries will have significant ramifications for rainforest ecosystems, which the animals are important in shaping through seed dispersal, tree control, and creation of watering holes.

In 2000, Dr. Rafael Reyna-Hurtado spotted a herd of white-lipped peccaries (*Tayassu pecari*) for the first time in the Mayan Forest. The sight, he says, took his breath away. Never before in his life had he seen nearly a hundred animals of the same species move so steadfastly, perfectly in a straight line, he says. "I was amazed," Reyna-Hurtado says of unexpectedly encountering them while helping a friend study tropical deer in Mexico. "It's a reason why I wanted to study peccaries." The white-lipped peccary is a heavy, pig-like mammal, most easily identified by the white markings under its snout. It feeds mainly on fruits, vegetation, roots and insects, and, less occasionally, small vertebrates like frogs and lizards. This peccary is most commonly found in the rainforests spanning Mexico to Argentina. Twenty years after his first encounter, Reyna-Hurtado is sounding the alarm on the dramatic decline of the white-lipped peccary. In a paper published in February, Reyna-Hurtado and colleagues found the white-lipped peccary population in Mesoamerica, the region that runs from Central Mexico down to Costa Rica, has declined by as much as 87 to 90% over the past 40 years — a decline that is nearly two-thirds higher than the IUCN's previous estimates. Published in the journal Biological Conservation, the study is the combined effort of 50 scientists and urges a reassessment of the white-lipped peccary's

conservation status and needs. Currently, the IUCN classifies white-lipped peccaries as vulnerable, but the study posits the status of the species is closer to endangered, particularly in Mesoamerica.

Herd life makes peccaries vulnerable

Over two decades of research, Reyna-Hurtado has found that the white-lipped peccaries' life in herds that range from 100 to 300 animals makes them especially vulnerable to human activity. There are two reasons for this: large herds are easy targets for hunters, and they can't survive in fragmented, deforested areas. "This is the first species that disappears when humans colonize new habitats, as 'white-lips' disappear even before tapirs and jaguars," Reyna-Hurtado says. While hunting is a severe threat, Reyna-Hurtado says he believes deforestation is the larger cause of peccary decline, since the species requires vast expanses of rainforest to survive. With people logging and burning forests in Mesoamerica for agriculture, livestock, wood and construction, peccaries are taking a hit. Reyna-Hurtado estimates that a normal-sized peccary herd requires 100 to 120 square kilometers (39 to 46 square miles) to safely roam — a requirement that is increasingly difficult to find. In particular, Reyna-Hurtado points to the cattle industry as one of the most notorious for pushing white-lipped peccaries off their habitat. "Cattle-ranching is a big threat for all tropical forests in Mesoamerica," he says. "[A]s we lose pristine forest, we will lose more white-lipped peccaries. This species is the indicator of pristine forest — if we have white-lipped peccaries, that means the forest is in the best conservation status." While Mesoamerica is losing its white-lipped peccaries at the most alarming rate, other regions where the species occurs are witnessing a decline too. Dr. Harald Beck, professor at Towson University and co-chair of the IUCN Peccary Specialist Group, estimates they've experienced a 40 to 50% decline in South America. In the Amazon, as in Mesoamerican forests, white-lipped peccaries are declining due to hunting and deforestation. "Tens of thousands of fires have been set all over primarily Brazil, Peru, and Bolivia to open up the rainforest for agriculture," Beck says.

Gardeners of the forest

Reyna-Hurtado and Beck both emphasize the importance of white-lipped peccaries to rainforest ecology. By moving in vast herds and trekking long distances, white-lipped peccaries play an important role in moving soil and maintaining a balance of various plant species in the forest."This is a species that keeps forest diversity by killing seeds of trees that otherwise will dominate the tropical forest," Reyna-Hurtado says. At the same time, these peccaries disperse seeds through the fruits they eat, increasing biodiversity and the range of these plants.

"They are like the gardeners of the forest," Reyna-Hurtado adds. White-lipped peccaries also perform ecological services for other wildlife. They create deep wallows in the rainforest soil to clean and cool themselves, which then serve as an important water source not only for peccaries, but also for other animals living in the rainforest. "Because the soil is moved into a deeper depression, [the wallows] become a breeding ground for a lot of amphibians," Beck says.Beck says he has witnessed other animals take advantage of the wallows during the rainforest dry season, some of them completely unexpected: fish from the local rivers relocating to the wallows; jaguars bathing in the water; and even bats and owls cooling down in the soil at night. "It's really a remarkable story," Beck says, calling these peccary wallows "islands of biodiversity."

But the drastic decline of white-lipped peccaries across Mesoamerica and South America has begun taking a toll on rainforest ecosystems. Scientists have witnessed the local extinction of three frog species that once depended on peccary wallows for breeding. Reyna-Hurtado and Beck, both of whom consider the white-lipped peccary a keystone species, say the ongoing

decline will drive further changes on the rainforest floor, as well as reduced diversity in plants and wildlife. “If there’s no enforcement, if there’s no protection, then it’s really hard in the near future to see peccaries having a chance to come back,” Beck says. “The pressure [on white-lipped peccaries] just keeps increasing.”

A new assessment

Beck and Reyna-Hurtado, a member of the IUCN Peccary Specialist Group, say a reassessment of the white-lipped peccary’s conservation status is necessary. “Rafael’s paper was really an alarm call for all of us in that we need to reassess it,” Beck says. “It’s overdue, it was around eight years ago that we did the last assessment. The Red List does not reflect reality and this needs to be changed.” However, both say a new IUCN assessment should be only the first step in what needs to be a more ambitious conservation approach. “The IUCN is only a label,” Reyna-Hurtado says. “But we hope that label will help people and governments to take real actions such as stopping hunting and protecting forests.”

Another member of the IUCN Peccary Specialist Group, Alexine Keuroghlian, is taking direct action to ensure conservation efforts. In 2000, she founded the Peccary Project to track the displacement of white-lipped peccary populations in Brazil. She also works directly with ICMBio, Brazil’s federal institute for biodiversity conservation, to develop a national conservation plan to protect peccaries and similar species.

In addition to an IUCN reassessment, Keuroghlian also recommends investment in more sustainable agricultural practices, increased enforcement against illegal hunting and land use, the creation of new conservation units and corridors, and an implementation of reintroduction efforts in areas where white-lipped peccaries have gone extinct. She says conservation efforts must address the multifaceted and complex causes of the white-lipped peccaries’ decline, as these causes are not isolated and are more interconnected than they appear.

“In highly deforested and fragmented biomes, like the Atlantic Forest and Cerrado, habitat loss is probably the main driver of declines initially,” Keuroghlian says. “But with fragmentation, hunters gain greater access to the herds, causing additional population declines.” While most of us will never encounter a white-lipped peccary herd in real life, our dinner plans may be contributing to their decline. “There is clearly a link to our meat consumption with the demand for beef, which of course has to be grown somewhere,” Beck says. That “somewhere” is increasingly over the ashes of rainforests in Mesoamerica and South America, razed to make room for cattle ranches. Inevitably, the destruction of these rainforests takes the herds of precious white-lipped peccaries with it.

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Cattle vs. hippopotamus: Dung in rivers of the Savannah

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Forschungsverbund Berlin, June 16, 2020

In many regions of the world, populations of large mammalian herbivores have been displaced by cattle breeding, for example in Kenya the hippos by large herds of cattle. This can change aquatic ecosystems due to significant differences in the amount and type of dung input. Researchers from the University of Eldoret in Kenya, the University of Innsbruck and the Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB) have therefore taken a closer look at the dung of hippopotamus and cattle. Animal dung can pollute water bodies with nutrients and impact water quality and the ecological functions of water bodies. For many aquatic ecosystems, however, the input of organic matter from the surrounding land is part of the natural matter cycling. In temperate latitudes, it is the leaf fall that brings nutrients into water bodies. In the rivers of the African savannah, it is the hippos with their dung. The increasing displacement of hippopotami by herds of cattle is changing the nutrient inputs into water bodies. Professor Gabriel Singer, Dr. Frank O. Masese and their team investigated the effects of nutrient and carbon inputs from dung on aquatic ecosystems in experiments. The researchers also developed a mathematical model to compare dung inputs from cattle and hippos into the Mara River in Kenya. According to the mathematical simulation, despite lower manure introduction by the individual cattle compared to a hippopotamus, the large number of cattle gives this animal group overwhelming influence.
Cattle dung is more nutritious and stimulates the growth of plants, bacteria and algae
With cattle dung, higher amounts of nutrients such as nitrogen, phosphorus and dissolved organic carbon enter the Mara River. In the experiments, the researchers were able to show that, as a result, more plant biomass is formed with cattle dung. The biomass of bacteria and algae was also higher than with hippopotamus dung. This can change food webs in the river.
"Just the exchange of an animal species that lives on the edge of the river changes the ecological status of the river. Our results show the high species-specific importance of the various large herbivores; they also show how changes in land use or the composition of the species lead to unintended consequences that are not initially the focus of management measures, but which must always be taken into account. Especially with such crucial ecosystems as the waters of the savannah," Gabriel Singer explains the significance of the investigation.
Journal Reference:
Frank O. Masese, Mary J. Kiplagat, Clara Romero González-Quijano, Amanda L. Subalusky, Christopher L. Dutton, David M. Post, Gabriel A. Singer. Hippopotamus are distinct from domestic livestock in their resource subsidies to and effects on aquatic ecosystems. Proceedings of the Royal Society B: Biological Sciences, 2020; 287 (1926): 20193000 DOI: 10.1098/rspb.2019.3000

Pablo Escobar's 'cocaine hippos' show how invasive species can restore a lost world

https://www.theguardian.com/environment/2020/mar/24/pablo-escobars-cocaine-hippos-show-how-invasive-species-can-restore-a-lost-world-aoe
Patrick Greenfield, Tue 24 Mar 2020

Descendants of the drug lord’s pets bear similarities to extinct megafauna

When the drug lord Pablo Escobar was shot dead in 1993, he left behind a zoo stocked with wild animals alongside his multibillion dollar cocaine empire. The lions, giraffes and other exotic species were moved from the luxurious Hacienda Nápoles estate east of Medellín to new homes, but nearly three decades later, dozens of hippos, descendants of animals left behind, are thriving in small lakes in northern Colombia, making them the world's largest invasive animal. Now scientists say that contrary to the conventional wisdom that large invasive herbivore mammals have strictly negative effects on their new environments, Escobar's "cocaine" hippos show how introduced species can restore a lost world.

A team of conservation biologists has compared the traits and impacts on the ecosystems from large invasive herbivore species like the Colombian hippo with their extinct counterparts from the Late Pleistocene (around 116,000-12,000 years ago) period like mammoths, giants sloths and giant wombats. They found some modern day invasive species restore parts of ecosystems not seen since before humans began driving the widespread extinctions of megafauna. Their new study, published in Proceedings of the National Academy of Sciences, found that some introduced herbivore species are an almost perfect ecological match for extinct species from the Late Pleistocene, such as modern day wild horses known as mustangs and the extinct pre-domestic horses in North America, while others bring back a mixture of traits. "The feral hippos in South America are similar in diet and body size to extinct giant llamas, while a bizarre type of extinct mammal – a notoungulata – shares with hippos large size and semiaquatic habitats," explained study co-author John Rowan, Darwin fellow in organismic and evolutionary biology at the University of Massachusetts Amherst. "So, while hippos don't perfectly replace any one extinct species, they restore parts of important ecologies across several species." By comparing ecological traits of herbivore species from before the Late Pleistocene extinctions to the present day, such as body size, diet and habitat, researchers were able to quantify the extent to which introduced species were more or less similar to extinct predecessors. The analysis found that by introducing large herbivore species across the world, humans had restored lost ecological traits to many ecosystems, thereby counteracting a legacy of extinctions and making the world more like the pre-extinction late Pleistocene. Erick Lundgren, lead author and PhD student at the University of Technology Sydney, told the Guardian: "The word 'invasive' doesn't really leave any room for organisms that do something that's beneficial for another species. 'Invaders' don't really help anything. And with that kind of anthropomorphic branding, you end up with a very limited range of research questions that are usually asked." The researchers give the example of wild pigs, which are widely disliked by farmers across the southern United States for destroying crops when large groups are "rooting" for food. But Lundgren said the behaviour is an ecosystem service that had been performed by other large herbivores that

Children walk past a sign warning of the danger of hippos near the Hacienda Nápoles. Photograph: Ivan Valencia/AP

have since become extinct. “There are many species that did what pigs do: just turning over soil. In North America, there were these giant peccaries. There were all these species that did the same thing in the late Pleistocene. For millions of years, everything evolved with this kind of rooting behaviour,” he explained. “If you actually look at what that rooting behaviour does, it is of course density dependent. So if you have 10bn pigs rooting over every inch of soil, there are species that are going to lose their preferred habitats, 100%. But rooting actually does some interesting things. In Tennessee, they’ve found that trees actually grow faster because of the rooting of wild boar because they’re incorporating leaf litter in the soil, increasing decomposition rates and more nutrients become available quicker for trees.” The study authors came from the University of Technology Sydney (UTS) in Australia, the University of Kansas, the University of California Davis and the Natural History Museum of Los Angeles County in the US., Sussex University in the UK, the Universidad de Alcalá in Spain and Aarhus University in Denmark.

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