

Suiform Soundings

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



IUCN/SSC: Wild Pig Specialist Group



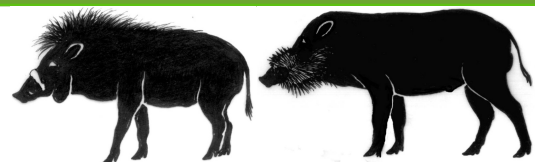
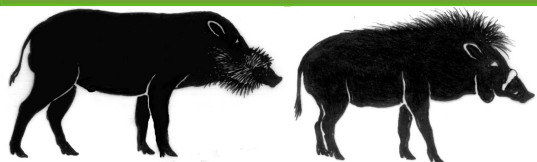
PECCARY SPECIALIST GROUP

Volume 22(1)

August 2023

ISSN: 1446-991-X





Suiform Soundings is the newsletter of the IUCN/SSC Wild Pig, Peccary, and Hippo Specialist Groups.

This newsletter is electronically available at:
<https://www.iucn-wpsg.org/newsletter>

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Photo front page:
Female Visayan warty pig (*Sus cebifrons*) from Negros / Phillipines with piglets: Photo: Justine Magbanua, Talarak Foundation Inc.

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



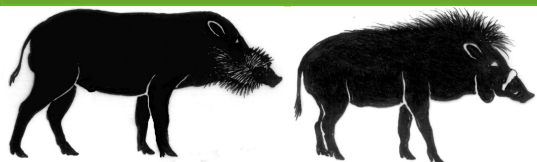
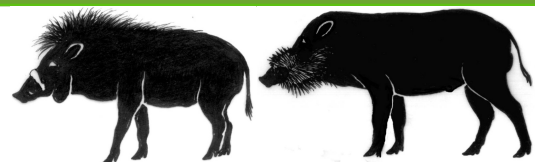
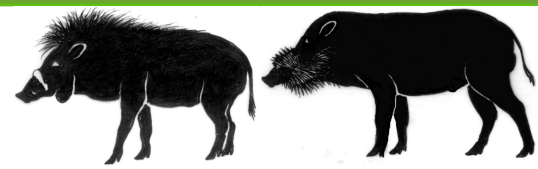
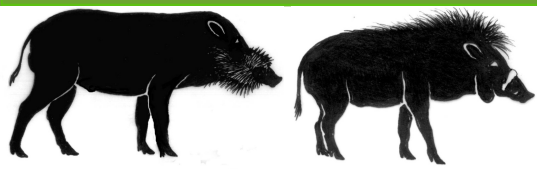


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Dear fellow reader,

I am glad to present you this issue of Suiform Soundings.

Please, take a look on the photo on this page. Emmanuel Kasarherou, the Director of the Musee du Quai Branly Jacques Chirac in Paris recently sent me this photo (via Alastair A. Macdonald). It shows a stone boar from the Lingjiatan culture, ca. 5,800 – 5,300 BP. This stone boar was unearthed from the Ligjiatan site in Hanshan, Anhui Province in China in the year 2007.



Stone boar from Lingjiatan culture, Hanshan, Anhui Province / China, ca. 5,800 - 5,300 BP.

Photo: E. Kasarherou, Director of Musee du Quai Branly Jacques Chirac, Paris.

This stone boar reminds us of the old and long-lasting relation of wild boar with humans. Nevertheless, this relationship is being threatened by humans. Along with hunting and the destruction of habitats, African swine fever is definitely one of the most dangerous threats to Eurasian wild boars and all the other Asian wild pig species at the moment (see our main article in this issue).

Unfortunately, Matthew Linkie has left the editorial board of Suiform Soundings. On behalf of the editorial board, I want to thank him for all his work, his comments and all his efforts for Suiform Soundings. We wish him all the best for his future. We are confident that wild pigs and peccaries will also benefit in the future from his passionate work in wildlife conservation! Thanks a lot, Matthew! It was a pleasure to work with you and we shall miss you in the editorial board!

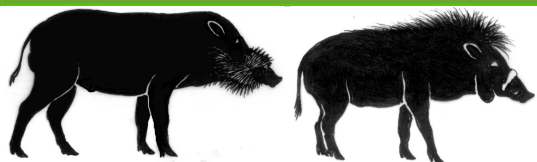
I hope you enjoy reading this issue of Suiform Soundings!

With warm regards,

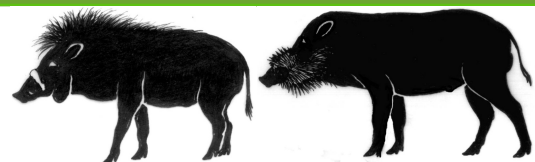
Thiemo Braasch

Chief Editor Suiform Soundings





African Swine Fever



Detection of African swine fever virus in fecal samples of Visayan warty pigs (*Sus cebifrons*) from a conservation center in Negros island, Philippines

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Abstract

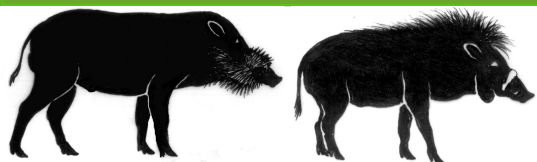
African swine fever (ASF) is a notifiable viral disease with no known treatment or vaccination. Early detection is the first step to containing the virus. The worldwide ASF epidemic has now spread to the Philippines, which has the second highest number of endemic suids, including the critically endangered Visayan warty pig (*Sus cebifrons*). Following the ASF-confirmed deaths of Philippine warty pigs (*S. philippensis*), categorized as vulnerable by the IUCN, an investigation was conducted in the University of the Philippines Los Baños campus to determine if the virus had spread to the Visayan warty pigs. Fifteen fecal samples, ten of which were confirmed to be from ten different pigs in the conservation center and the other five samples collected from the wild, with no indication of whether the samples originated from a single pig or five different pigs from the area, were collected and examined via quantitative real-time PCR assay (qPCR). The results presented five of 15 samples testing positive for ASFV, suggesting continued spread of the virus, possibly from the lack of manpower in nationwide surveillance, from illegal import and transport of diseased pigs, or from poorly implemented biosecurity measures. As of March 2023, the pigs from the conservation center that positively tested for ASF are reported to still be alive two years since sample collection in February 2021; no reports of deceased Visayan warty pigs in the wild have been made, suggesting the possibility that the Visayan warty pig may possess a degree of resistance to the virus, and thereby potentially play a significant role in vaccine development.

Keywords: African swine fever, Visayan warty pig, *Sus cebifrons*, quantitative real-time polymerase chain reaction assay, fecal samples

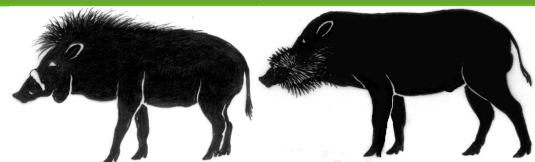
Introduction

The African Swine Fever (ASF) outbreak in the Philippines began in July 2019, with deaths reported initially in domestic pigs in Rizal, a province in Southern Luzon (Bonquin, 2019). In January 2021, the death of nine Philippine warty pigs (*S. philippensis*) in a privately-owned forest patch in Davao del Norte, Mindanao, as well as two pigs exhibiting similar clinical signs seen in ASF-positive domestic pigs, called for a postmortem examination and a PCR assay, which confirmed the deaths to be from ASF (Chavez et al., 2021). In May 2021, an estimated 100 wild pig deaths in Abra province were reported by pig hunters. The meat was sent for testing and was found to be positive for ASF infection (Malnawa, 2021; Quitasol, 2021). As of December 2022, seven more Philippine warty pig deaths were reported in Bukidnon. Though the DNA of the pigs





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was too degraded to allow for testing, the province already reported positive for ASF cases. The monitoring update of ASF spread in the country released by the Bureau of Animal Industry (BAI) last September 2022 confirmed the entirety of Regions IV-B, V, VI, VII, and ARMM as ASF-free zones, though it must be noted that the memorandum did not take account of wild pig deaths from suspected or confirmed ASF. Philippine warty pig distribution is limited to areas in Luzon and Mindanao, as well as the Visayan islands of Samar and Leyte, where the majority of the areas have active cases of ASF in domestic pigs. In contrast, the Visayan warty pig (*S. cebifrons*) resides only in the western Visayan islands of Negros, one of the last few areas that remain ASF-free, and Panay, which reported its first ASF case in October 2022. To confirm whether the Visayan warty pigs on Negros remain unaffected by the ASF outbreak, a PCR assay can be performed on fecal samples collected from captive pigs in a conservation center.

Methods

Sample Collection

All fecal samples were collected on different dates of February 2021. Samples from the conservation center were collected from 13 – 15 February at two in the afternoon by personnel. Samples from the wilderness in Bayawan were collected from 4 – 9 February at random times of the day by researchers tracking the pigs. Each sample was contained in a resealable freezer bag before being packaged in individual plastic containers.

DNA Extraction

Each sample was transferred from its plastic resealable container to a respective stool sample container with a corresponding label. Each sample had 200 mg taken and placed in individually labeled 2 ml microcentrifuge tubes. The DNA was extracted using the Qiagen QIAamp® Fast DNA Stool Mini Kit (Qiagen, Holden, Germany) following the manufacturer's instructions.

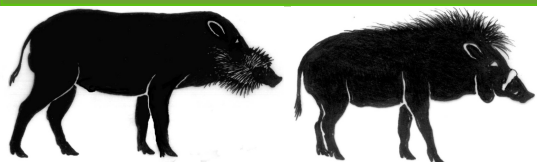
Conventional Polymerase Chain Reaction (PCR) Assay

The PCR master mix utilized a total of 25 µL volume per reaction; the mix was composed of 12.5 µL of Promega GoTaq® Colorless Master Mix (Promega, Wisconsin, USA), 10 µL of nuclease-free water, 2 µL of each sample DNA, and 0.25 µL each of the forward and reverse primers. The primer sets used for the assay were ASF-VP72-F sequence 5'-CCC-AGG-RGATAA-AAT-GAC-TG-3' (forward primer); primer ASF-VP72-R sequence 5'-CAC-TRG-TTCCCT-CCA-CCG-ATA-3' (reverse primer). The samples were then subjected to non-nested uniplex conventional PCR as per the manufacturer's instructions.

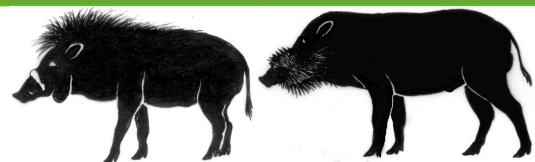
Quantitative Real-time Polymerase Chain Reaction (PCR) Assay

The PCR master mix utilized a total of 20 µL volume per reaction; the mix was composed of 10 µL of the GoTaq® Probe qPCR Master Mix (Promega, Wisconsin, USA), 6 µL of nuclease-free water, and 0.8 µL each of the forward and reverse primers. The primer sets used for the assay were ASF-VP72-F sequence 5'-CCC-AGG-RGA-TAA-AAT-GAC-TG-3' (forward primer); primer ASF-VP72-R sequence 5'-CAC-TRG-TTC- CCT-CCA-CCG-ATA-3' (reverse primer), same as in the conventional PCR. The amplicons produced from the conventional PCR assay were utilized as the template for the qPCR assay, with 2 µL from each sample being added to each tube. The master mix volume was multiplied by 32 to accommodate all 15 samples with expected excess; each sample was duplicated once and distributed in two tubes. The final mixture was then





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subjected to PCR assay following the manufacturer's instructions.

Initial denaturation was set at 95 °C for five minutes, followed by 45 cycles. A subsequent denaturation step was set at 95 °C for ten seconds. Annealing was performed at 60 °C for 30 seconds. A fluorescent-labelled hydrolysis probe set at a concentration of 5 pmol/μl:(5'-[6-carboxy-fluorescein (FAM)]-CCA-CGG-GAG-GAA-TAC-CAA-CCC-AGT-G3'-[6-carboxy-tetramethyl-rhodamine(TAMRA)]) or (5'-[6-carboxy-fluorescein(FAM)]-TCCTGG-CCR-ACC-AAG-TGC-TT-3'-[black hole quencher (BHQ)]) was included to detect the concentration of the final products.

Results

Detection of ASFV in fecal samples

An initial qPCR assay of the 15 samples yielded zero positive and 15 negative results due to the low concentration of viral DNA produced in the run. A subsequent attempt to amplify DNA concentration was then conducted via conventional PCR assay before running a second test via qPCR.

As per the OIE Terrestrial Manual, a cycle threshold (Ct) value < 40.0 signifies a positive test result. In particularly strong positive results, the Ct value < 30.0 (2021). Sample P4-1 resulted in the lowest Ct value of Ct = 35.13 while sample P7 resulted in the highest at Ct = 39.16. Samples P4, P8, and P10 tested positive for ASFV as well at Ct = 38.22, Ct = 36.11 and Ct = 36.84, respectively. In summary, samples P4, P4-1, P7, P8, and P10 tested positive for ASFV based on their cycle threshold values. Viral DNA detection and quantification via qPCR assay yielded five out of 15 samples testing positive for ASFV.

Detection rate of ASFV

In the final qPCR assay that was performed, five out of the 15 samples were found to be positive for ASFV. This finding indicates a detection rate of 33.33%. Table 1 summarizes the detection rate of ASFV in the sample population tested. Note that the detection rate is applicable to the fecal sample population, but not necessarily to the population of Visayan warty pigs from which the samples were collected.

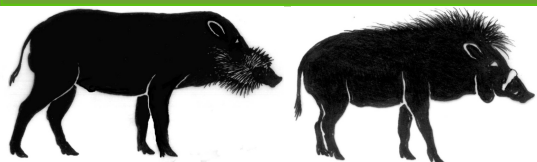
Discussion

Use of PCR in molecular detection

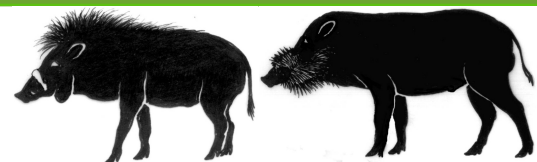
Utilization of PCR to amplify and detect viral concentration in living organisms has been practiced since its introduction in the early 1980s. Throughout its technological evolution over the years, PCR has become the gold standard in nucleic acid detection (MacLachlan and Dubovi, 2017). Its ability to amplify the concentration of a select nucleic acid sequence from a wide variety of source materials (from soft tissue to excretions) has made the PCR assay one of the most effective and efficient assays in its field. Samples can be taken either directly from the living organism or from their excretions, the latter of which providing the advantage of minimizing disturbance of the organism's body systems and environment (MacLachlan and Dubovi, 2017; Nieto-Pelegrín et al., 2015; de Carvalho-Ferreira et al., 2014).

It can be speculated that the initial run of the qPCR assay yielded negative results due to the possibility of the samples being weakly ASF-positive, which lowered the sensitivity and specificity of the assay as a result (Fernández-Pinero et al., 2012). The initial run was also deemed invalid





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when the results revealed the negative controls had a Ct < 40, indicating contamination during the experiment. As per the OIE Terrestrial Manual, negative test samples and negative controls should be detected at Ct > 40; positive test samples and positive controls should be detected at a Ct < 40, with particularly strongly positive samples at a Ct < 30 (2021).

In detecting ASFV in wild and endangered pig species, such as the Visayan warty pig, both inhabitants and their habitats must not be unnecessarily stressed or disturbed during sample collection. Given this, sample collection is limited to animal excreta such as fecal pellets, urine, and saliva; the latter two would require immediate collection and at proximity, which may risk harming both the animal and the person collecting. On the other hand, fecal samples from suspected infected pigs that do not exhibit diarrhea are more tangible and more feasible to collect (FAO, 2022; Viltrop et al., 2021; de Carvalho-Ferreira, 2014).

Of the 15 fecal samples collected from two different areas in Negros, ten samples were from ten different pigs in the conservation center, whereas the other five samples were obtained from the wild, with no indication of whether the samples originated from a single pig or five different pigs. As the labels on the containers of the samples had faded over time, it could not be determined from which area and which pig or pigs the positive samples came. Detection rate of ASF-positive pigs would also differ from the detection rate of ASF-positive samples; the former would range between 33.33% to 50%.

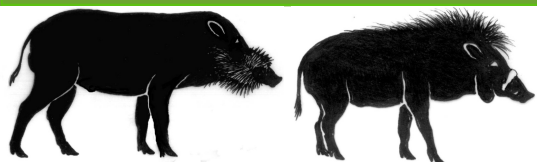
Feces has been proven to be a suitable source of the ASF virus given the right conditions. In one study, the virus was both stable and detectable during the first 21 days post-inoculation 50-80% of the time. Environmental temperature heavily affects the longevity and persistence of the virus, be it on the field or in storage. In temperatures between 5-12 °C, the virus possessed a half-life between two to four years; in contrast, at a temperature of 30 °C, the half-life of the virus was estimated at 15 days (de Carvalho-Ferreira et al., 2014). For this experiment, the samples were stored in a -80 °C freezer for over a year.

The ASF outbreak and its key players

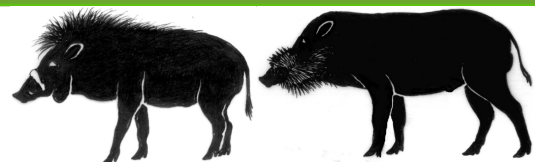
The ASFV possesses genes capable of inhibiting hosts defenses by shutting down antiviral pathways, programmed cell death (apoptosis), and antiviral responses of type I interferon, which works to activate early innate immune responses that ultimately lead to the activation of adaptive immune responses (Dixon et al., 2020). One study covering the ongoing spread of the disease in Europe has reported a “slow epidemic movement” of an estimated 1.5 km per month, able to persist as it spreads in areas with low incidence stretching over the years (Viltrop et al., 2021). The inhibitory action of the virus accounts for the 100% morbidity and mortality rates of the disease, which in turn have made ASF a notifiable disease (OIE, 2021; Martinez et al., 2018; Costard et al., 2009).

The recent global ASF outbreak began in the North Caucasus region and in the Russian Federation in 2007, where infection has continued to spread to neighboring countries and continents. The disease was initially believed to fade out over time as it did in past epidemics through disease eradication in domestic pigs, through a high case fatality rate and nonexistent long-term disease carriers, but the continued spread of the disease proved otherwise (Viltrop et al., 2021).





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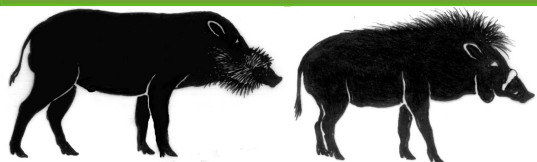
In the Philippines, the first case of ASF in wild boars was reported in northern Luzon in early 2021, then in southern Mindanao in less than six months, this time affecting the vulnerable Philippine warty pig (Chavez et al., 2021; Cimatú, 2021; Dumlao, 2021; Malnawa, 2021; Quitasol, 2021). Despite the advantage of a natural sea border, the Philippines continues to be plagued by ASF; the Panay islands, one of the two last known habitats of the critically endangered Visayan warty pig, reported positive cases in late 2022. This study was conducted to determine whether the virus has spread to the Visayan warty pig.

Emphasis on early detection is often made when discussing control measures against ASF. Early detection can be done through active and passive surveillance, where the latter method relies on diagnostic testing of sick or deceased domestic pigs and wild boars (Gallardo et al., 2021; Pikalo et al., 2021). In contrast, Dixon and colleagues refer to diagnostic testing of sick and dead boars as a form of active surveillance (2020). In this experiment, the diagnostic test results of a small number of randomly selected Visayan warty pigs using their fecal matter presented one-third of positive samples, confirming that ASF has spread to this species.

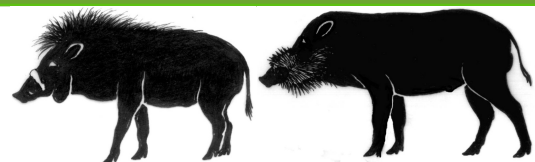
In the recent global ASF outbreak, the main players seem to be wild boars, as a five-year observational study between 2007 and 2012 suggested two routes of possible introduction of the virus: 1) consumption by wild boars of improperly disposed infected carcasses, or 2) a possible migration of infected wild boar, leading to a possibly permanent virus transit (Gogin et al., 2013). Several texts suspect the wild boars play a key role as disease reservoirs, which may explain the longevity and persistence of the virus in both wild boar and domestic swine populations over the years (Dixon et al., 2020; Nieto-Pelegrín et al., 2015; de Carvalho-Ferreira, 2014). Viltrop and colleagues observed that the virus was able to survive in the environment regardless of outbreaks in domestic pigs, concluding that the virus no longer relied on direct contact between free-range domestic pigs and wild boars, or between infected carcasses and wild boars to keep spreading; in previous epidemics, outbreaks faded out through disease eradication in domestic pigs, leading to a high case fatality rate (CFR), but effectively culling long-term disease carriers (2021).

Ten of the wild boars from which the fecal samples were collected belong to a conservation center on Negros island; direct contact with domestic pigs or with improperly disposed carcasses would have likely been minimal. Confirmed infection of a fraction of these samples in a minimally interactive environment would likely imply a new means of virus spread: human involvement. In one instance, the ASF outbreak had been initially contained via tightened security measures and heightened border patrol in the province of Cotabato for almost a year when a second wave was reported in May 2022. The provincial veterinarian stated that limited manpower for surveillance and monitoring was taken advantage of by ambulant vendors (Magbanua, 2022). Gaps in surveillance and lapses in border patrol allow for unregulated entry of pork and its byproducts near to or within the habitat range of Visayan warty pigs (Cannon, 2021). Reported incidences of smuggling pork have increased following the rise of importation. Smuggling jeopardizes the country's food safety and security, as the commodities are undocumented and unregulated. After a new strain of swine flu emerged in China between 2011 to 2018, there were calls for cessation of smuggling from the country, as the strain was a descendant of the zoonotic H1N1 strain from the 2009 swine flu pandemic (n.a., 2023; Arcalas, 2020). Discrepancies in reports between the Bureau of Customs (BOC) and the Bureau of Animal Industry (BAI) imply corruption at work, with





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government officials cooperating with smugglers, as the taxes could have been used in financially aiding affected farmers, only for them to be unpaid and unaccounted for (Talavera and Romero, 2021). Authorities rejected the suggestion of closing select trading ports, stating that doing so would not be as efficient a solution as meticulous inspections of vessels that dock and leave the ports, which is what the current protocol is (Sison Jr., 2023). With corrupt government officials working with smugglers, as well as refusals to control the number of ports to open for trade and entry, there is a high chance of unregulated, infected pork being circulated in the country, aided by long and porous borders of the country's islands.

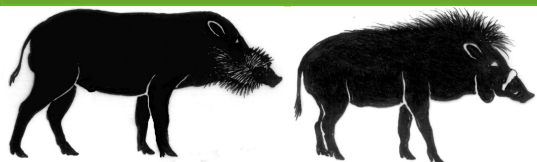
The government's response towards the spread of ASF has mainly focused on transport bans and mandatory culling, though cases of ASF infection continue to be reported nationwide. Strategies to control the spread are unfavorable and disadvantageous towards small-scale and backyard farmers, who comprise nearly 90% of the swine industry, subsequently also providing for most of the pork and pork byproduct demand in the market (Domingo et al., 2022). Festivals in various municipalities were held for producers to sell their remaining pork stocks to earn income and avoid ASF spreading to their farms. Proceeds earned from these festivals would then be spent on purchasing piglets for affected raisers, under the condition that the ASF outbreak would be contained (Lena, 2022a; Lena, 2022b; Wedzerai, 2022). Financial compensation under unpredictable conditions is not an effective long-term solution. This is seen in hog raisers that were no longer financially supported by the Department of Agriculture (DA) resorting to slipping past culling mandates by selling their infected pork and pork products at local markets (Magbanua, 2022).

Other financial support programs that the Department of Agriculture (DA) established are the Integrated National Swine Production Initiatives for Recovery and Expansion (INSPIRE) and the Bantay ASF sa Barangay (BABay ASF) programs to steadily repopulate and restock the supply of pork and pork products and to fund improved biosecurity measures in small enterprises and backyard farms, respectively (Domingo et al., 2022; Wedzerai, 2022; DA Communications Group, 2021). A number of local government units (LGU) that have begun to implement the BABay ASF program are either still in the containment zones (areas with confirmed ASF+ cases, are adjacent to ASF+ cases, are at high risk for ASF infection, or at low risk but adjacent to ASF+ cases), or are providing pork and pork byproducts to other areas still in containment zones (Calipay, 2023; Tupas, 2021). Production of healthy swine was promoted by the provincial government in Ifugao by lifting transport restrictions. Ifugao, an ASF+ zone as of January 2023, implemented the BABay ASF program in 2022 (Calipay, 2023; Lihgawon, 2022).

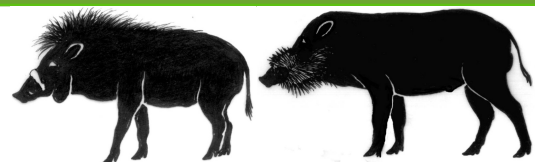
The Department of Labor and Employment (DOLE) encouraged affected farmers to sign up for the Tulong Panghanapbuhay sa Ating Disadvantaged/Displaced Workers (TUPAD) Program to earn cash for work for a maximum of 30 days. Income generated from this one-month job contract varied among provinces (Garcia Jr., 2022; Wedzerai, 2022).

Domingo and colleagues evaluated the various food animal industries in the country, pointing out how the prices on pork and pork products had increased due to the decrease of production caused by ASF. The government response was to lower the pork tariff to stabilize pork prices, subsequently hurting the profits of local producers (2022). Briones and Espineli observed that





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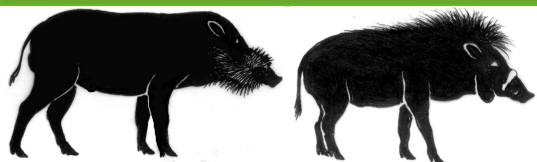
rather than providing direct production support for the industry, the government focused on an indirect price policy via tariffs (2022). Should the domestic swine population continue to decline and constrain local producers, there would be an increasing pressure on hunting wildlife as an alternative (Luskin et al., 2020).

Control of the virus and conservation action

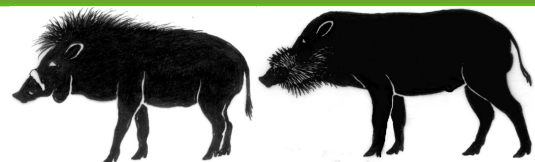
It was reported that the small population of wild boars from which fecal samples were collected are still alive as of March 2023. There have been no reports of dead wild pigs discovered in the wilderness of Bayawan, from where the five other fecal samples were obtained. The population of these pigs did not exhibit any signs or symptoms of illness or infection, suggesting that they may possess a level of resistance against the virus that other endemic species such as the Philippine warty pig, which have been recorded to die from ASF infection, do not. Research on the common warthog (*Phacochoerus africanus*) reveals that the species possesses innate immunity against ASF due to adaptive introgression (Garcia-Erill et al., 2022). Common warthogs have been documented to occur sympatric to the desert warthog (*Phacochoerus aethiopicus*) and interbreeding with them; which led to the hypothesis that significant immune system-related genes originated or adaptively introgressed from the desert warthogs. A similar scenario of adaptive introgression was documented in the European house mouse (*Mus musculus domesticus*) possessing rodenticide-resistant variants that originated from the Algerian mouse (*Mus spretus*); both species occur allopatric to each other, with no records of hybridization (Hendrick, 2013). Advanced genetic research on Visayan warty pigs may reveal a shared ancestor and gene variant with African suids, or an undiscovered gene variant that is also resistant to the virus. One study found that the PTGS2 gene, responsible for inflammatory reactions, plays a key role in immune response to ASF; another study found that overexpression of the LDHB gene inhibited ASFV replication, with tripartite motif-containing (TRIM) proteins also possibly contributing to ASFV resistance (Feng et al., 2023; Garcia-Erill et al., 2022). Further research on this suspected level of immunity may even suggest that wild pigs may be able to buffer the high mortalities of initial outbreaks (Cannon, 2021). On the other hand, the possibility of the Visayan warty pigs being resistant to ASF may support the theory of these pigs playing a role as a wildlife reservoir, although another study has founded that pigs that have fully recovered from viral infection do not become long-term carriers of it (Penrith et al., 2004).

Should further studies confirm any significant degree of resistance of Visayan warty pigs to the ASF virus, the outcome may lead to increased conservation awareness and efforts, not only for the Visayan warty pigs, but for other endemic species, such as the Philippine warty pigs. In the middle of a global outbreak of ASF, the potential resistance of Visayan warty pigs against the virus can significantly contribute to vaccine research. Visayan and Philippine warty pigs are said to share a common ancestor and occur allopatric to each other (Groves and Grubb, 1993; Oliver et al., 1993). There may be a possibility for the latter species to develop resistance, either through intensive genetic research and engineering, or even through a hypothetical vaccine that utilizes the resistance of Visayan warty pigs and other naturally resistant African suids. A previous study had recorded that antibodies against ASFV persisted in the system for at least two years without repeated exposure to the virus (Penrith et al., 2004). The opportunity to increase the resistance of Philippine warty pigs and other native pigs against ASF through genetic modification has been achieved against porcine respiratory and reproductive syndrome (PRRS) virus (Netherton et al.,





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2019). Concentrated efforts on the conservation of one species may work to conserve others simultaneously (Meijaard et al., 2013). In the case of Philippine warty pigs, which have had recorded die-offs from ASF since the beginning of the outbreak, local support of Visayan warty pigs would be beneficial.

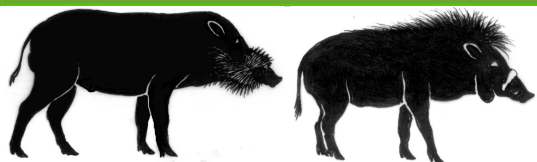
Protecting the remaining populations of Visayan warty pigs is not only advantageous to its closest suid relatives, but even to other players in the ecosystem they inhabit. Dubbed as engineers of the forest, Visayan warty pigs are responsible for the healthy condition of forests and of both predator and prey animals (Gonzalez, 2023). Their soil rooting behavior allows for natural aeration and planting of fallen seeds; their tendency to wallow and create shallow water holes allows other species to drink from the very same holes formed, and as long as they remain as the main food source for predator animals, wildlife and human interactions can be reduced if not avoided (Gonzalez, 2023; Luskin et al., 2020). If Visayan warty pigs were to go extinct, the ecosystem would be heavily negatively impacted.

Conservation support for the species may contribute to the national economy in the far future. Presenting Visayan warty pigs to locals in a more positive light will gain them favor and support. This can be done through practical control measures that will keep the pigs from raiding crops and breeding with domestic swine and through inciting a sense of national pride by highlighting the endemicity and uniqueness of the pigs. Bringing international attention to the pigs via awareness campaigns and public announcements such as broadcasting the birth of a piglet may also reflect similar support for the conservation of the species. The more people that are made aware of the existence and situation of Visayan warty pigs, the more likely they are to visit and support conservation centers and other similar institutions and increase revenue and funding through this (Meijaard et al., 2013).

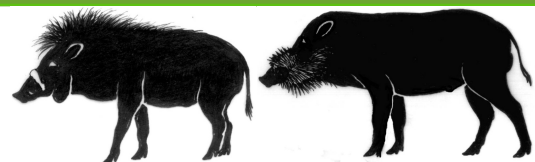
Current measures to control the spread of the virus include the government banning hunting of wild boars and culling wild pigs within a one-kilometer radius from the area of infection (Agoot, 2021). Both methods are similar to the preventive services agreed on by veterinarians and government units in the Primorye Territory (Primorsky Krai), which allowed them to successfully contain the ASF outbreak in their area (Momot et al., 2021). A major difference between the territory and the Philippines is the geographical structure; Primorye is located southeasternmost of Russia, a small territory bordered by China and North Korea, whereas the Philippines is an archipelago. The latter would have more ports than the former, which would allow several points of entry of the virus. Primorye also likely did not need to be cautious about culling wild boars as much as the Philippines should, considering the endemicity and conservation status of the Visayan warty pigs.

The main limitation encountered during this experiment was the prolonged storage of the samples in the freezer. Though the samples themselves were not compromised, the labels on the resealable bags had faded in the year the containers were stored in the freezer. As a result, One other setback in the experiment is the small sample size, limited by the already reduced number of existing Visayan warty pigs. A small sample size increases bias towards the healthy population, lowering the sensitivity of the PCR assay, and therefore not accurately presenting the progress of the virus.





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Conclusions and recommendations

Given the results of the PCR assay, Visayan warty pigs in the Philippines have tested positive for African swine fever. Considering the sample population are pigs in a conservation center, possible sources of infection and spread may be from human intervention through poor biosecurity practices, loose surveillance protocols, or unregulated entry of pork products. Conservation, rescue, and breeding centers should test the remaining boars and improve biosecurity measures to ensure the survival of the remaining boars in their facilities.

To ensure peak sensitivity and lowered bias, de Carvalho-Ferreira and colleagues propose increasing the sample population in succeeding experiments (2014). The sample population showed no signs of illness prior to sample collection and even after sample testing; as of March 2023, all the pigs remain in good health. Further research can be done to examine the level of resistance of Visayan warty pigs, particularly with reference to the natural resistance of African suids.

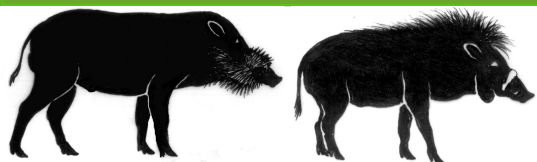
Visayan warty pigs testing positive for ASF but not immediately dying from the disease should be reported to authorities, especially in this case, where we aren't certain whether the ASF-positive samples originated from the wild, from the conservation center, or from both. It wouldn't be recommendable to cull the pigs regardless of whether they survive the viral infection or not, as culling would be counterproductive to the conservation of the species whose population may not even be in the thousands.

Based on the animal health pivot grid by the Philippine Animal Health Information System Website (Phil-AHIS), only a population of two unspecified wild and exotic animals have been recorded between the years 2015-2019. The grid itself is severely outdated and generalized, not even specifying the type of wild or exotic animals that were recorded. Accurate, definitive, and up-to-date reports of deaths in wild pigs especially in light of the ASF outbreak emphasizes the gravity of the outbreak and the detrimental effects of the virus on the country's endemic pigs, which are naive to the virus. An accurate population count of wild pigs may not be possible considering their elusive behavior, but an estimated population count would still be able to shed light on effects of ASF on wild pigs and not just the domestic swine.

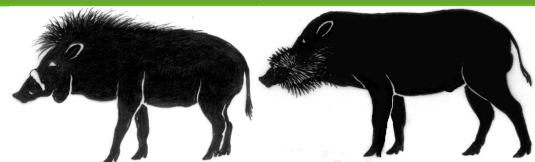
Retesting of fecal samples of Visayan warty pigs should be performed as soon as possible, using OIE-validated PCR assays. This is to confirm where the positive samples in the assay were obtained from, be it from the pigs in the conservation center or in the wild, and to confirm that the kits that had been used in this study were reliable despite not being licensed under the OIE Register of Diagnostic kits. This would also allow for a more accurate monitoring of the health status of the pigs as well.

Visayan warty pigs testing positive for ASFV must be brought to public attention, although the manner of reporting should be done in such a way that it does not antagonize the pigs. Media outlets must emphasize on the causes of the outbreak, which are continued pork importation and improper carcass disposal, and on inadequate surveillance and deficient farmer assistance, which have continued the spread (Wedzerai, 2022; Adriano, 2021; Cannon, 2021; Simeon, 2019; Buttke et al., 2015). Given this suggested manner of reporting, the public perception towards pigs





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may be less antagonistic, and may even lead to support for the conservation of the species at the height of the outbreak. An undesirable consequence may be that the blame is shifted to other stakeholders, such as swine farmers struggling to earn while being disadvantaged by government mandates. Choosing to emphasize suggestions to contain the outbreak may sway the public into action towards local support, both for farmers and pigs.

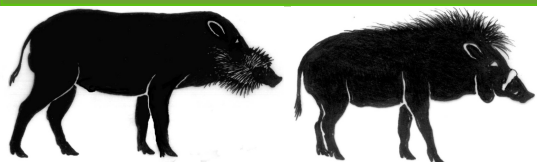
Reports published in Chinese and in English regarding wild boars in Hong Kong had noticeably focused on business districts and high-income neighborhoods, as opposed to data gathered by the Agriculture, Fisheries and Conservation Department (AFCD) (Wang and Mumby, 2022). If reports in the Philippines could focus more on management plans and their progress, it might be possible that public perception may improve and even inspire support for both farmers and wild boars.

Meijaard and colleagues also suggested appealing to national pride by emphasizing the endemicity and unique physical features of the Visayan warty pigs (2013). Their intelligence may also be highlighted, as the species was the first to be documented using tools during nest building, as observed in captivity (Root-Bernstein et al., 2019).

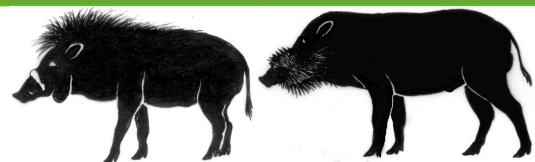
The One Health approach to garner support for the pigs requires also supporting human and environmental health (Luskin et al., 2020). Due to its geographical location, the Philippines is prone to natural disasters that heavily impact the agricultural sector and lead to major losses in several industries, including the swine market. In the current situation, the government opted to import stocks to cater to demands, and locals took to hunting wild pig species to compete with the market. The crop-raiding behavior and widespread ASF cases in wild pigs adds hunting pressure on Visayan warty pigs and threatens their population, and if used as an alternative pork source, the lack of research may jeopardize food safety and security, as wild pigs would not have received the same management as their domestic counterparts.

Optimizing veterinary services is advantageous for the survival of the pigs, as well as for pushing forward the One Health agenda. In the Wuqiaohe Basin in China, physical barriers such as night lights, noises, and fences of various materials were deemed ineffective; although fences were the most operational, they were also the costliest among the options. Biological barriers in the form of crops favored by wild boars have also been attempted, although the availability of crops, as well as the physical and financial investment put into them may differ from a Philippine context (Liu et al., 2019). The Primorye Territory in Russia suffered from only two ASF outbreaks between 2019 and 2020, both of which were eradicated with the cooperation of veterinarians and the local government. Their main tactic emphasized preventive services, which included chemical cleanups of farms and related enclosures, culling of pigs and burning their corpses within a 10-km radius from the infected area, as well as properly killing their waste products (Momot et al., 2021). The National Academy of Science and Technology in the Philippines (NAST PHL) has rallied for affordable alternatives to swill feeds, which was a suspected cause of the outbreak in farms in Southern Luzon back in 2019, as well as improving veterinary public health and biosecurity practices (2021).





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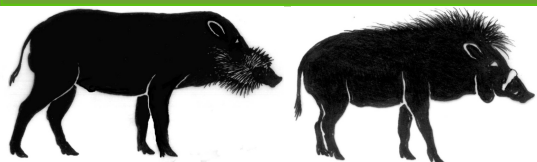


Oliver had observed that illegal logging and the spread of agriculture also involved hunting down the pigs in the area (1993). Should the government focus more on pig restocking, recovering agricultural land, and improving biosecurity measures, deforestation may be at the very least reduced, and forests would likely be restored, leading to a more suitable habitat for wild pigs, and luring them back into the wild and away from residential areas. With the wild pigs returning to the forests, forest health itself would be restored, in that birds and smaller mammals are also able to feed and drink again from the fallen and uneaten fruits and the water holes formed from wallowing, and even the soil is aerated and the seeds are planted due to the rooting behavior of the pigs, allowing for continued growth of both plant and animal life (Gonzalez, 2023; Cannon, 2021; Luskin et al., 2020; Dell'amore, 2019).

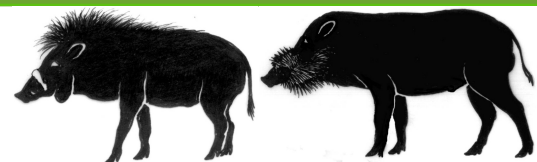
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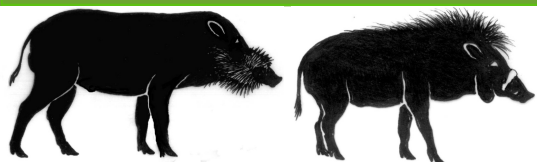


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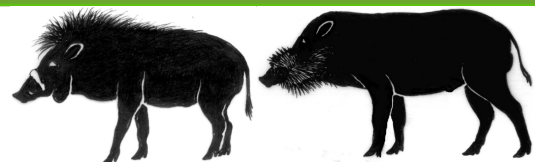


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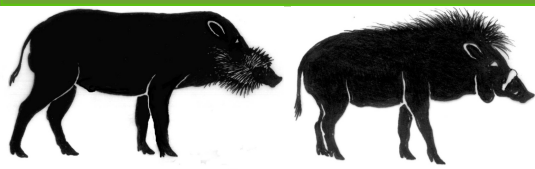


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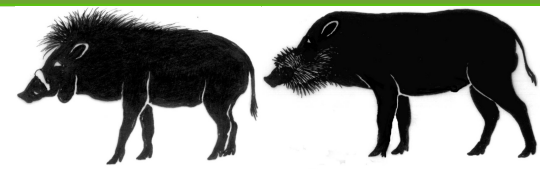


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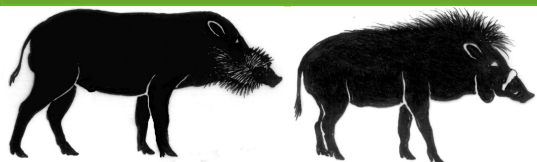


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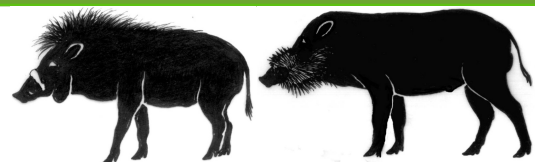


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Physiology and Anatomy



Seasonal hair growth and loss in wild boar (*Sus scrofa*) and its implications for research

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Editor's note

This article was published as a poster on the 36th Congress of International Union of Game Biologists, Warsaw, Poland, 28th to 31st August 2023.

Introduction

Knowledge about hair growth and loss in wildlife is important for research in different contexts. For instance, for measuring stress and reproductive hormones, biomonitoring of heavy metals and – depending on the species – for telemetry studies. In wildlife telemetry, when devices are glued onto the fur of mammals, in some species it is essential to know when the fur, more precisely the undercoat that prevents the glue from touching the skin, is completely grown and when the change of coat begins. This allows scientists to plan the capture, sampling, tagging, and recovery of tags, as well as estimating how long the tag will provide usable data.

Methods

To get an overview of the seasonal hair growth and loss in wild boar, we examined culled individuals from Nuremberg's imperial forest (Nürnberger Reichswald) in Bavaria, Germany (Fig. 1) for 12 consecutive months. Mid of each month (July 2022 - June 2023), we examined the fur of two to four wild boars (N=33), depending on hunting bags, from three different age classes (<12 months (n=6), 12-24 months (n=20), >24 months (n=7) and both sexes (n=15 males, n=18 females) for presence of undercoat in autumn and its loss in spring.

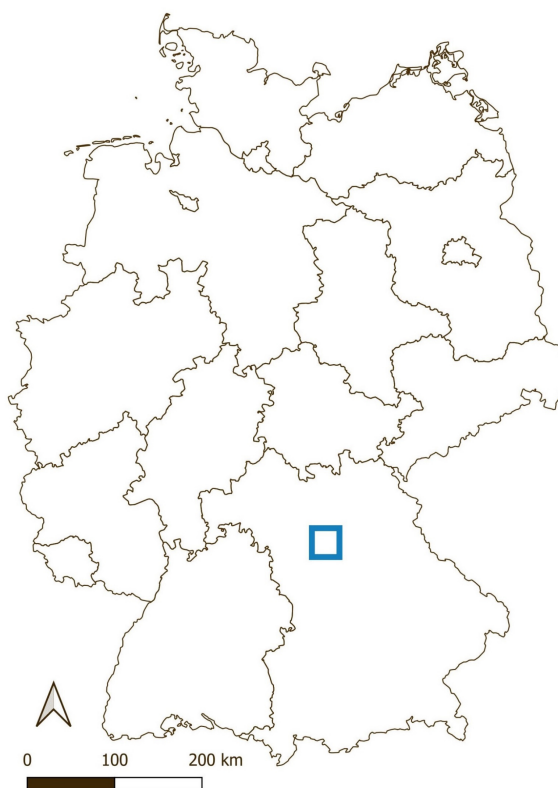
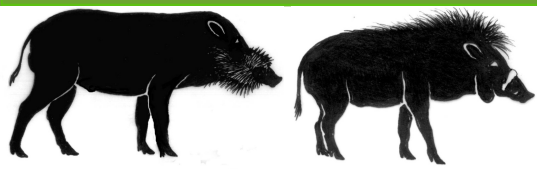


Fig. 1: Location of the study area in Germany.





Physiology and Anatomy

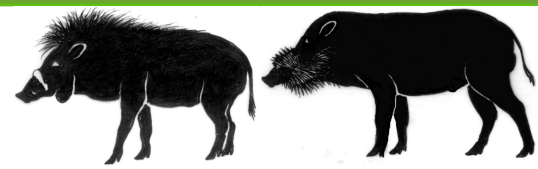


Fig. 2: Winter coat in wild boar is characterized by robust long bristles and felt like undercoat.



Fig. 3: Loss of undercoat starts in April. Note the plant material in the undercoat. Wild boar are not just a pest but also have an ecological function in ecosystems (e.g. seed dispersal).

Results

We observed the first growth of undercoat in the mid of August. Felt-like undercoat was fully grown by mid of September. Change of coat with shed of undercoat started in April in some individuals. Loss of bristles started in June. Due to the limited number of examined individuals per month, conclusions about age- and sex- related differences were not possible. Typical seasonal coats can be seen in Fig. 2 – 5.

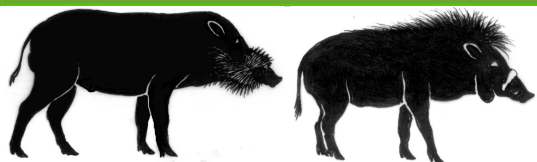


Fig. 4: The long bristles along the dorsal line start to shed in June.

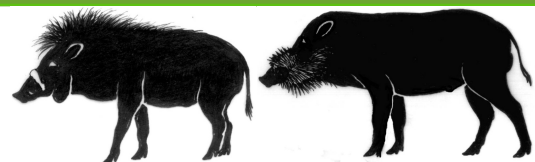


Fig. 5: Summer coat in wild boar is characterized by homogeneous short and bristly hairs.





Physiology and Anatomy



Discussion and Conclusion

In wild boar, hair from undercoat can be used for analyses from September onwards, because after that, there will be no further growth and therefore no more storage of hormones and trace elements will happen.

In wild boar, collars, the standard method for fixing GPS-tags on larger terrestrial mammals, often fail as neck and head have nearly the same diameter. Thus, collars often slip off or become too tight. An alternative solution for fixing GPS on wild boar is to glue the tag on the fur so it cannot get lost until it drops off with the next change of coat. The disadvantage of this method is, in contrast to collars, that the dwell time of the tag is limited by hair growth and loss. According to our results, telemetry tags can be glued onto wild boar in September and can remain on the animals at least until April. Thus, the interesting time of mating, birth, and separation of the previous year's piglets from females and driven hunts in autumn and winter could be covered.

As we focused on the growth and loss of undercoat, further research should focus on the long bristles. This could be of interest for hormone analyses and biomonitoring because knowledge of the growth rates could allow exact dating of the results.



Yvonne de Jong & Tom Butynski

Have you seen wild pigs in Africa?

To conserve Africa's wild pigs (Suidae), it is essential that changes in their geographic distributions are carefully monitored and documented.

'WildPigBase' is a 'living' locality database which is updated when new data become available. If you have seen any of the five species of African wild pig (bushpig, common warthog, desert warthog, giant forest hog, red river hog) we invite you to complete a brief online form on

www.wildsolutions.nl/wildpigs/

or contact us at

yvonne@wildsolutions.nl.

We will use these data to update that species' distribution map for various conservation initiatives, including the species assessments for the 'IUCN Red List of Threatened Species', and acknowledge your record in WildPigBase.

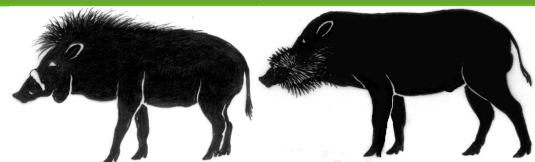
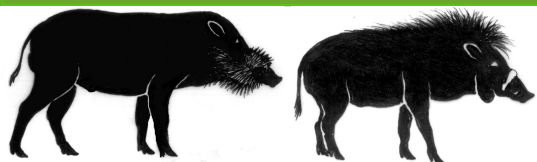
Thank you, your help is much appreciated!

Yvonne de Jong, Tom Butynski & Jean-Pierre d'Huart

yvonne@wildsolutions.nl /

www.wildsolutions.nl





Movement sensors can detect disease in wild boar

<https://www.sciencedaily.com/releases/2023/09/230912113544.htm>

by Max-Planck-Gesellschaft, September 12 2023

Accelerometers reading the behavior of wild boars can pick up when animals are infected with a fatal virus.

Behavioral sensors attached to wild boars have been used to detect when animals are sick with African Swine Fever, a fatal viral disease that affects both boar and domestic pigs. Accelerometer sensors, which measure tiny changes in movement, showed that wild boars reduced their daily activity by up to 20 percent when infected with the virus. The findings, published by scientists from the Max Planck Institute of Animal Behavior, show that lightweight sensors can detect sickness behavior in wild boar -- raising the possibility of a minimally invasive tool to assist in the control and prevention of African Swine Fever.

Although the virus cannot be transmitted to humans, African Swine Fever is a major threat to the global pig industry and has significant economic and social impact. The highly contagious virus spreads easily between wild boar and domestic pigs, and so knowing when a disease outbreak occurs in the wild and on farms is important for curbing the spread of African Swine Fever. But detecting disease in wild animals is not straight forward. Currently, testing for African Swine Fever in wild boar is done by sampling animals that are either hunted or found dead, which creates a long lag between when the disease emerges in a population to when it is actually detected.

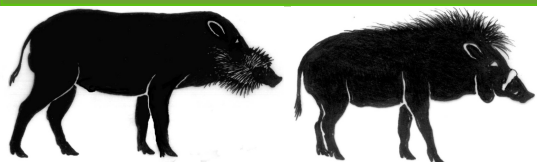
Seeking to reduce this lag, scientists from Germany, Spain and Austria teamed up to investigate if technology that 'reads' an animal's behavior could be harnessed for early detection of disease in wild boar. Their findings point to the potential of accelerometer sensors as an accessible tool that can support the existing disease management approaches for African Swine Fever surveillance and control. "This is a game-changer for wildlife disease monitoring," says Kevin Morelle, first author of the study and a scientist with the Max Planck Institute of Animal Behavior. "We show that a lightweight behavioral sensor deployed on a wild animal can be a sentinel for potential health threats."

Accelerometers measure animals' movements

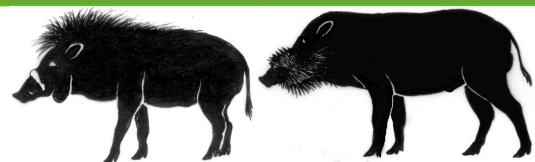
The scientists attached accelerometer tags, weighting 30 grams, on twelve wild boars that were studied in controlled conditions. The boars were infected with African Swine Fever as part of a separate study aimed at developing a vaccine against the disease. The accelerometers, which are the equivalent of 'Fitbits' or pedometers, took ultra-high resolution measurements of the animals' movements. The measurements, called 'Overall Dynamic Body Acceleration', showed how much the boars were active. The scientists found that when boars became sick with African Swine Fever, they were ten to twenty percent less active daily than when they were healthy. To validate the findings, the study authors attached accelerometers to a group of healthy boars living in natural conditions. They then compared the activity patterns of infected and healthy wild boar.

This study is the first to demonstrate that African Swine Fever can be detected at onset in wild boar by sensing and analyzing the movement behavior of animals. The findings could benefit a wide range of stakeholders involved in the control and prevention of African Swine Fever. However, the authors say that more needs to be done before the benefits of the movement technology are realized. This includes testing sensors in populations of wild boar living in natural conditions where the disease is known to occur. Further, the authors plan to design an algorithm





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for accelerometers that could analyze movement data to deliver real-time health assessments, such as when animals are infected with a virus. Says Morelle: "We still need to test the tool in real case situations to figure out if behavioral analysis can detect disease in wild animals that are living in different population sizes. We hope these first results pave the way for a behavioral system that provides vital insights into the spread of disease in wild animals, and facilitates timely control measures to save wildlife and domestic animals."

Escaped 'lioness' in Berlin was most likely a wild boar, mayor says

<https://www.theguardian.com/world/2023/jul/21/escaped-lioness-berlin-most-likely-wild-boar>
by Philip Oltermann, 21 Jul 2023

Experts reach conclusion after analysing video of animal that triggered lion hunt.

A 30-hour search for an escaped lioness that had residents on the southern fringes of Berlin shelter in their homes and the rest of the German capital on tenterhooks has found that what was thought to be an exotic feline predator was most likely a common wild pig.

After no more sightings of the big cat were reported overnight, Michael Grubert, the mayor of the municipality of Kleinmachnow, said two leading experts had analysed the video that had originally triggered the lion hunt. "With a relatively high degree of certainty the tendency is towards a wild boar," Grubert said.

"As far as it is humanly possible to judge, we are not dealing with a lion," he added. "There is no hazardous situation. All tipoffs have led nowhere."

On Thursday morning, Brandenburg police had urged residents in three municipalities on the outskirts of Berlin via a warning app to stay indoors and bring pets and farm animals inside. In a statement to the press, police warned of a "loose, dangerous animal", which it later identified as most likely being a lioness.

Overnight, police said they had received information from two witnesses who had filmed the predator attacking and killing a wild pig. Two police officers had also seen the animal, a spokesperson claimed. Helicopters, armoured vehicles, drones, thermal-imaging cameras and more than 300 police officers spent a day and a night scouring woodlands in the area.

On Thursday evening, police renewed their warning, telling people to avoid forested areas around the edges of southern Berlin. An outdoor concert in Kleinmachnow was moved indoors.

At 7.30pm on Thursday the tabloid Bild reported a further sighting of the "lioness" in a wooded area in the same district, announcing an imminent showdown that never materialised.

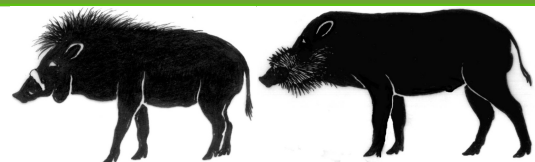
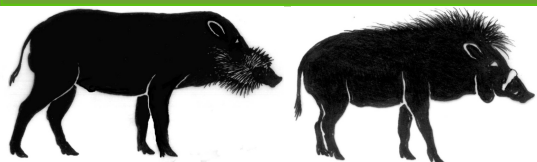
But biologists increasingly voiced scepticism about the video of the original sighting being shared on social media networks. On Friday, Grubert cited two such experts who believed that the curvature of the filmed animal's back was too flat for a large cat.

The sound of a lion roaring in the Zehlendorf district inside Berlin's borders turned out to have been played through bluetooth speakers by a group of teenagers. "Neither helpful for the police nor the local community," a spokesperson said. No traces of the boar that the lion was supposed to have killed were ever found.

At 9am on Thursday, police searched another small wooded area in Kleinmachnow with drones and thermal cameras, only to disturb a family of boars.

Grubert and a spokesperson for Brandenburg police on Friday morning tried to justify the 30-hour lion hunt. "The risk situation was such that it was justifiable to employ police," Grubert said.





Rising monkey and pig populations pose human disease risk

<https://www.sciencedaily.com/releases/2023/06/230630123229.htm>

by University of Queensland, June 30 2023

Exploding populations of wild pigs and macaque monkeys in Southeast Asia are threatening native forests and disease outbreaks in livestock and people, according to research led by The University of Queensland.

Dr Matthew Luskin, from UQ's School of the Environment, and his team collated and analysed species population data from across the region, some of it collected with a network of cameras.

"Macaques and wild pigs are taking over Southeast Asia's disturbed forests," Dr Luskin said.

"Humans are largely to blame for this by altering forests with logging and establishing palm oil farms which provide food and ideal breeding conditions for these animals.

"We saw that wild boar and macaque numbers were 400 per cent higher in forests near the plantations than in untouched environments. "These animals take full advantage of the farmland, raiding crops and thriving on calorie-rich foods."

Setting and monitoring the camera traps provided Dr Luskin with an up-close experience of the exploding numbers. "I encountered huge troops of macaques in Thailand, Malaysia, and Indonesia -- they were everywhere in the forest edges, following us and interfering with our equipment," Dr Luskin said.

"At first it was frustrating but then was eerie as we became completely surrounded." Dr Luskin said there were significant human health risks in the rising pig and macaque populations.

"The wildlife origins of the COVID-19 pandemic show that mammals in human-modified ecosystems often host high pathogen loads and pose serious zoonotic disease risks," he said.

"Both pigs and macaques are recognised as carriers of diseases that can be transmitted to people and they're the most common species in a region considered to be the global zoonotic disease hotspot." Collaborator, Professor Carlos Peres from the University of East Anglia (UK), said abnormally high populations of wildlife species that are disease reservoirs often occur in human-modified tropical forests.

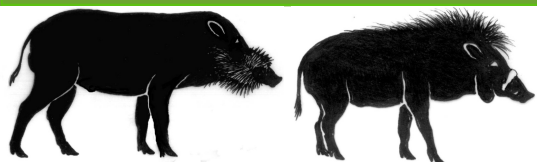
"This study again shows that densely settled rural areas in Southeast Asia may be a source of future human epidemics," he said.

University of East Anglia and Southern University of Science and Technology (China) PhD candidate, Jonathan Moore, said the immediate effects of the population explosions could be seen on native flora in the affected regions.

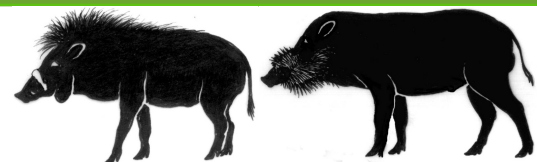
"Both pigs and macaques trigger negative cascading impacts in these pristine ecosystems," Mr Moore said. "They kill the seeds and seedlings of native plants and eat bird and reptile eggs. "The Malaysian pigs alone were found to reduce rainforest tree regeneration by 62 per cent."

The researchers say action is needed to minimise population expansions of wild pigs and macaques. "Efforts to manage the populations of these species have failed in the past because of their rapid reproductive capacity and public outcry," Dr Luskin said. "Nobody favours needless killing of wildlife but the negative social and ecological impacts from hyperabundant pest species does demand ethical and urgent management solutions."





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Wild pigs threaten biodiversity hotspots across South America, study shows

<https://news.mongabay.com/2023/06/wild-pigs-threaten-biodiversity-hotspots-across-south-america-study-shows/>

by Vitor Alexandre Araujo Prado dos Anjos, 12 June 2023

New research shows that the expanding range of wild pigs across South America poses a greater threat to protected areas and biodiversity hotspots than previously thought.

A study published in the *Journal for Nature Conservation* indicates that significant portions of South America's most biologically diverse places harbor habitats that can sustain wild pigs, with the Atlantic Forest topping the list, as 85% of its total terrain is deemed suitable for the animals.

The increasing presence of wild pigs presents challenges for conservationists as well as local residents, whose crops are often destroyed as the pigs become accustomed to eating human foods.

Researchers stress that scientists, local communities and managers of protected areas must work together to find appropriate means of controlling the wild pig populations.

Wild pigs are recognized worldwide as a nuisance to the environment. The IUCN lists them as one of the worst invasive species due to their potential to damage crops, harbor diseases and disrupt ecological processes.

Now, research published in the *Journal for Nature Conservation* reveals that the expanding presence of wild pigs (*Sus scrofa*) across South America poses a greater threat to biodiversity hotspots and protected areas than previously believed.

Researchers assessed the species' suitability ranges at different analytical levels and discovered that a significantly higher number of protected areas are invaded or potentially at risk than shown in previous research. Furthermore, nearly half (44.8%) of wild pig occurrences studied were inside biodiversity hotspots.

In South America, domestic pigs arrived with European settlers, and wild boars were introduced by the Argentinian rancher Pedro Olegario Luro at the beginning of the 20th century for hunting purposes. Over time, the boars have dispersed throughout the continent, interbred with domestic pigs and successfully established populations.

The assessment reveals compelling insights into the vulnerability of specific hotspots in the region. Notably, the Atlantic Forest emerges as the most susceptible, with a remarkable 85% of its total area deemed suitable for wild pigs (meaning habitat that allows them to thrive), followed by Cerrado (61.3%), Chilean Winter Rainfall-Valdivian Forests (37.5%) and tropical Andes (5.6%).

These results raise yet another alert for conservationists to take precautionary measures, since invasive species may cause further damage to wildlife in already threatened areas.

The expansion of wild pigs across South America

Brazilian ecologist Clarissa Alves da Rosa, a researcher at the National Institute for Amazonian

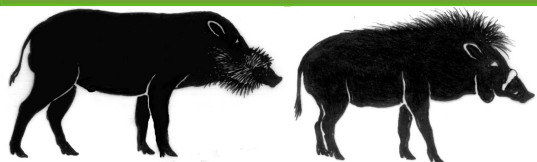


Wild pigs in Mato Grosso, Brazil, scampering away.

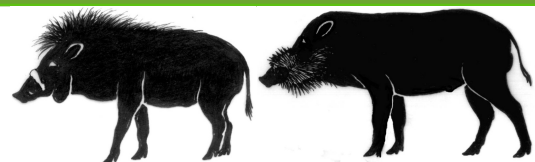
Research reveals that the expanding presence of wild pigs across South America poses a greater threat to biodiversity hotspots and protected areas than previously believed.

Image by Bernard DUPONT via Flickr (CC BY-SA 2.0).





Articles in the news



Research who was not involved in the study, tells Mongabay in a phone interview, “The increase of boars in Brazil as a whole, and especially in the Atlantic Forest, is associated with the species’ interaction with human beings.”

She explains that invasive species, such as wild pigs, may supplement their diets with human-grown food. And when that happens, she further adds, the wild pig “tends to really increase and expand its population. When we mention a fragmented biome, such as the Atlantic Forest, this supplementary feeding comes from agricultural crops — mainly corn and sugarcane. What happens is that they have the perfect environment — there are forest fragments where they can take shelter and agricultural crops where they can feed.”

She also mentions that another contributing factor to the increased range of the species is that some people, interested in maintaining the boar population, transport and release them to areas where they previously were not present in order to secure hunting permits, as they are the only species permitted to be hunted in Brazil. Regarding this issue, Alves da Rosa mentions, “There is a debate within academia about whether we consider boars as a resource or as a problem.”

She further adds: “If it is considered a resource, there is an interest in maintaining its population because people don’t want this resource to disappear. Even though in terms of public policy and science, we label boars as a problem, we know that the population as a whole sees it as a resource. It ends up being a source of food, and some people enjoy hunting them.”

Impacts on biodiversity

In her Ph.D. studies within Itatiaia National Park, one of Alves da Rosa’s objectives was to explore whether wild pig behavior could replace the beneficial ecological functions provided by peccaries (Tayassuidae family), a social mammal often mistaken for a pig and a threatened species in the region. Through her investigation, she uncovered distinct environmental impacts caused by these two species, despite their similar behavior.

While both wild pigs and peccaries engage in “snouting” the soil, Alves da Rosa observed a significant difference: Wild boars, due to their longer snouts, create larger holes that remove crucial soil layers, akin to plowing the soil. On the contrary, peccaries contribute to the formation of small ponds through their digging activities, which serve as vital breeding sites for some amphibians.

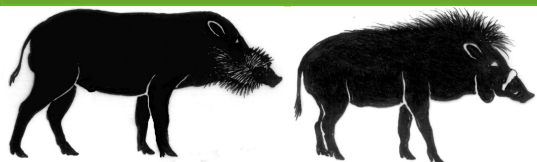
In addition to removing important soil layers, wild pigs are associated with various environmental impacts such as destroying water springs, uprooting native plants and preying on seeds and small invertebrates, according to Alves da Rosa. These examples illustrate the damage that wild pigs may cause in relevant areas for biodiversity conservation and further stress the importance of assessing their potential distribution.

These findings raise particular concern in the Atlantic Forest — the region found to be the most vulnerable to wild pig invasions in the recent study — which is home to more than 20,000 species of plants, including 6,000 endemic species and the highest tree diversity per hectare worldwide. Simultaneously, it has the highest number of threatened and extinct species of any biome in Brazil, as indicated in the recently published report by the Brazilian Institute of Geography and Statistics.

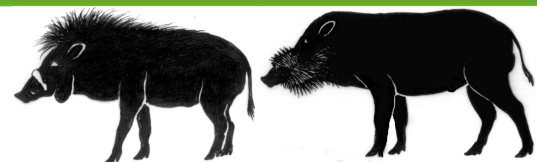
Methods and results

The Journal for Nature Conservation study assessing broad-scale potential distribution of wild pigs in South America involved an international, multidisciplinary team of 17 scientists who used a method called ecological niche modeling by combining records of 6,502 wild pig occurrences, both direct (sightings) and indirect (tracks and camera trapping) over the course of 116 years





Articles in the news



(1906-2022) with environmental data and information from 278 protected areas.

This approach enabled them to investigate the current and potential dispersion of wild pigs across ecoregions, protected areas and hotspots in South America, specifically encompassing Argentina, Brazil, Uruguay, Paraguay, Chile and Bolivia.

Sixty-eight ecoregions were compared, showing that 41 already had records of wild pigs, while 64 presented suitable or partially suitable conditions to sustain their presence. Only four ecoregions were classified as completely unsuitable, and three of them are cold deserts with extreme weather conditions. These results reflect the high adaptability of pigs to different environments.

The article adds that the relative success of the species in colonizing different habitats can be attributed to their “high reproductive potential,” “highly plastic diet,” “wide climatic and topographic tolerance” and “behavior adaptability under contrasting conditions of human pressure.”

Regarding the protected areas in South America, the study highlighted that the protected landscapes and national parks are at greater risk. While comparing the number of affected areas and the potential risk in each country, Uruguay ranked first in both categories, having all of its protected areas “invaded” by wild pigs.

The results obtained by the researchers differed significantly from previous assessments done in individual countries.

The article states that the potential area of distribution in Argentina was considerably bigger than noted in a 2019 report published on the website *Categorización de los Mamíferos de Argentina*. Meanwhile, in Chile, the new research finds an estimated potential distribution area of more than 150,000 square kilometers (58,000 square miles), which is much larger than the 27,600 km² (10,650 mi²) of occupation noted in a 2015 assessment published in the journal *Mastozoología neotropical*. In Brazil, the pig’s presence was confirmed in 205 previously unreported municipalities, increasing the total number by 17.8%.

Such variations could be explained by the different methodological approaches undertaken and also because of “the inclusion of a large number of new records spanning a longer period of time,” the article states. The authors add that with this new approach, it was also possible to identify places where the species may be present but still undetected.

In addition to the article, Luciano La Sala, the study’s lead author, also made available a dynamic web application with visual representations of the study results that conservationists and policymakers can readily consult.

“We know that biological invasions are better controlled in the earlier stages. When boars are detected in a protected area it is because they already reached a problematic populational level,” explains Alves da Rosa.

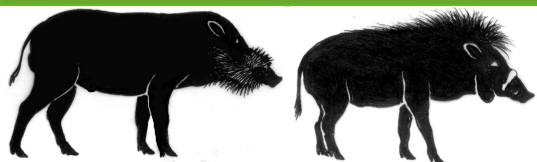
This is why assessments of this nature provide important information for protected-area managers, allowing them to take precautionary measures to prevent the establishment of new wild pig populations, thus preventing further loss of critically endangered species in vulnerable areas.

Social and economic impacts

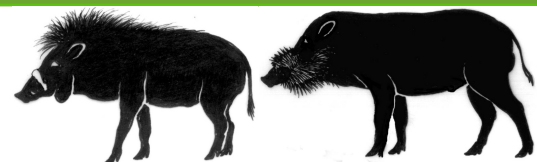
Environmental impact is not the only concern raised by the expansion of these wild pigs. The social and economic impacts are also significant. Alves da Rosa, who also worked with local communities surrounding Itatiaia National Park, mentions that “when we start noticing a meaningful environmental impact, it’s because the social impact is already extensive.”

Rosilene Cosmo Correa, also known as Lena, is a small-scale farmer who grows corn, potatoes and sugarcane and lives in Aiuruoca, a city located in the mountainous Mantiqueira region of the





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Atlantic Forest — a place surrounded by fields and araucaria (*Araucaria angustifolia*) forests, some of the pig's favorite places due to the availability of Brazilian pine nuts (known as pinhão in Portuguese).

In a phone call, Lena describes her first experience dealing with wild pigs back in 2015. "I was cultivating a sugarcane plantation, and I had a dream of buying my first car. I was going to sell this harvest for 8,000 reais (about \$1,600)." Within three days of continuous wild pig attacks, she says, "not even a single sugarcane was left."

After this episode, Lena started working as a maid to help with her household income. "Since then, I dropped everything and I started going out to work, because there's no way I can sustain myself on my farm anymore."

The expansion of wild pigs in the region is provoking drastic changes to the livelihoods of small producers. Since the attacks recur, people feel discouraged to farm and resort more to shopping in supermarkets, explains Lena.

"In the past, we had a lot of things at home. If we have corn here in the fields, we have a lot. We have everything; corn is everything. Cane is also the basis of everything."

She also talks about the Brazilian pine nut, an important regional product that is getting increasingly difficult to collect since wild pigs quickly consume them.

"The women who didn't work outside used to pick the pine nuts to sell, you know? A lot of pine nuts were sold and it helped a lot throughout the year, because with that money women could do a lot of things. Now there are no more pine nuts to sell."

When asked about how people in her community are taking action, she says, "There are a few people who take initiative and say, 'I'm going to hunt a pig today,' but they can't do it, because they have no adequate equipment or training, and they are also afraid [of being attacked by the pigs]."

Davi Andrade Sampaio, who is also a small producer in Aiuruoca, talks in a phone call about the challenges he faces when hunting these wild pigs.

When chasing a pig, a hunter might need to cross different properties and that might result in conflict, explains Davi. He says some landowners are animal rights defenders and are against hunting; in some cases, they might even call the inspectors from the Brazilian Institute of Environment and Renewable Natural Resources. In this scenario, the hunters have to call back the dogs and retreat, he mentions.

Both Davi and Lena, agree on the fact that greater measures must be adopted to control the pigs. They feel that their problem is still broadly unacknowledged and they're fearful of the future consequences of the rapid dispersion of the pigs in their region.

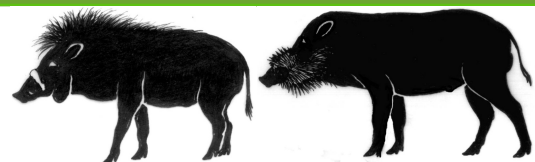
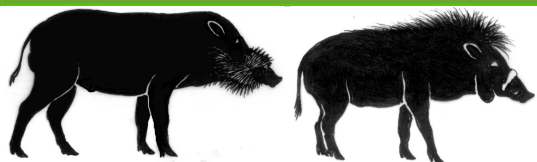
To effectively manage wild pig populations, a comprehensive understanding of the interplay between protected and rural areas is essential, as wild pigs move and circulate between these two environments. Protected areas provide shelter for wild pigs, while rural areas serve as abundant sources of food for their sustenance. As a result, conservation managers and farmers living near protected areas must coordinate efforts to address this problem.

Challenges and possibilities for wild pig control

According to Alves da Rosa, eradication of wild pigs is utopian, only occurring successfully on islands. To minimize the problem, researchers, managers and local communities must work together, she further explains.

In Brazil, public power lacks the financial, technical and logistic conditions to effectively manage wild boars in protected areas. In such conditions, the burden of this responsibility falls entirely on





autonomous hunters. “Protected areas are primarily dedicated to biodiversity conservation, so how do we let hunters within them?” she says.

Alves da Rosa emphasizes that before introducing hunters into protected areas, it is crucial to establish a strong and trustworthy relationship.

Moreover, managing wild boars requires more than just controlling their population within protected areas. It also necessitates effective management in the surrounding areas to ensure comprehensive control measures.

Another concern she raises is the limited budget within protected areas, which often leads managers to prioritize wild boar control only when the situation is already beyond control. Ideally, effective management should be a priority from the early stages of the invasion. Early detection systems and proactive population management would be the ideal approach to address the issue before it escalates. However, the current reality is far from achieving this scenario.

‘Then what happens?’

The presence of wild pigs in South America is turning into a serious concern not just for conservationists but also for people living in rural areas. The expansion of the wild pigs, despite being a recognized international problem, remains largely unsolvable and unacknowledged.

Researchers once again note their potentially damaging impacts on regional biodiversity in already threatened areas such as the Atlantic Forest and Cerrado. Assessments of this kind provide crucial information for managers, scientists, policymakers and conservationists who may reallocate and reinforce their efforts to protect areas at greater risk.

Small farmers find themselves in a difficult spot, being unable to address this issue alone without support from authorities, says Lena. “We are in no position to defend ourselves. Everything we do is as a small producer. So if we don’t have the money and don’t produce, how are we going to do anything? And then what happens? Nothing, right!”

Bearded pigs a ‘cultural keystone species’ for Borneo’s Indigenous groups: Study

<https://news.mongabay.com/2023/03/bearded-pigs-a-cultural-keystone-species-for-borneos-indigenous-groups-study/>

by John Cannon, 20 March 2023



Bearded pigs (*Sus barbatus*) play a prominent role in the lives of many people living on the island of Borneo. Scientists have found evidence that it’s been hunted for thousands of years. Image courtesy of Mike Prince via Wikimedia Commons (CC BY 2.0).

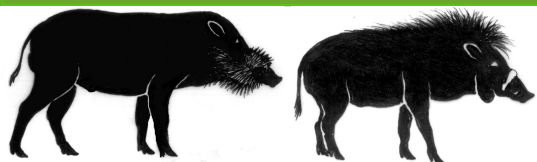
A recent study examined the impacts of ecological and sociocultural influences on bearded pig populations in Malaysian Borneo.

The researchers found that the presence of pigs is “compatible” with Indigenous hunting in certain areas.

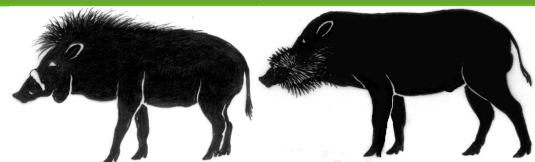
The team’s findings point to the importance of a nuanced understanding of nearby human cultural values and local ecology in determining policies toward hunting.

Bearded pigs play a prominent role in the lives of many people living on the island of Borneo. For some ethnic groups, they’re a





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hunter's most-prized quarry, providing an important source of protein, and a shared pig is often a central part of community celebrations.

Now, a recent study provides quantitative evidence for the first time that Bornean bearded pigs (*Sus barbatus*) can persist even in areas where they're highly sought-after by local Indigenous groups.

"For thousands of years, the bearded pig has been hunted," said David Kurz, a conservation scientist and postdoctoral fellow at Trinity College in the U.S. and the lead author of the study published Feb. 17 in the journal *npj Biodiversity*. "We know that from archaeological evidence."

Prior research has also shown that hunting affects the movements of bearded pigs and the areas they frequent. Kurz and his colleagues wanted to know whether the pig's presence could be tied to specific social and cultural factors in the areas where they occur.

The team began with camera trap-recorded detections of bearded pigs from 18 field sites in the Malaysian states of Sabah and Sarawak on the island of Borneo collected between 2010 and 2014. In their analysis, they examined how certain variables might determine whether pigs were present in specific areas. For example, they included ecological factors, such as a location's proximity to water or the edge of the forest, as well as "socio-cultural variables," like whether the humans living nearby had a tradition of hunting pigs, and how accessible the terrain was for hunters.

Muslims in Malaysia, as elsewhere, generally don't eat pork. But many members of Borneo's large Indigenous minorities, such as the Kadazandusun-Murut in Sabah and the Iban in Sarawak, practice Christianity and hold bearded pig meat in high regard. Kurz's earlier research sought to understand how pig hunting had changed in these societies with changes to the island, like the influx of oil palm plantations over recent years.

"We heard people say things like, 'I live in the forest. This is my food,'" Kurz said. "We really saw the importance of the bearded pig in dietary and cultural terms." Because of its role in some groups' lives and the impact that social practices have on its presence, the team dubbed the bearded pig "a cultural keystone species."

The team aimed to integrate those social variables along with what they knew about the pig's ecology to produce more nuanced maps showing where the occurrence of pigs was most likely.

Their findings suggested a strong relationship between the culture of the people living nearby and the number of pigs. Pigs were likely to be more numerous in easily accessible areas where fewer of the nearby humans were from pig-hunting cultures, such as places in Malaysian Borneo where Islam predominates. They also found high probabilities of finding pigs near pig-hunting cultures in areas that were difficult for hunters to reach, such as those far from roads or cities.

Peter Williams, a postdoctoral researcher and ecologist at Michigan State University in the U.S., who wasn't involved in the research, said the study demonstrates "the importance of considering culture and how humans are affecting wildlife."

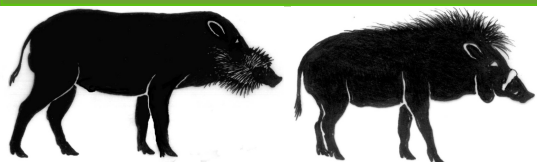
That's not to say hunting isn't a concern, Kurz said, especially when hunting moves beyond the subsistence level and starts to supply commercial markets.

"Hunting in tropical forests, especially in Southeast Asia, is a big conservation threat," he said. "I don't want to sugarcoat that."

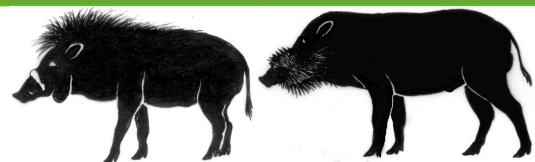
Still, the study demonstrates the possible coexistence of Indigenous hunting and the sustained presence of bearded pigs.

"In essence, that is showing something that Indigenous communities have known for thousands of years," Kurz said, "which is that there's potential compatibility between Indigenous





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environmental stewardship and ecological sustainability.”

The authors say that managing bearded pig populations requires an inclusive process with a diversity of voices from different parts of society. But their data do suggest that restrictions on hunting in readily accessible areas near pig-hunting groups are likely more important than, say, limits on hunting in inaccessible areas with pig-hunting groups nearby. Restrictions on hunting when the nearby human population doesn't place a high cultural value on bearded pigs also aren't as critical.

A 'baseline' for recovery?

Recently, Malaysian Borneo's bearded pigs have had to contend with African swine fever. It's not clear how much this virulent disease has affected pig numbers, but studies have found that fatality rates range from about 50% to 100% (but only for pigs — the disease doesn't affect the humans who eat the meat). Bearded pigs are probably nowhere near as numerous as they were in the early 2010s when the scientists collected the data for this study, the authors write.

Their findings do provide a “baseline” against which the bearded pig's recovery can be measured, Kurz said — at least since humans have altered the animal's habitat with logging, oil palm agriculture and the expansion of urban areas over the past several decades.

“It's an imperfect target, but it does give us some kind of number,” Kurz said.

Even before swine fever hit, the Bornean bearded pig was considered vulnerable on the IUCN Red List. Bearded pigs' swift reproductive rates could help them recover, Kurz added: A single sow can have multiple litters of 12 or more piglets a year in the right conditions. But whether bearded pig numbers can withstand continued hunting is an open question. To reach sustainable levels, the authors call for the inclusion of Indigenous leaders in wildlife management decisions, taking into account the culture and traditions of local human groups.

“Conservation has shown us that if you don't include local communities, then you're unlikely to have long-term sustainable solutions,” Kurz added. “It's both more ethical and more effective to consider long-term needs of human communities alongside long-term needs of ecological communities, and often there are compatible links that promote both.”

'Incredibly intelligent, highly elusive': US faces new threat from Canadian 'super pig'

<https://www.theguardian.com/us-news/2023/feb/20/us-threat-canada-super-pig-boar>
by Adam Gabbatt, 20 February 2023

Northern states on alert for invasion of cross-bred pig that threatens flora and fauna – and is difficult to stop.

For decades, wild pigs have been antagonizing flora and fauna in the US: gobbling up crops, spreading disease and even killing deer and elk.

Now, as fears over the potential of the pig impact in the US grow, North America is also facing a new swine-related threat, as a Canadian “super pig”, a giant, “incredibly intelligent, highly elusive” beast capable of surviving cold climates by tunneling under snow, is poised to infiltrate the north of the country.

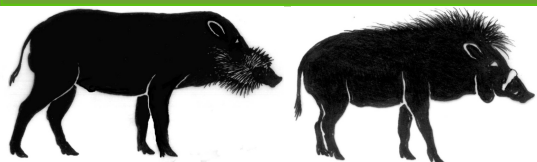
The emergence of the so-called super pig, a result of cross-breeding domestic pigs with wild boars, only adds to the



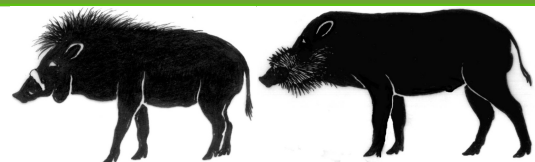
Two feral hogs are caught in a trap on a farm in rural Washington County, Missouri.

Photo: David Carson/AP





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problems the US faces from the swine invasion.

Pigs are not native to the US, but have wrought havoc in recent decades: the government estimates the country's approximately 6 million wild, or feral, pigs cause \$1.5bn of damage each year.

In parts of the country, the pigs' prevalence has sparked a whole hog hunting industry, where people pay thousands of dollars to mow down boar and sow with machine guns. But overall, the impact of the pigs, first introduced to the US in the 16th century, has very much been a negative, as the undiscerning swine has chomped its way across the country.

"We see direct competition for our native species for food," said Michael Marlow, assistant program manager for the Department of Agriculture's national feral swine damage management program.

"However, pigs are also accomplished predators. They'll opportunistically come upon a hidden animal, and the males have long tusks, so they're very capable of running and grabbing one with their mouth.

"They'll kill young fawns, they're known to be nest predators, so they impact turkeys and potentially quail."

The wild pigs are also responsible for a laundry list of environmental damages, ranging from eating innocent farmers' crops to destroying trees and polluting water. They also pose "a human health and safety risk", Marlow said.

A pig is a "mixing vessel", capable of carrying viruses, such as flu, which are transmittable to humans. National Geographic reported that pigs have the potential to "create a novel influenza virus", which could spread to humankind.

The first record of pigs in the continental US was in 1539, when the Spanish explorer Hernando De Soto landed in Florida with an entourage which included 13 swine.

During the four-year expedition, which saw De Soto order the slaughter of thousands of Native Americans, declare himself "an immortal 'Son of the Sun'", and then die of a fever, the number of pigs grew to about 700, spread across what is now the south-eastern US.

But it is only relatively recently that the pigs have become a problem.

"They lived a benign existence up until, you know, probably three or four decades ago, where we started seeing these rapid excursions in areas we hadn't seen before," Marlow said.

"Primarily that was the cause of intentional releases of swine by people who wanted to develop hunting populations. They were drugged and moved around, not always legally, and dropped in areas to allow the populations to develop. And so that's where we saw this rapid increase."

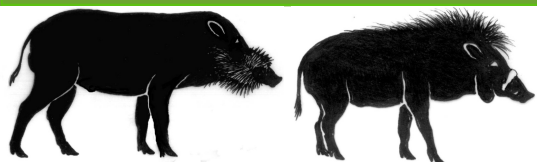
The number of pigs in the US has since grown to more than 6 million, in some 34 states. The pigs weigh between 75 and 250lbs on average, but can weigh in twice as large as that, according to the USDA. At 3ft tall and 5ft long, they are a considerable foe.

Marlow said his team had managed to eradicate pigs in seven states over the past decade, but with little realistic hope of getting rid of the swine completely, there are also fears over the potential impact of pig-borne disease, particularly African swine fever.

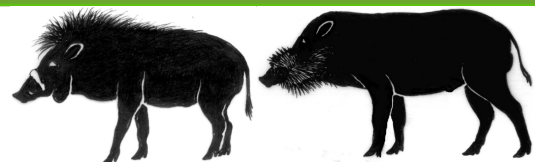
The disease is always fatal to pigs, and in China, which is home to more than 400 million pigs – half of the world's pig population – African swine fever wiped out more than 30% of the pig population in 2018 and 2019. African swine fever has presented in Europe, too, but Marlow said it has not yet been detected in the Americas.

That's something that Ryan Brook, who leads the University of Saskatchewan's Canadian wild pig research project, hopes to maintain.





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In Canada, like in the US, wild pigs are a relatively recent problem. Up until 2002 there were barely any wild pigs in the country, but Brook said the population has exploded in the past eight years. The animals are now spread across 1m sq km of Canada, predominantly in Alberta, Manitoba and Saskatchewan.

“Wild pigs are easily the worst invasive large mammal on the planet,” said Ryan Brook.

“They’re incredibly intelligent. They’re highly elusive, and also when there’s any pressure on them, especially if people start hunting them, they become almost completely nocturnal, and they become very elusive – hiding in heavy forest cover, and they disappear into wetlands and they can be very hard to locate.”

Brook and others are particularly troubled by the emergence of a “super pig”, created by farmers cross-breeding wild boar and domestic pigs in the 1980s. The result was a larger swine, which produced more meat, and was easier for people to shoot in Canadian hunting reserves.

These pigs escaped captivity and swiftly spread across Canada, with the super pig proving to be an incredibly proficient breeder, Brook said, while its giant size – one pig has been clocked at more than 300kg (661lbs) – makes it able to survive the frigid western Canada winters, where the wind chill can be -50C.

“All the experts said at that time: ‘Well, no worries. If a wild pig or a wild boar ever escaped from a farm, there’s no way it would survive a western Canadian winter. It would just freeze to death.’

“Well, it turns out that being big is a huge advantage to surviving in the cold.”

The pigs survive extreme weather by tunneling up to 2 meters under snow, Brook said, creating a snow cave.

“They’ll use their razor-sharp tusks to cut down cattails [a native plant], and line the bottom of the cave with cattails as a nice warm insulating layer.

“And in fact, they’re so warm inside that one of the ways we use to find these pigs is to fly first thing in the morning when it’s really cold, colder than -30, and you will actually see steam just pouring out the top of the snow.”

Given the damage the pigs have wrought, a range of attempts have been made to get rid of them. Scientists and researchers in the US and Canada have had some success with catching whole sounders of pigs in big traps, while in the US attempts have been made – sometimes unsuccessfully – at poisoning wild pigs.

One method that has worked in the US, Brook said, is the use of a “Judas pig”. A lone pig is captured and fitted with a GPS collar, then released into the wild, where hopefully it will join a group of unsuspecting swine.

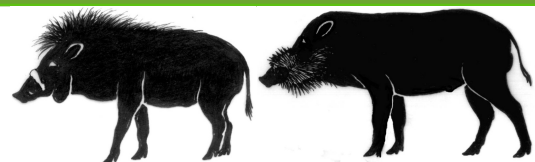
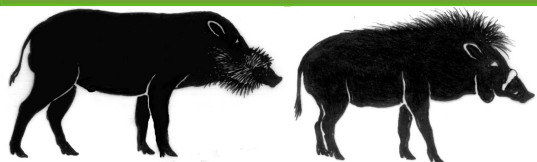
“The idea is that you go and find that collared animal, remove any pigs that are with it, and in ideal world then let it go again and it will just continue to find more and more pigs,” Brook said.

Brook said a variety of methods are required to tackle the pig problem. But the efforts are more about managing the damage caused by these non-native mammals, rather than getting rid of the pigs completely. In Canada, that chance has gone.

“Probably as late as maybe 2010 to 2012, there was probably a reasonable chance of finding and removing them. But now, they’re so widespread, and so abundant, that certainly as late as 2018 or 19 I stopped saying that eradication was possible. They’re just so established,” Brook said.

“They’ve definitely moved in, and they’re here to stay.”





Deforestation could pose disease threat to Amazon's white-lipped peccaries

https://news.mongabay.com/2023/02/deforestation-could-pose-disease-threat-to-amazons-white-lipped-peccaries/?mc_cid=98592dd212&mc_eid=20727fb8b4

by Sean Mowbray, 22 February 2023

White-lipped peccaries are vital ecosystem engineers and an important source of food for people living in the Amazon.

Deforestation has reduced their habitat and, in addition, researchers highlight that disease is an understudied factor in their conservation.

Scientists say it could represent an additional threat to an already vulnerable species, as continuing deforestation and expanding agricultural frontiers can bring greater contact between domestic animals and wildlife, potentially leading to spillover events.

Ongoing deforestation of the Amazon Rainforest jeopardizes multiple species, such as the white-lipped peccary (*Tayassu pecari*). It can also increase the risk of other threats like disease, potentially including spillover events from domestic animals. How this is impacting the species remains broadly unknown and understudied, according to a recent paper published in the journal *Biological Conservation*.

Researchers point to two main questions: how diseases influence local and cyclical disappearances of peccary populations and how introduced diseases might impact the species more broadly, a problem potentially exacerbated by deforestation.

White-lipped peccaries undergo regular boom and bust cycles, recurring over two decades or more. Researchers say these disappearances are natural and that the species may exhaust available resources before eventually succumbing to disease. White-lipped peccaries are listed as vulnerable to extinction by the IUCN, the world conservation authority, and at the national level in Brazil.

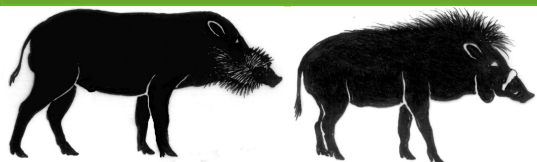
In the recent paper, scientists reviewed past research on disease in white-lipped peccaries and found that significant knowledge gaps exist. "Infectious diseases are probably involved in the emergence of repeated local episodes of disappearance of [white-lipped peccary] populations in the Amazon region," the authors wrote. "However, the impact of infectious diseases on the decline of peccary populations has not yet been evaluated."

How much introduced diseases influence these boom-and-bust cycles is unclear, Pedro Mayor, a researcher at Barcelona Autonomous University and an author of the study, told Mongabay in an interview. In the Amazon region, domestic animals are concentrated mainly around forest edges, yet the disappearances occur within the rainforest, he said. "There doesn't seem to be a relation between production animals and these wild populations. But the problem is that there are so few studies on diseases on white-lipped peccaries and wild populations," he continued.

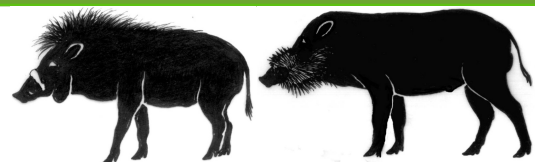
Meanwhile, however, deforestation and hunting can leave populations more vulnerable, Maria Fernanda Menajovsky, a researcher at the Barcelona Autonomous University and lead author on the paper, told Mongabay in an interview. "Pathogens that are usually in the populations may become more dangerous under these circumstances."

From the limited studies conducted, some "important diseases" have been found in wild peccaries, such as those that can cause high death rates, particularly in young animals, Menajovsky added. She pointed out that antibodies of Aujeszky's disease, also known as pseudorabies, were found in wild peccaries. But these were limited both geographically and in





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sample size. In short, it remains unknown how extensive any crossover is or where potential risk hotspots may exist.

For Harald Beck, co-chair of the IUCN Peccary Specialist Group, who was not involved in the study, the hypothesis that these natural disappearances involve diseases is a solid one, but details are currently lacking. A separate question raised by the paper, he stated, was whether and to what extent introduced diseases may be impacting populations more broadly. “Is it possible that some of those diseases are spreading from livestock? Can it be that some pigs that are not indigenous bring in some diseases?” he told Mongabay via a video call.

An ecosystem engineer under threat

White-lipped peccaries are pig-like animals that roam in herds of up to and more than 100. They are an important source of protein for Indigenous populations and their ecological role is equally vital. As “ecosystem engineers,” the species helps maintain the ecosystems in which they live, said Beck.

For instance, they regulate the growth of certain plant species and provide habitat and drinking water for multiple species when they create muddy wallows. “They’re creating breeding ground and foraging habitat for many amphibians and many other animals,” Beck said. Their eating habits, consuming species such as palms, also help to shape forest environments.

Peccaries require large tracts of land to roam and forage. With habitat loss, expanding farmland, and hunting comes the possibility for disease to spread between domestic animals and wildlife, researchers say. Parceling out habitat into smaller areas can cut populations off from one another, while diseases can potentially spread quickly amongst these herd animals as they are highly social, regularly interacting by rubbing their snouts on one another, Beck said.

Across their wide range, white-lipped peccaries have already lost much of their habitat and are now extant in only around 21% of the species’ historical range, according to the IUCN Red List. A study published in 2020 estimated that the species’ range in Mesoamerica has been reduced by as much as 87%. Populations in the Amazon, however, are more stable yet still face risks from ongoing loss of their habitat.

Joares May Júnior, a wildlife pathologist with the Federal University of Rio Grande do Sul, stated that possible points of interaction between peccaries and domestic animals are important to consider when assessing the risk of disease. “All these animals look for salt in the wild,” he told Mongabay by phone. “The salt is a point between wild animals and domestic animals to have interactions, so this is one step.”

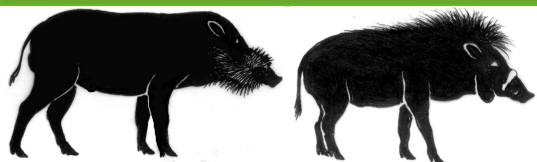
Other possible interaction points can happen via hunting or white-lipped peccaries leaving forested areas to raid crops. A previous study showed that wild peccaries’ and feral pigs’ foraging habits overlap in Brazil’s Pantanal region. “All these kinds of interaction, all this overlap, increases the risk to exchange parasites or to exchange viruses. That’s the kind of interaction we have in Brazil,” added May Júnior, who was not involved in the study.

For him, the research was important as it highlighted that the exchange of disease can occur at multiple levels. Importantly, continued deforestation and agricultural expansion can amplify this risk.

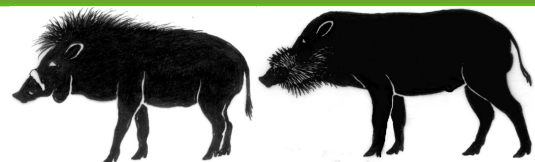
More broadly, wildlife disease is considered an understudied and persistent threat to multiple species in tropical regions, such as Brazil and elsewhere around the world, potentially impacting some of the world’s most endangered species to an as yet unknown degree.

To address existing knowledge gaps, the study authors called for more expansive research efforts to assess the current disease situation facing white-lipped peccaries, involving the collaboration





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of local people. Studies on infectious diseases in captive peccaries and domestic pigs in the Amazon region could also provide insights into “potential emerging pathogens,” they stated. Beck agreed that such investigations were necessary to inform any potential conservation action to protect this culturally and ecologically important species. “If you’re able to preserve [peccaries] and preserve the habitat, you preserve many other endangered species, from amphibians to birds to primates,” he said. “A healthy peccary population also means a healthy forest community overall.”

Hippos had found refuge in Uganda’s national parks. But that may be changing

<https://www.nationalgeographic.com/animals/article/hippos-poached-in-ugandas-national-parks>
by Dina Fine Maron, August 10 2023

Demand for hippo ivory and meat is a growing threat for some of the world’s largest animals. Hippo poaching has recently intensified within some of Uganda’s 10 national parks, according to new evidence. Ranger reports and a new aerial survey show hippo numbers have dropped, and the bodies are often missing—telltale signs of poaching. The findings raise new concerns for the safety of the vulnerable animals.

The gregarious, massive herbivores are known to congregate in the parks, and poachers appear to be increasingly targeting the animals for their teeth—which are carved and sold internationally as hippo ivory—as well as for local meat consumption.

A new aerial survey, which hasn’t yet been publicly released, indicates hippopotamus numbers in the country’s national parks have declined, says Charles Tumwesigye, deputy director of field operations at the Uganda Wildlife Authority (UWA). “We know there’s a reduction in hippos, especially in Murchison Falls National Park,” which is home to close to 3,000 of Uganda’s 10,000 estimated hippos, he says.

The International Union for the Conservation of Nature classified hippos as vulnerable in 2016, stating the animal’s chief threats were habitat loss and degradation alongside unregulated and illegal hunting. The sixteen-foot-long animals can also be slow to recover from population losses, partly because females typically have just one offspring every other year.

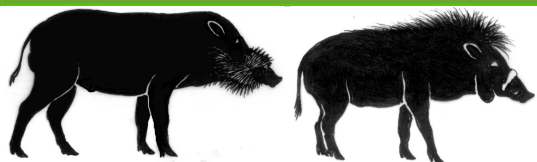
Uganda has experienced a “perfect storm for organized crime to pick up people who are desperate” says Michael Keigwin, founder of the nonprofit Uganda Conservation Foundation, which supports UWA’s rangers. A drought in the country, subsequent flooding, and earlier pandemic lockdowns have all strained local farming economies and other businesses, driving more people to poach, he says.

The country banned commercial hippo teeth exports in 2014, but there’s still a large market for the carvings internationally, with the teeth sourced legally and illegally from various countries.

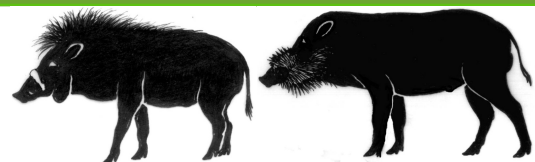
Keigwin says he believes the high-value teeth are poachers’ main target in Uganda, though they often harvest the meat as well. As evidence, he points to the carnage his teams have seen in the national parks: Poachers often “leave the bones and the head and that’s it,” he says. “Everything else is gone.” Sometimes, he adds, the poachers take the whole body and cut it up later, which may make tracking the losses even harder.

In the past couple years, Keigwin says, his teams have consistently discovered stripped down remains, particularly at Murchison Falls National Park and at Queen Elizabeth National Park, another stronghold for the species. As many as 60 percent of the hippos at Murchison have been





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poached during the pandemic, he estimates.

But Tumwesigye, who is a National Geographic Explorer, says the number of deaths is still being determined. “We can’t confirm that yet until we have the results of the recent survey,” which are expected in late August after analysis of the aerial work is complete, he says.

The hippo ivory is routinely carved into jewelry and figurines marketed primarily in Asia, but also in Europe and North America.

Since the bodies are often gone, it remains unclear if the poachers are hunting hippos primarily for their meat, teeth, or both, Tumwesigye says. “We are thinking it might not be entirely hippo teeth trade, but also bushmeat, because when it’s bushmeat they take the carcasses,” he says, adding that he believes they’ve likely lost more hippos to the bushmeat trade overall.

Hippo crimes

Seizures of hippo teeth have spiked this year in Uganda, according to Focused Conservation, a global nonprofit that investigates wildlife crime alongside UWA’s Wildlife Crime Unit. The conservation group issued an alert last month stating that between January and June 2023, Ugandan authorities seized 598 hippo teeth. Yet in all of 2022, according to the group’s figures, authorities only seized 32 teeth.

Focused Conservation says it put the hippo data together on behalf of United for Wildlife, a group founded by the Royal Foundation and Prince William that aims to end the illegal wildlife trade. In the report, Focused Conservation also stated that government officials have been directly implicated in illegal wildlife trade in Uganda, and that well-connected traffickers are sometimes able to procure permits to export hippo teeth despite the 2014 ban.

Investigations remain ongoing. Just because a seizure is recent doesn’t necessarily mean the teeth are from freshly killed hippos, says Tumwesigye. “It’s difficult to connect it.”

To kill a massive animal like a hippopotamus, poachers must be extremely skilled and efficient. Keigwin says that poachers in Uganda are both—often completing this arduous task and dragging off the carcass in under 30 minutes.

At night, poachers take unlicensed fishing boats into areas of Uganda’s national parks, harpoon one of the multi-ton animals, butcher it, and drag it away, he says.

When hippos emerge from the water to feed, poachers also employ other tools, including large snares, pits where hippos may fall onto spikes, and triggers that can drop a weighted spear down from above into the animals’ shoulder blades, Keigwin says. With any of these approaches, he adds, groups of poachers may also then need to spear the injured animals to kill them.

“The main thing we need to do is improve our strategies for patrols within protected areas,” says Tumwesigye. “Hippos stay in specific areas which are known, so once we intensify our patrols, we should be able to combat the poaching.”

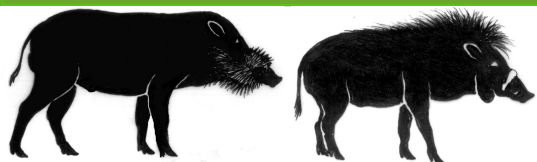
“We’ve done our best and UWA has done an extraordinary amount—everything they could—but they’ve been vastly understaffed and under-resourced,” says Keigwin, who added that during the pandemic his group fed rangers, provided fuel for cars, veterinary drugs for animal rescues and much more.

Dangerous neighbors

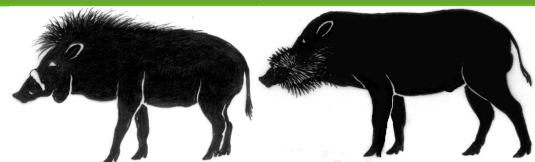
Though hippos are a large tourism draw in Uganda, the animals also make for dangerous neighbors. Each year, hippos kill an estimated 500 people across Africa, making them one of the world’s deadliest mammals.

The animals require vast areas of fresh water with spots shallow enough to stand—hippos can’t actually swim—but they also must be able to completely submerge themselves to keep cool and





Articles in the news



prevent their skin from cracking. Hippos are also very territorial, which puts the animal in direct conflict with humans that may encroach into their habitat or get too close to their young.

“There is a pressing need for more conservation coordination within and among regions where hippos are found—west, east, and south Africa—to create meaningful and coordinated actions that protect both hippo populations and hippo habitat,” says conservation ecologist Rebecca Lewison at San Diego State University, who co-authored the IUCN evaluation for the species.

In Uganda and elsewhere in Africa, tensions around hippos have grown as farming and aquaculture has expanded into the animal’s traditional habitat, leading to the deaths of both hippos and humans. The flooding in Uganda also exacerbated these interactions as hippos’ territories shifted closer to populated areas.

A global trade in hippo parts

Hippos are native to 38 sub-Saharan countries in Africa with an overall estimated population of between 115,000 and 130,000 wild hippos, according to the IUCN’s 2016 assessment. Yet previous overestimates of hippo numbers have made tracking the species’ health and management difficult, according to the group.

At last year’s summit meeting on the international treaty that regulates the global wildlife trade, a proposal to ban all commercial cross-border trade of hippo and hippo products did not pass.

Some reports suggest that the global hippo ivory trade has remained stable or declined in recent years, but global tracking of this trade remains flawed and inconsistent, proponents argued, which may mask threats against the animals. (Read about the fight against the underground trade in hippo teeth.)

Recent analysis from Traffic, a global nonprofit that focuses on the wildlife trade, noted that between 2009 and 2018, hippo-exporting countries reported trading about 55,000 pounds and 40,000 specimens of hippo ivory while importing countries and territories reported receiving about 80,000 pounds and 23,000 specimens. How to explain the discrepancies remains unclear. Uganda, Traffic said, was responsible for 40 percent of the ivory exports during that period.

Such disparities are “concerning and point to a larger issue of the viability of hippo populations in the future,” says Lewison.

“Hippos are bloody important for the ecosystem, not just for their grazing but the algae that grows on their poop is incredibly important for fisheries,” says Keigwin. “Tourism requires hippos, too,” he says, “and to lose them to this extent is extremely damaging.”

Madagascar hippos were forest dwellers

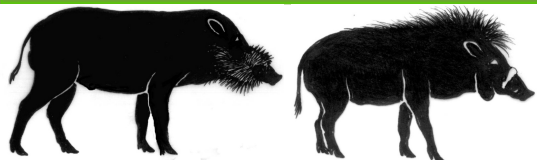
<https://www.sciencedaily.com/releases/2023/07/230707153831.htm>

by University of Cincinnati, July 7, 2023

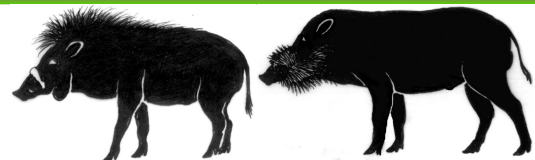
Extinct dwarf hippos that once roamed Madagascar lived in forests rather than open grasslands preferred by common hippos on mainland Africa. The findings suggest grasslands that now cover much of the enormous island off the eastern coast of southern Africa were a relatively recent change facilitated by people rather than a natural habitat sustained in part by these famously large vegetarians.

Extinct dwarf hippos that once roamed Madagascar lived in forests rather than open grasslands preferred by common hippos on mainland Africa, researchers at the University of Cincinnati discovered.





Articles in the news



The findings suggest grasslands that now cover much of the enormous island off the eastern coast of southern Africa were a relatively recent change facilitated by people rather than a natural habitat sustained in part by these famously large vegetarians.

The study was published in the journal *Plants, People, Planet*.

When Madagascar broke away from Africa's mainland 150 million years ago, its plants and animals evolved in geographic isolation in the Indian Ocean. Madagascar had no elephants, giraffes, rhinos or other big mammals like those found on the mainland today.

But it did have hippos.

About the size of a cow, the dwarf or Malagasy hippo was far smaller than its four-ton cousin, the common hippopotamus. Even so, the Malagasy hippopotamus was among the largest land animals on the island along with Nile crocodiles and the flightless and enormous elephant bird.

These hippos likely resembled today's secretive and endangered pygmy hippos found in the forests and swamps of West Africa's Liberia and Guinea, said Brooke Crowley, a UC professor of geosciences and anthropology and lead author of the study.

"Ecologically, we think the Malagasy dwarf hippos were pretty close to the pygmy hippos that live in forests in West Africa," Crowley said.

Crowley and her research colleagues conducted an isotopic analysis of stable carbon and nitrogen found in the bones of extinct Malagasy dwarf hippos that roamed the island more than 1,000 years ago. These isotopes, found in the bones of animals, leave behind a fingerprint of the foods they ate. And this provides clues about their preferred habitats.

Researchers took samples from the bones of dwarf hippos at museums along with those the team collected on the island. They found that dwarf hippos did not regularly graze on grass in dry, open habitats, even in regions dominated by grassland today. Instead, they preferred plants found in the wetter, more forested landscapes. This suggests forest was more abundant before people began changing the landscape to grow cultivated plants, graze domesticated cows and goats and obtain firewood and building materials.

Common hippos on the mainland love grass. Their name derives from the Greek words for "river horse." Each night they leave the safety of rivers and waterholes to find fresh pasture, cropping grass like a horse, before returning in the morning.

But the researchers' analysis found that grass represented only a small part of the diet of Malagasy dwarf hippos. Instead, they behaved more like browsers, feeding on sedges and leaves. As a result, hippos likely had little influence on maintaining or expanding grasslands on the island.

"For years we've seen evidence that these animals were not grazers," said Laurie Godfrey, a study co-author and professor emerita at the University of Massachusetts Amherst.

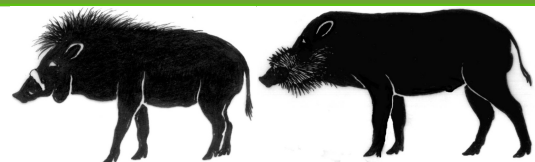
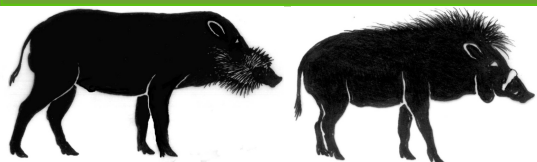
Godfrey said there is evidence to suggest that people caused the extinction of hippos on the island when they created permanent communities and moved from hunting and gathering to raising domestic animals and crops. She calls her idea the "Subsistence Shift Hypothesis," which she said is an elaboration on a similar idea first proposed by noted archaeologist Robert Dewar.

"There is pretty compelling convergent evidence showing that many of the extinct animals disappeared in a short window of time coinciding with the transition of people from hunting and gathering to pastoralism," UC's Crowley said.

Crowley thinks restoring native forests is key to helping conserve wildlife on the island. Based on their study, expansive grasslands were not a critical habitat, at least for the island's hippos.

"Some colleagues argue that grasslands are ancient and that we need to protect and manage





them like we do forest," Crowley said. "I would argue that forests are far more important. We are not contending that grasses did not exist in the past, but pointing out that there is no evidence for large grasslands devoid of trees prior to about 1,000 years ago."

It's a point the researchers make in the study as well.

"It is clear that Madagascar faces a biodiversity crisis much greater than that which it has already endured. Preventing this crisis will demand new conservation actions," the study concluded.

The study was supported by grants from the National Science Foundation, the African Regional Research Program Fulbright and the National Geographic Society.

Imports of ivory from hippos, orcas and walruses to be banned in UK

<https://www.theguardian.com/environment/2023/may/23/imports-of-ivory-from-hippos-orcas-and-walruses-to-be-banned-in-uk>

by Helena Horton, 23 May 2023

Ministers to close loophole in 2018 Ivory Act that means animals other than elephants can be targeted.

Ivory imports from hippopotamuses, orcas and walruses will be banned under new legislation to protect the endangered species from poaching.

The Ivory Act, passed in 2018, targeted materials from elephants, but a loophole meant that animals other than elephants, including hippos, were being targeted for their ivory.

After a consultation, ministers have decided to tighten the ban to include all ivory-bearing species, so these will not be poached to fill the gap in the trade left by the elephant ivory ban.

Ministers said the hippopotamus was the species most at risk from the trade in its ivory after elephants, and the other species were already threatened by the climate crisis. They added that continued trade in their ivory could exacerbate these threats and make their long-term survival less likely.

The elephant ivory ban faced immense challenges, with antique traders taking the government to court in an ultimately unsuccessful battle to squash the legislation.

Trudy Harrison, biodiversity minister at the Department for Environment, Food and Rural Affairs (Defra), said: "This is a pivotal moment in delivering one of our key manifesto commitments on international conservation.

"The Ivory Act is one of the toughest bans of its kind in the world and by extending greater legal protections to five more species, we are sending a clear message the commercial trade of ivory is totally unacceptable.

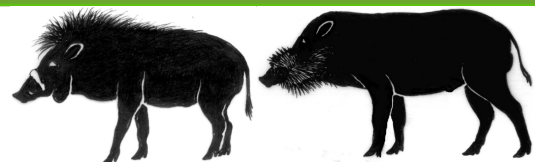
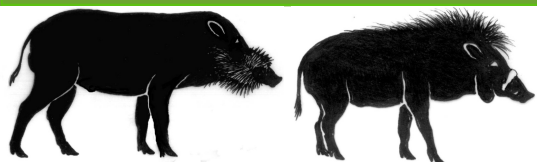
"The UK has long led the way in conservation and our ban shows continued global leadership in doing all we can to protect the world's most endangered species."

Ivory is used for ornaments, musical instruments and jewellery, among other items, and animals are poached across the globe for profit in what can be a lucrative market.

The hard, white material comes from the tusks and teeth of animals. It consists mainly of dentine, one of the physical structures of teeth and tusks.

Charities welcomed the ban. Frances Goodrum, head of campaigns and programmes at the International Fund for Animal Welfare UK, said: "[We] are encouraged by early indications that the ban is having a significant impact on the trade in elephant ivory, yet other species are still poached globally to meet an unnecessary demand for 'luxury' ivory products, including the





hippopotamus, walrus, narwhal, sperm whale and killer whale.

“We welcome Defra’s decision to extend this powerful legislation, which will go a long way in cracking down on a damaging trade. Today is a good day for conservation and a step change towards international commitments to safeguard our natural world.”

Removing 70 of Pablo Escobar’s hippos to cost Colombia \$3.5m

<https://www.theguardian.com/world/2023/mar/30/removing-pablo-escobars-hippos-to-cost-colombia-35m>

by Guardian staff and agencies, 30 Mar 2023

Animals to be sent overseas in effort to contain growing population that risks upsetting local ecosystem.

Colombia has said that the cost of transferring 70 hippos that belonged to deceased drug lord Pablo Escobar to overseas sanctuaries will be \$3.5m.

The cocaine baron brought a small number of the animals from Africa to Colombia in the late 1980s. But after his death in 1993 the animals were left to roam freely in a hot, marshy area of Antioquia department, where environmental authorities have been helpless to curb their numbers. Authorities said they plan to capture and move nearly half of the hippopotamuses in the coming months, with 10 bound for the Ostok Sanctuary in northern Mexico, and 60 destined for an as-yet unnamed facility in India.

“The whole operation should cost around \$3.5m,” Ernesto Zazueta, the owner of the Ostok Sanctuary said.

He and the local governor of the Colombian region that is home to the hippos say they plan to lure the animals with bait into pens, where they will remain confined before being put in special crates for the transfer.

Since the hippos escaped after Escobar’s death, the government has repeatedly failed to tame the booming population who have made the Magdalena River basin their home.

In 2009 it tried culling the animals but stopped after a graphic photo caused national outrage. A sterilization program remains in place but the hippos breed faster than local experts can find, catch and castrate them.

From the original four hippos that escaped from Escobar’s country estate about 130 exist today – the largest population outside Africa. With no natural predators to keep them in check their population will keep growing exponentially. One study estimated that by 2034 the hippos will number 1,400.

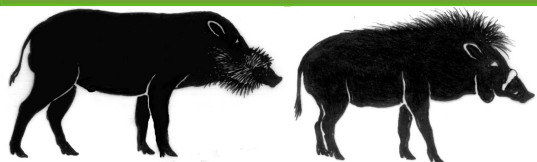
Studies have warned that the hippos are damaging the ecosystem in the Magdalena – the largest river in one of the most biodiverse countries in the world. Each hippo eats about 40kg of grass a night meaning their excrement alone is poisoning the water, killing fish and jeopardising the river’s rich biodiversity.

The hippos are also increasingly coming into conflict with the local people and hippo attacks have become more common in recent years.

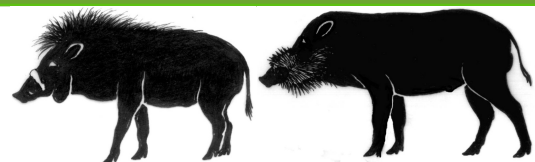
The environment ministry declared the hippos an invasive species last year, which opened the door to an eventual cull, but the hippo transfer plan is seen as a final life-saving measure.

Agence France-Presse contributed to this report.

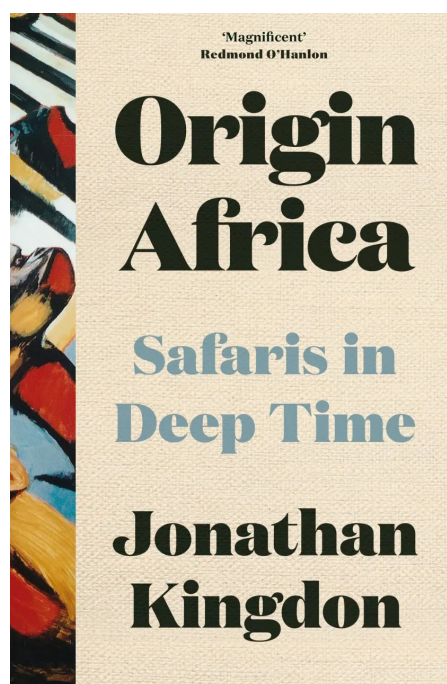




New books on Suiformes



Origin Africa – Safaris in Deep Modern Time



Jonathan Kingdon is the most famous artist of African wildlife. He is well known for the books “Mammals of Africa” and “The Kingdon Field Guide to African Mammals”!

“Origin Africa – Safaris in Deep Time” is his latest masterpiece.

This book deals with the natural history of the African continent and the evolution of human beings there. All the different aspects of evolution, ecology and biogeography are discussed. A detailed discussion of all the chapters is far beyond the scope of this short review. Regarding Suiformes, the common hippo are mentioned and a marvellous drawing of mandible clashing between adult hippos is shown.

What makes this book unique is the combination of science, art and Jonathan Kingdon's descriptions of his own adventures, experiences and his retrospections. Each chapter is written in a vivid style. Browsing through the book the reader is overwhelmed by all the pictures, drawings and photos of African wildlife and African art! There are few scientists like

Jonathan Kingdon who are both great artists and extraordinary writers. All this makes his most recent book a masterpiece and the most personal one the author has written so far. The book is a declaration of his love of the African wildlife, the many different people living in Africa and their marvellous art! Many thanks to Jonathan Kingdon for sharing his experiences and knowledge with us!

Reviewed by Thiemo Braasch

Origin Africa – Safaris in Deep Time
by Jonathan Kingdon
472 pages, William Collins 2023
ISBN: 9780008423001

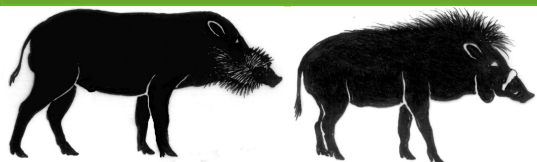
Handbook of Mammals of Madagascar

Madagascar is home to 175 non-volant mammal species that are endemic there. Lemurs are the most well known mammals on this island. If volant species (mostly bats) are included 213 of 220 mammal species are endemic on it (c. 97 %). This degree of endemism of mammalian species makes Madagascar a unique island. It is a unique place in the world.

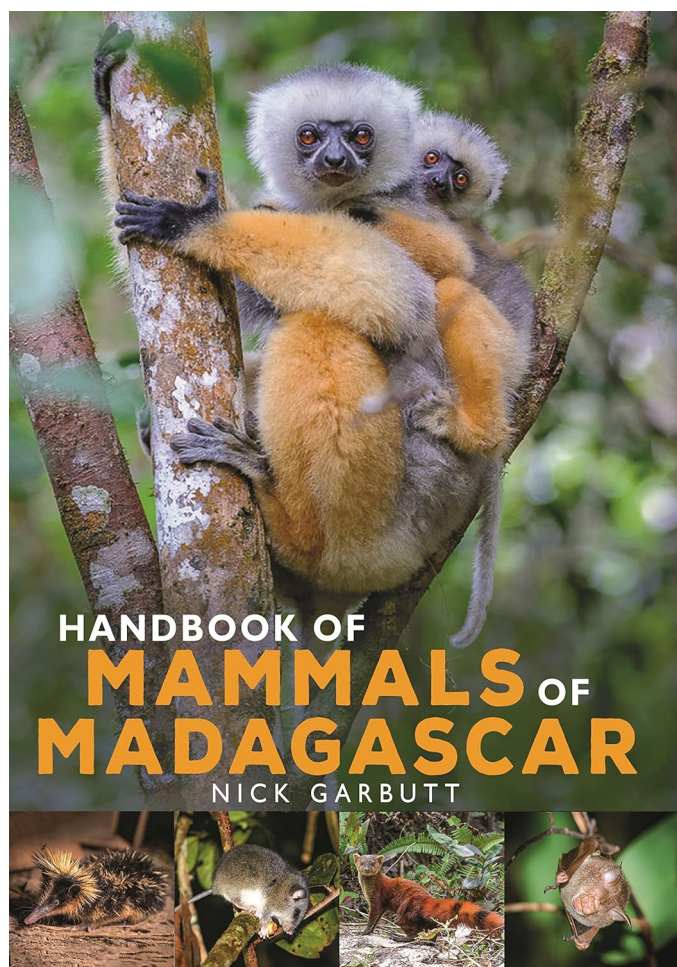
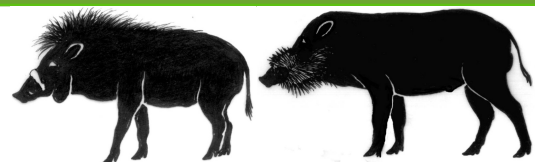
After a short introduction the first chapters deal with the biogeography, regions and habitats of Madagascar and give an overview of the taxonomy of mammal species there.

The main part of the book deals with the species accounts. Each species is presented by a distribution map, measurements, description and identification, habitat and distribution, behaviour,





New books on Suiformes



a description of where to see it and at least one clear photo (if possible). These photos show the biodiversity of lemurs and other species on Madagascar and are really great!

Regarding bushpigs there are two theories how they reached the island. While some authors suggest that they arrived on Madagascar from the African mainland naturally and should be considered native, the majority view is that they were introduced by humans and became naturalised. There are no known remains in subfossil deposits and the earliest written reference dates to the mid-17th century. Recent genetic studies confirm their close relation to mainland African populations.

Bushpigs are found in the west, east and north of Madagascar in all major habitats from rainforest to dry deciduous and spiny forests and open savanna and from sea level to above treeline at 2,000 m. They are dependent on water and food availability.

The last chapters of the book deal with threats to Malagassy mammals, conservation and the island's protected areas, important mammal

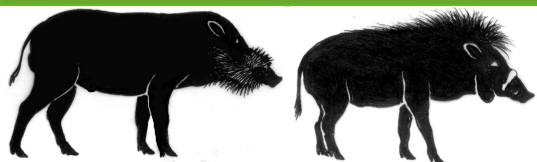
watching sites and the extinct mammal fauna of the island. There were three now-extinct dwarf hippo species on Madagascar: *Hippopotamus lemerlei*, *Hippopotamus laloumena* and *Hippopotamus madagascariensis*. These species became extinct more than 1,260 years BP. However, some authors report oral fabric, fables, and stories from several regions of the island suggesting that they may have survived until the late 19th century.

A glossary at the end of the book is helpful for readers who are not familiar with scientific terms. Overall, this book is a great overview on the mammalian biodiversity and the different mammal species of Madagascar and where to watch them. The book will help scientists and interested tourists to explore the wildlife on this unique island!

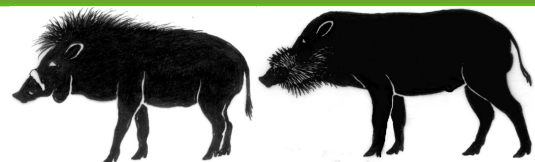
Reviewed by Thiemo Braasch

Handbook of Mammals of Madagascar
by Nick Garbutt
488 pages, Bloomsbury Publishing 2023
ISBN: 9781472985934

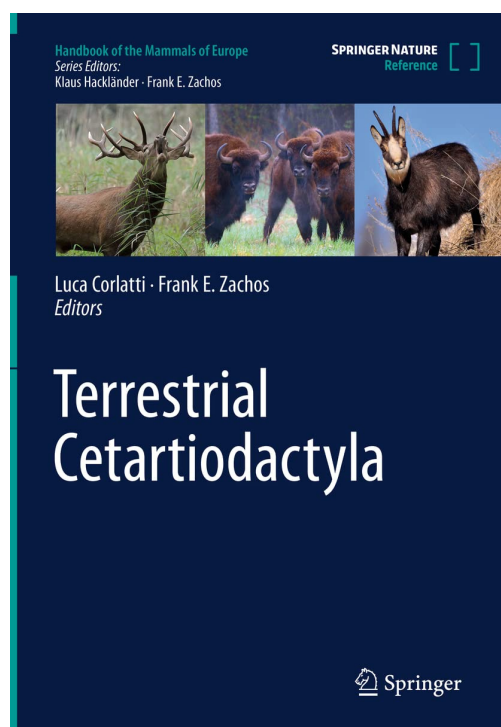




New books on Suiformes



Terrestrial Cetartiodactyla



This book has been published in the “Handbook of the Mammals of Europe”-Series. It deals with all the even-toed ungulates of Europe and includes introduced species like Chinese Water Deer, Reeve’s Muntjac and Barbary Sheep.

Each species is presented in the same way: common names in different languages, taxonomy, systematics and palaeontology, current distribution, description of the species, physiology, genetics (chromosomes, phylogeny and phylogeography, genetic diversity and structuring, hybridization), life history (growth, reproduction, survival), diet (habitat selection, movement ecology, food consumed), behaviour (social behaviour, mating behaviour, senses, activity), diseases (pathogens and parasites, epidemiology) population ecology (population dynamics, anthropogenic impacts, population trends), conservation status, management (introductions, reintroductions and restocking, impacts, conflicts and humans and damage control, hunting and hunting

regulation, economic value, health management), future challenges for research and management and a list of references for each species account. There is also a distribution map for each species, some lovely photos, and photos of skulls, where necessary.

Regarding Eurasian wild boar subspecies, the authors of this chapter follow the classification of Groves (2007) and list four different subspecies: *Sus scrofa scrofa* in Europe from the Iberian Peninsula to Belarus, *Sus scrofa attila* from Central Belarus and the Carpathians to Western Russia, *Sus scrofa meridionalis* as an endemic subspecies of Sardinia and Corsica and *Sus scrofa lybicus* from the Balkans to the Near East. The authors also briefly discuss Italian populations and the differences of subspecies in Central-Eastern Europe.

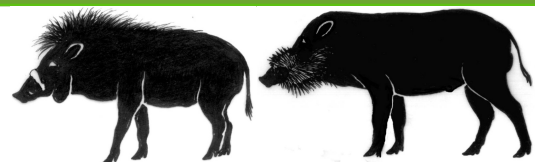
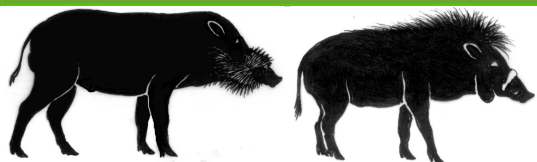
This is the most updated overview of the Eurasian Wild Boar. The large number of references offers help to delve deeper into each subject. This book is also the most updated overview of other European even-toed ungulates and introduced even-toed ungulates in Europe. Some species accounts offer more details on specific subjects like genetics or conflicts with humans. As for the Northern Chamois and the Southern Chamois the species accounts present comparisons of the two species and the differences between them.

Generally, the book is a very helpful source to study wild terrestrial artiodactyla in Europe. It will become one of the references for the even-toed ungulates of Europe.

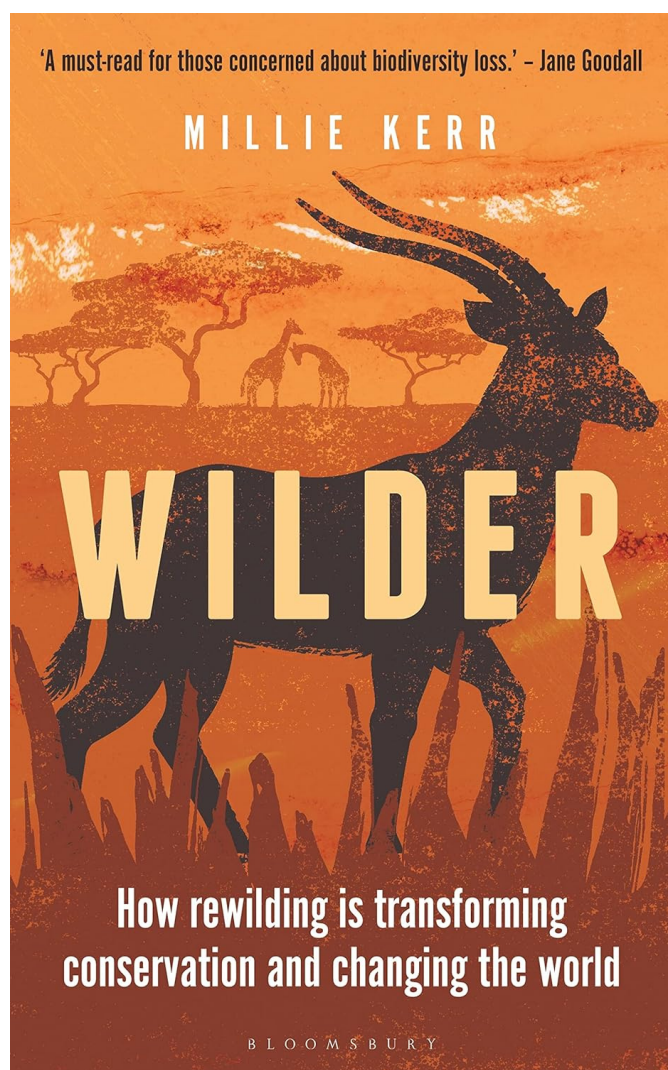
Reviewed by Thiemo Braasch

Terrestrial Cetartiodactyla – Handbook of the Mammals of Europe
by Frank E. Zachos and Luca Corlatti (editors)
400 pages, Springer Nature 2022
ISBN: 9783030244743





Wilder – How rewilding is transforming conservation and changing the World



How is it possible to restore ecosystems? How might it be possible to preserve the last existing pockets of wild areas with all their wildlife? When these questions are raised one of the answers is rewilding. The idea of rewilding is more than the conservation of wildlife and their habitats. It means the restoration of whole ecosystems. The wildlife journalist Millie Kerr takes the reader all around the world from Argentina to China, from Texas to Rwanda, from England to the Galapagos Islands and from New Zealand to Mozambique. She introduces the idea and the concept of rewilding in a vivid way. Then she shows the implementation of rewilding with different examples and the background and circumstances of these projects.

Wild pig species, hippos and peccary species are keystone species in the ecosystems they inhabit. Although not explicitly named in the book, these are species that can help to rewild places and to restore ecosystems services.

There are many scientific articles about habitat restoration. Rewilding has been part of some documentaries in TV. Millie Kerr writes about her personal experience with people working for rewilding projects. This style

makes the book easy to read and entertaining! It is a charming way of advertising the idea of rewilding. The book will hopefully get a broad audience and spread the idea of rewilding!

Reviewed by Thiemo Braasch

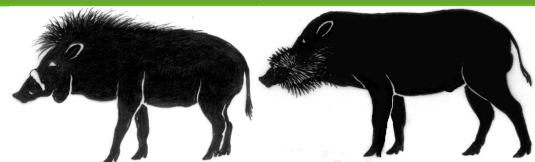
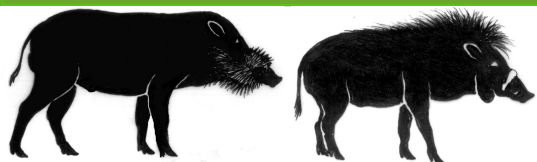
Wilder – How rewilding is transforming conservation and changing the World

by Millie Kerr

368 pages, Bloomsbury Sigma 2022

ISBN: ↑9781472990426





General articles about Suiformes

Socio-ecological factors shape the distribution of a cultural keystone species in Malaysian Borneo

Kurz, D. J., Connor, T., Brodie, J. F., Baking, E. L., Szeto, S. H., Hearn, A. J., ... and J.S. Brashares 2023

Biodiversity, 2(1), 4, doi: <https://doi.org/10.1038/s44185-022-00008-w>

Biophysical and socio-cultural factors have jointly shaped the distribution of global biodiversity, yet relatively few studies have quantitatively assessed the influence of social and ecological landscapes on wildlife distributions. We sought to determine whether social and ecological covariates shape the distribution of a cultural keystone species, the bearded pig (*Sus barbatus*). Drawing on a dataset of 295 total camera trap locations and 25,755 trap days across 18 field sites and three years in Sabah and Sarawak, Malaysian Borneo, we fitted occupancy models that incorporated socio-cultural covariates and ecological covariates hypothesized to influence bearded pig occupancy. We found that all competitive occupancy models included both socio-cultural and ecological covariates. Moreover, we found quantitative evidence supporting Indigenous pig hunting rights: predicted pig occupancy was positively associated with predicted high levels of Indigenous pig-hunting groups in low-accessibility areas, and predicted pig occupancy was positively associated with predicted medium and low levels of Indigenous pig-hunting groups in high-accessibility areas. These results suggest that bearded pig populations in Malaysian Borneo should be managed with context-specific strategies, promoting Indigenous pig hunting rights. We also provide important baseline information on bearded pig occupancy levels prior to the 2020–2021 outbreak of African Swine Fever (ASF), which caused social and ecological concerns after mass dieoffs of bearded pigs in Borneo. The abstract provided in Malay is in the Supplementary file.

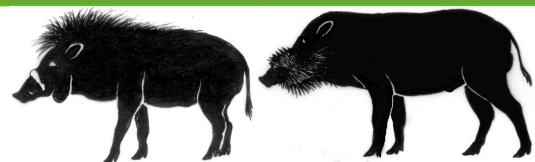
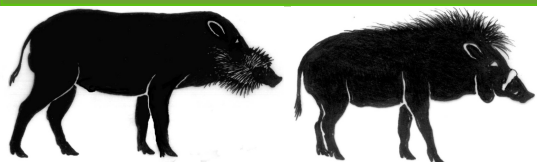
Spatiotemporal overlap with invasive wild pigs (*Sus scrofa*) varies by species and season in a temperate ecosystem

Saldo, E. A., Jensen, A. J., Muthersbaugh, M. S., Butfiloski, J. W., Cantrell, J., Kilgo, J. C., ... and D.S. Jachowski 2023

Ecosphere, 14(6), e4500, doi: <https://doi.org/10.1002/ecs2.4500>

Wild pigs (*Sus scrofa*), which are invasive in many regions globally, can alter ecosystems and compete with native species through interference competition and resource exploitation. Wild pig impacts on other species may increase with greater niche overlap, which could vary over time based on environmental conditions, resource availability, or biological traits like diet, especially as seasonal variation in wild pig diet has been widely documented. A limited number of studies have assessed spatial or temporal overlap between native species and invasive wild pigs, with only a handful simultaneously assessing overlap in these niche dimensions. We investigated the potential for interspecific interactions involving invasive wild pigs in the Piedmont region of South Carolina, USA, by examining seasonal spatiotemporal overlap with other wildlife using N-mixture models and diel activity overlap analyses. Site use by white-tailed deer (*Odocoileus virginianus*) and coyote (*Canis latrans*) was negatively associated with wild pig activity in the fall, when the species had high diel activity overlap, indicating spatial partitioning could reduce interference competition with wild pigs in this season. Conversely, white-tailed deer site use was positively associated with wild pig activity in the winter, suggesting higher spatial overlap may be necessary





if resources are limited. Site use by bobcat (*Lynx rufus*) and nine-banded armadillo (*Dasypus novemcinctus*) in the spring, along with raccoon (*Procyon lotor*) and wild turkey (*Meleagris gallopavo*) site use in the summer, was positively associated with wild pig activity. With the exception of diurnal wild turkey, diel activity overlap between these species and wild pigs was high, although temporal partitioning could have occurred at finer spatiotemporal scales than we examined. Our results collectively emphasize the importance of accounting for seasonal spatial and temporal responses by individual species to invasive wild pigs, with special consideration given to species in seasons where high niche overlap with wild pigs is anticipated.

Third-party intervention and post-conflict behaviour in agonistic encounters of pigs (*Sus scrofa*)

Maffezzini, N., Turner, S. P., Bolhuis, J. E., Arnott, G. and I. Camerlink 2023

Frontiers in zoology, 20(1), 1-15, doi: <https://doi.org/10.1186/s12983-023-00508-w>

Background

Third-party interference in agonistic contests entails a deliberate intervention in an ongoing fight by a bystanding individual (third party) and may be followed by post-conflict social behaviour to provide support to a specific individual. The mechanisms behind third-party intervention are, however, still largely understudied. The aim of this study was to investigate third-party interference, with the predictions that (1) the interferer derives benefits from its action by winning a fight, (2) that patterns of intervention depend on familiarity, (3) that dyadic fights last longer than triadic fights, and (4) that interferers engage in non-agonistic social behaviours afterwards. Pre-pubertal pigs (*Sus scrofa*) (n=384) were grouped with one familiar and four unfamiliar conspecifics (all non-kin) to elicit contests for dominance rank. Third-party interference was analysed for the first 30 min after grouping, along with the behaviour (nosing or aggression), contest duration, contest outcome, and interferer behaviour after the fight (post-conflict social behaviour).

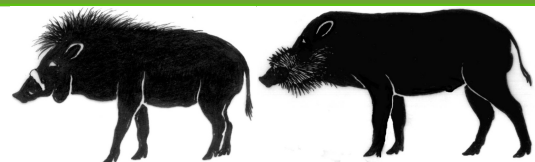
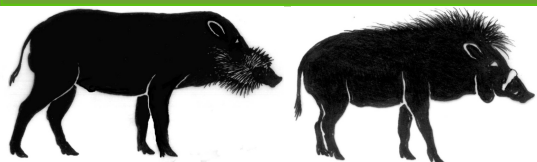
Results

Three types of interference were observed: non-agonistic involvement (nose contact) by the interferer in a dyadic fight; a triadic fight with each of three contestants fighting one opponent at a time; and triadic fights with two opponents jointly attacking the third one (two-against-one fights). The likelihood of a third-party intervention to occur did not depend on the presence of a familiar animal in the fight. However, once intervention was triggered, interferers attacked unfamiliar fight initiators more than familiar ones. Two-against-one fights lasted longer than other triadic fights and occurred more often when both initial contestants were females. Results of 110 triadic fights (out of 585 fights in total) revealed that interferers were more likely to win compared to the initial opponents at equal body weight. The most common post-conflict behaviour displayed by the interferer was agonistic behaviour towards another group member, independently of familiarity.

Conclusions

The general lack of discrimination for familiarity suggests interference is not driven by support to familiar individuals in pigs. The results show that intervening in an ongoing fight gives the interferer a high chance of contest success and may be a strategy that is beneficial to the interferer to increase its dominance status.





Conservation prioritisation through genomic reconstruction of demographic histories applied to two endangered suids in the Malay Archipelago

Schleimer, A., Frantz, A. C., Richart, L., Mehnert, J., Semiadi, G., Wirdateti, ... and F. Drygala 2023

Diversity and Distributions, 29(6), 713-726, doi: <https://doi.org/10.1111/ddi.13689>

Aim

The biodiversity of the Malay Archipelago is the product of the region's rich biogeographical history with periods of island connectivity and isolation during the Pleistocene glacial cycles. Here, the case of two endemic suid species, the Javan (*Sus verrucosus*) and Bawean (*S. blouchi*) warty pigs, was used to illustrate how biogeographic processes and recent anthropogenic pressures can shape demographic histories with significant implications for species conservation.

Location

Malay Archipelago, with focus on Bawean and Java.

Methods

We employed genome-wide single nucleotide polymorphisms from the Porcine SNP60 v2 BeadChip to assess interspecific genetic differentiation, to estimate divergence times and to perform demographic model selection.

Results

In contrast to the hypothesis of recent divergence during the last glacial maximum, *S. blouchi* was found to have diverged from *S. verrucosus* at least 166 k years ago following a founder event. The contemporary *S. blouchi* population was characterised by a recent bottleneck that reduced the effective population size to less than 20. The genomic assessment supports the single species status of *S. blouchi*, as was previously proposed based on morphometrics. The demographic history of *S. verrucosus* showed evidence of secondary contact with the sympatric banded pig (*S. scrofa vittatus*) that colonised Java 70 k years ago.

Main Conclusions

While the Javan and Bawean warty pigs have persisted throughout the Pleistocene climatic oscillations, contemporary pressures from human activities threaten their survival and immediate action should be taken to grant legal protection to both *S. verrucosus* and *S. blouchi*. This study highlighted the use of demographic history modelling using genomic data to identify evolutionary significant units and inform conservation.

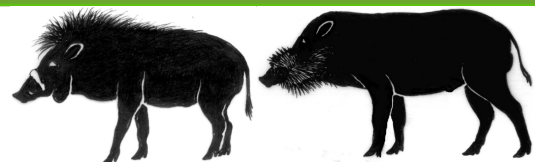
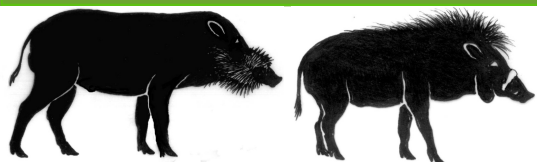
Local-scale habitat configuration makes a niche for wildlife encroaching into an urban landscape: grubbing sites of wild boar *Sus scrofa* in a city matrix

Ciach, M., Tetkowski, P. and I.Fedyń 2023

Urban Ecosystems, 26(3), 629-639, doi: <https://doi.org/10.1007/s11252-022-01310-y>

Urban environments may offer certain species diverse and abundant food resources of natural and anthropogenic origin. However, the local-scale configuration of habitats and urban infrastructure may influence foraging decisions regardless of the availability of food. In recent years, the expansion of wild boar *Sus scrofa* into areas significantly transformed by humans has been observed in many parts of its range. Grubbing (rooting) is a major foraging mode of the species, during which disturbance of the upper soil layers enables these animals to find and consume food items. However, the factors that determine the selection of grubbing sites in the urban landscape, where the balance between food availability and the avoidance of humans may influence foraging decisions, are not known. Our aim was to identify local-scale factors that





influence grubbing site selection and the size of grubbed patches in an urban landscape. The characteristics of 108 wild boar grubbing sites in the city of Kraków (Poland) were compared to randomly selected control sites. The probable presence of a grubbing site was positively correlated with the proportion of meadows and fallow land in the vicinity and with increases in both canopy cover and distance to pavements. The size of a grubbed patch was positively correlated with the percentage of meadows in the vicinity, increasing distance to buildings and decreasing distance to pavements. We found a non-random pattern of grubbing sites in the urban landscape and indicated that the local-scale configuration of vegetation and urban infrastructure contribute to foraging site selection by wild boar. Our study highlights that the encroachment of wildlife into the urban landscape is a complex process, driven by both resource availability and the avoidance of human-related disturbances.

Home ranges and movement patterns of wild boars (*Sus scrofa*) at the northern edge of the species' distribution range

Miettinen, E., Melin, M., Holmala, K., Meller, A., Väänänen, V. M., Huitu, O. and M. Kunnasranta 2023

Mammal Research, 1-13, doi: <https://doi.org/10.1007/s13364-023-00710-5>

In Finland, the wild boar (*Sus scrofa* L.) lives on the northernmost edge of the species' distribution range, and the population mainly originates from individuals immigrating from Russia. Most of the current population lives in the southeastern part of the country, and the wild boar is steadily expanding further. To develop effective risk and population management in novel northern wild boar regions, detailed information about the species' local ecology is required. To estimate wild boar movement patterns, 17 adult wild boars were monitored using GPS collars from May 2020 to September 2022 in the core region of the current distribution. The average total home ranges of wild boars (87.1 ± 17 km² MCP, 33 ± 5.5 SE km² 95% KDE) were larger compared with studies from southern latitudes. The length of nocturnal activity times varied seasonally. All studied individuals at the border zone (N = 15) showed continuous transboundary movements, with home range core areas located mainly on the Russian side. Wild boar locations were predominantly in the Russia border zone, especially resting sites during the daytime. Most locations in Finland were from night-time feeding excursions. Our study shows that, although home ranges are large, adult wild boars are relatively sedentary also in northern latitudes. However, the movement capacity of the species enables the transboundary spread of diseases such as African swine fever. Our results provide information for risk management and emphasize the importance of transboundary collaboration in the monitoring and management of common wild boar populations.

Influence of COVID-19 lockdown and hunting disturbance on the activity patterns of exotic wild boar (*Sus scrofa*) and axis deer (*Axis axis*) in a protected area of northeastern Argentina

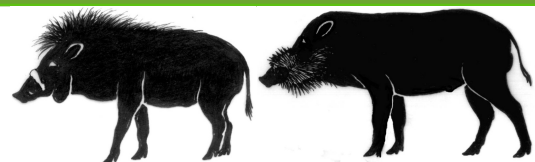
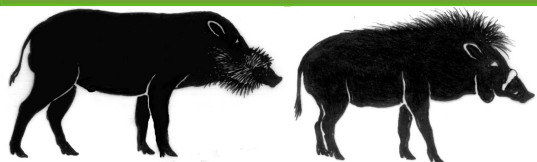
Nicosia, G., de Miguel, A., Fumagalli, A., Diego-Arnaldo, R. B., and R. E. Gürtler 2023

European Journal of Wildlife Research, 69(5), 96,

doi: <https://doi.org/10.1007/s10344-023-01725-8>

Wildlife diel activity patterns are relevant for studying animal responses to human disturbance and management of overabundant and invasive species. Exotic wild boar (*Sus scrofa*) and axis deer (*Axis axis*) in a protected area of northeastern Argentina have been intensely managed through controlled shooting over bait since 2006. This program kept wild boar at bay but failed to curb axis





deer numbers for unknown reasons possibly related to the timing of hunting sessions. We used camera traps to assess the seasonal diel activity patterns of both ungulates over 2017–2021 and to test whether hunting-related activity and COVID-19 lockdown modified those patterns, and whether hunting-shift intervals overlapped with ungulate core activity. Wild boar activity strongly differed between summer and winter, showing cathemeral activity in summer and nocturnal activity in winter. Axis deer cathemeral activity displayed moderate inter-seasonal and inter-annual changes. The activity cores largely differed between both ungulate species. The lockdown-related suspension of hunting and other park operations over roughly 1 year did not modify the seasonal activity patterns of wild boar, whereas axis deer increased its daytime activity in summer. Ungulate activity remained consistent over successive 48-h interval preceding, accompanying, and following hunting sessions, suggesting that short-term hunting-related disturbance did not influence their temporal activity. Unlike wild boar, detection of axis deer was substantially higher during intervals matching overnight hunting shifts rather than during evening shifts. Matching the timing of hunting sessions to ungulate activity cores (i.e., night hunting) may substantially increase culling and the efficiency of management efforts.

Feral pig (*Sus scrofa*) activity and landscape feature revisitation across four sites in eastern Australia

Wilson, C., Gentle, M., and D. Marshall 2023

Australian Mammalogy, doi: <https://doi.org/10.1071/AM22034>

Quantifying feral pig movements and understanding the fine-scale ecological drivers of feral pig landscape use are important factors for optimising pest management programs. We tracked 59 GPS-collared feral pigs at four sites in eastern Australia between 2017 and 2021, for a mean of 375 ± 277 (s.d.) days. The mean number of successful GPS fixes was $15\,577 \pm 11\,833$ (s.d.) and these were recorded at 30-min intervals. We calculated mean hourly and daily distances travelled to determine feral pig activity and investigated the influence of sex, site, season and time of day on this activity. We also investigated the proximity of highly active sites to habitat covariates, along with intensity and frequency of site use. Male daily movement, 4.9 km (95% CI = 4.2, 5.6 km), was significantly greater than it was for females, 3.6 km (95% CI = 3.0, 4.1 km) and males maintained a high level of activity all night, while female activity was predominantly crepuscular. Study site was a significant determinant of daily movement, but season was not, across either sex or site. Highly-visited site selection was negatively associated with distance from creeks, dams, cultivation, open herbaceous vegetation and medium woody vegetation. Both medium woody vegetation and dam sites had the longest duration of use (3 and 2.7 h respectively) and the shortest time between visitations (14.5 and 13 h respectively). Quantifying feral pig activity and key habitat feature preference are important steps in improving management programs. Better prediction of feral pig movement and behaviour allows for more targeted placement of control tools, potentially increasing encounter rates.

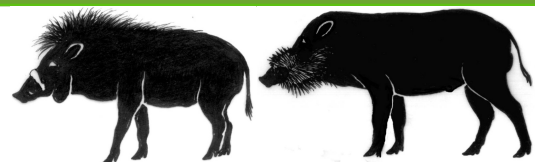
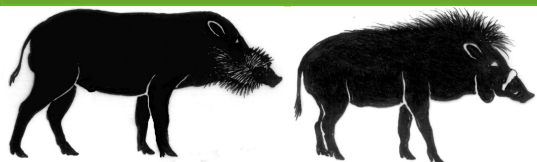
Factors influencing the activity ranges of feral pigs (*Sus scrofa*) across four sites in eastern Australia

Wilson, C., Gentle, M. and D. Marshall 2023

Wildlife Research, doi: <https://doi.org/10.1071/WR22095>

Context: Understanding the home-range size and the ecological drivers that influence the spatial distribution of feral pigs is of paramount importance for exotic-disease modelling and the





improvement of pest management programs.

Aims: To investigate various factors affecting home- and core-range size and test selection of habitat, to better inform disease modelling and pest management programs.

Methods: In this study, 59 GPS-collared feral pigs were tracked over four sites in eastern Australia between 2017 and 2021. Using minimum convex polygon (MCP) and the nearest-neighbour–local convex hull (k-LoCoH) as home-range estimators and foliage projective cover (FPC) as an estimator of landscape-scale shelter, we investigated the influence of sex, site, season, year and body weight on range size and tested selection of habitat by using chi-squared and Jacob's index tests.

Key results: Home-range sizes were highly variable, with k-LoCoH90 (home) ranges between 0.08 and 54.97 km² and k-LoCoH50 (core) ranges between 0.01 and 7.02 km². MCP90 ranged between 0.15 and 242.30 km², with MCP50 being between 0.07 and 60.61 km². Sex and site both significantly ($P < 0.001$) influenced home-range size, but season and year did not. Home-range size was shown to increase with body mass for both sexes ($P = 0.001$). Importantly, the data indicated that feral pigs prefer habitat within 20–40% FPC (woodland), whereas open forests (51–80% FPC) and closed forests (>80% FPC) were actively avoided. Typically, use of open vegetation (1–10% FPC) was also avoided, but this behaviour varied and was dependent on site.

Conclusion: Feral pig ranges are influenced by sex, site and body mass but not by season and year. Broad-scale selection for shelter indicated that feral pigs prefer habitat between 20% and 40% FPC.

Implications: Targeting or avoiding such areas respectively for control or monitoring tool placement may result in improved, efficient outcomes to monitor or manage feral pig populations. Feral pig distribution modelling may also find benefit in the consideration and further study of the above factors and the influence of food and water sources on the activity ranges and behaviour of feral pigs.

Understanding the interface between European wild boar (*Sus scrofa*) and domestic pigs (*Sus scrofa domesticus*) in Sweden through a questionnaire study

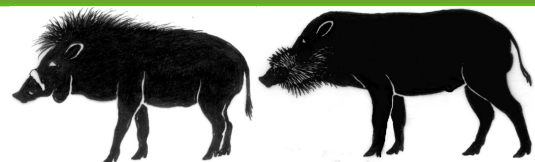
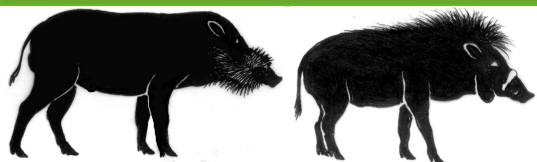
Ernholm, L., Ståhl, K., Neimanis, A., Widgren, S. and S. Sternberg-Lewerin 2023

Doi: <https://doi.org/10.21203/rs.3.rs-2916788/v1>

In recent years, the wildlife/livestock interface has attracted increased attention due to disease transmission between wild and domestic animal populations. The ongoing spread of African swine fever (ASF) in European wild boar (*Sus scrofa*) emphasize the need for further understanding of the wildlife/livestock interface to prevent disease spill-over between the wild and domestic populations. Wild boar may also act as a potential source for other infectious disease agents, although ASF may currently be considered the most severe threat from wild boar to domestic pigs. To gather information on the wild boar situation at commercial pig producing farms in Sweden, a digital questionnaire survey was distributed through the animal health services.

Most pigs produced for commercial purposes in Sweden are raised without outdoor access. Around 80% of the responding pig producers saw wild boar or signs of wild boar activity in the vicinity of their farm at least once during the year. Observations were significantly correlated with geographical region, but there was no correlation between farm characteristics (farm size, main type of production, outdoor access) and observed wild boar presence or proximity. However, observations made in closer proximity to the farm were positively correlated with higher frequency of wild boar observations.





Hunting and strategic baiting were the most common mitigation strategies used to keep wild boar at bay. At 12 out of 14 responding farms, pigs with outdoor access could be raised solely indoors, if needed. Pigs with outdoor access are required to be fenced in, but double fencing in these outdoor pig enclosures was not practiced by all. A perimeter fence surrounding any type of pig farm is very rare. More than half of the producers that grew crops with intended use for pigs reported crop damage by wild boar.

This study shows that although pigs raised for commercial purposes in Sweden are, to a large extent, kept indoors the potential for indirect contact with wild boar exists and must be considered. Variable local situations may require an adaptive approach regarding biosecurity efforts.

The mass mortality of Asia's native pigs induced by African swine fever

Luskin, M. S., Moore, J. H., Mendes, C. P., Nasardin, M. B., Onuma, M. and S. J. Davies 2023
Wildlife Letters, doi: <https://doi.org/10.1002/wil2.12009>

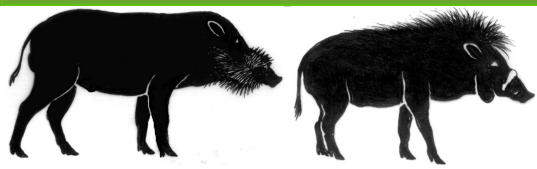
Asia's wild pigs are ecosystem engineers and a key food for predators and people. The arrival of African swine fever (ASF) in 2018 induced near-100% fatality in domestic pigs and decimated the Chinese pork industry in 2020 but outcomes for wild pigs have been delayed and unclear. Here we report on the mass mortality of native wild boar (*Sus scrofa*) in Peninsular Malaysia. ASF was confirmed at our long-term study site in February 2022 and wild boar carcasses increased >100-fold in June 2022 compared to prior years. Camera trapping revealed an 87% decline in wild boar activity in 2022 compared to five prior surveys. Wild boars retired in old birthing nests and pairs of animals died next to each other in the open. Similar results are being anecdotally reported across the region with immense repercussions suspected on ecology and conservation. We urge a rapid research response to take advantage of this unique natural experiment.

Co-occurrence of native white-tailed deer and invasive wild pigs: Evidence for competition?

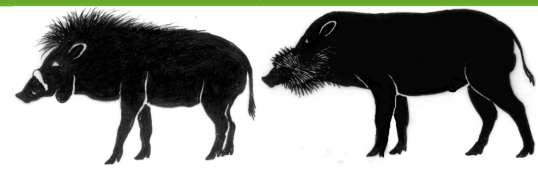
Garabedian, J. E., Cox, K. J., Vukovich, M. and J.C. Kilgo 2023
Ecosphere, 14(3), e4435, doi: <https://doi.org/10.1002/ecs2.4435>

Understanding whether invasive and native species compete for shared resources where they co-occur is essential for mitigating the negative impacts of invasive species on native ecosystems. Here, we examined how the presence and density of an invasive species, wild pigs (*Sus scrofa*), affect native white-tailed deer (*Odocoileus virginianus*; hereafter, deer) on the Savannah River Site, SC, USA. We examined potential changes in deer areas of use, temporal overlap, and occupancy to evaluate the effects of wild pig occurrence and density on deer space use, diel activity, and co-occurrence with wild pigs across 9 months during 2018 and 2019. Wild pig density had the strongest effect on deer space use in high- and moderate-use areas. Declines in deer space use in response to wild pig density were most pronounced in March and October 2018 and April 2019 for females, while male space use declined in response to wild pig density in October and December 2018. Both species were largely nocturnal with high overlap in diel activity across months. Deer occupancy responses to wild pig density varied across months, with negative responses in May and October 2018 and positive responses in July 2018 and April 2019. Deer and wild pigs co-occurred at 30%–59% of camera stations across months, with broadscale co-occurrence patterns being unaffected by changes in shared cover or wild pig occurrence. Overall, our results suggest that deer make fine-scale behavioral adjustments to





New scientific articles



avoid wild pigs, providing evidence that competition is likely occurring even where wild pig density is relatively low. Such fine-scale behavioral plasticity in deer appears to mitigate the costs of competition with wild pigs and may be a mechanism enabling long-term co-existence of deer and wild pigs. Our study provides novel insight on the complexities of spatiotemporal relationships between invasive wild pigs and native deer and suggests that the negative effects of interactions between deer and wild pigs may be more pronounced when deer life history needs are particularly demanding. In areas where eradication of invasive wild pigs may be impossible, maintaining low wild pig densities may help mitigate, but may not eliminate, the negative effects of wild pigs on deer.

Sex-specific seasonal variations of wild boar distance traveled and home range size

Cavazza, S., Brogi, R. and M. Apollonio 2023

Current Zoology, zoad021, doi: <https://doi.org/10.1093/cz/zoad021>

Distance traveled and home range size describe how animals move in space. The seasonal variations of these parameters are important to comprehensively understand animal ecology and its connection with reproductive behavior and energy costs. Researchers usually estimate the distance traveled as the sum of the straight-line displacements between sampled positions, but this approach is sensitive to the sampling frequency and does not account for the tortuosity of the animal's movements. By means of the continuous-time movement modeling which takes into account autocorrelation and tortuosity of movement data, we estimated the distance traveled and monthly home range size of 28 wild boar *Sus scrofa* and modeled their inter-sexual seasonal variability. Males traveled longer distances and used larger home ranges than females, particularly during the rut in autumn-winter, consistently with the different biological cycles of males and females. Males enlarged their home ranges during the rut but traveled constant average distances along the year, whereas females traveled shorter distances in correspondence with the peak of food resources and birth periods but exhibited constant home range size across seasons. The differences between the seasonal variation patterns of distance traveled and home range size, observed in both sexes, revealed the complex relationship between these two aspects of spatial behavior and the great opportunity of including both distance traveled and home range size in behavioral ecology investigations. We provided a detailed analysis of wild boar spatial behavior and its relationships with the reproductive cycles of males and females, promoting a deeper comprehension of their behavioral ecology.

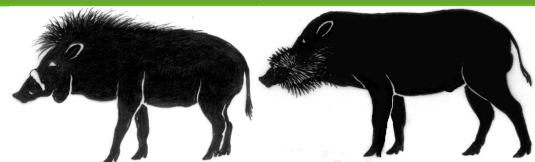
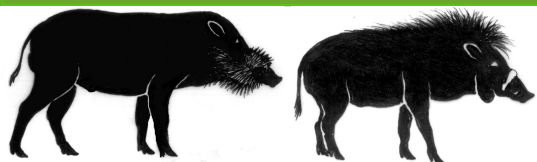
Biological invasions disrupt activity patterns of native wildlife: An example from wild pigs

Dykstra, A. M., Baruzzi, C., VerCauteren, K., Strickland, B. and M. Lashley 2023

Food Webs, 34, e00270, doi: <https://doi.org/10.1016/j.fooweb.2022.e00270>

Activity patterns are an important behavioral trait linked to animal interactions within food webs. Biological invasions can have impacts on the behavior of native species through predation and competition, but few studies have determined if invasions lead to shifts in activity patterns of native species. Wild pigs (*Sus scrofa*) are a generalist, invasive vertebrate in North America that may affect activity patterns of native species through competition and predation. We hypothesized native species' activity patterns would differ from their expected activity pattern (i.e., typical hours of daily activity) and be more variable across sites occupied by wild pigs. We used a U.S. nationwide and a regional camera trapping dataset to determine if wild pig presence affected activity patterns of a nocturnal, diurnal, and crepuscular species: northern raccoon (*Procyon*





lotor), eastern gray squirrel (*Sciurus carolinensis*), and white-tailed deer (*Odocoileus virginianus*), respectively. We simulated expected activity patterns of each species and overlapped them with observed activity patterns of respective species in populations where wild pigs were present and where they were not detected. Overlap coefficients were used in generalized linear mixed models to determine if wild pig presence explained deviations from the expected activity pattern. When wild pigs were detected, raccoons remained nocturnal, but their activity patterns were less variable, squirrel activity on the ground was less diurnal and their activity patterns were more variable, and deer activity patterns remained similar in both respects. These results highlight how biological invasions may differentially influence native species activity patterns, potentially altering food web-level interactions.

Movement Patterns and Population Dynamics of Giant Forest Hog Groups in Kibale National Park, Uganda

Reyna-Hurtado Rafael, Chapman Colin A, Melletti Mario, Mukasa Martin and Jean Pierre d’Huart 2023.

Movement Ecology of Afrotropical Forest Mammals Chapter 2: 9-26. DOI: https://doi.org/10.1007/978-3-031-27030-7_2.

African wild suids living in forests have been poorly studied, and some species such as the giant forest hog (*Hylochoerus meinertzhageni*) – one of the largest species of wild pigs in the world – are disappearing at alarming rates. Of particular concern are the eastern Africa populations that are endangered by habitat encroachment and illegal hunting. Here, we present results of the first ecological study on this species in the Kibale National Park, a mid-elevation, tropical forest in western Uganda. The goal of our research was to determine group’s movement patterns, group size and structure, habitat use, and foraging patterns. At intermittent periods over 5 years, we tracked a group of this species using handheld GPS, and for 2 years we deployed automated camera traps in salt licks and bathing places. Home range of the group of giant forest hogs was estimated at 11.2 km² (kernel density estimator at 99%) with a core area of 2.4 km² (kernel density estimator at 50%). Areas with dense bushes and sparse trees surrounded by mature forests were their favorite habitat where they feed on the herbaceous plants and rest in shady areas of approximately 5 × 5 m located under the densest thickets called “sleeping sites.” Giant forest hogs were captured on camera traps 7893 times within 141 independent events that showed that group size is highly variable and ranges from 3 to 11 individuals with occasional sightings of solitary individuals, usually subadult males. Occupancy rate value was medium ($\psi = 0.778$; SE = 0.01), and the species presented a low detection probability ($P = 0.172$; SE = 0.01). Large groups are composed of a dominant male, one or two additional males, several adult females, and up to four juveniles. Conservation of this species in eastern Africa requires the protection of forest ecosystems and associated mosaic of habitats with dense bushes and open gaps surrounded by mature forest.

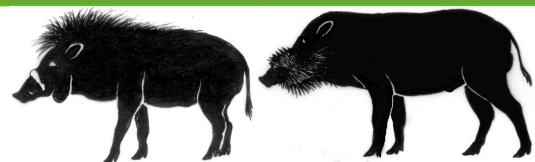
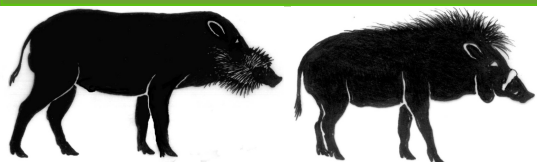
Diversity of diurnal large mammals in bayo community managed forest, Salamago Woreda, South Omo Zone, Southern Ethiopia

Chankallo T. H. and S.T. Kabtehyimer 2023.

Ukrainian Journal of Ecology 13 (3): 1-14, DOI: [10.15421/2023_433](https://doi.org/10.15421/2023_433).

An ecological study on diurnal mammals was carried out in Bayo Community Managed Forest located in Salamago Woreda, South Omo Zone. The objective of the study was to investigate the





diversity of diurnal large mammals in the study area. Based on the habitat type and topography of the study area, 11 transect, i.e., 7 in forestland and 4 in Wooded Grassland were laid to collect the data. Besides direct methods, indirect methods such as faecal droppings, fresh tracks, carcass or shell count, den (burrow), hair, and digging were used. Data were analyzed using descriptive statistics, SPSS and SMART software. A total of 20 species of diurnal large mammals belonging to six orders and eight families were identified. The species identified were *Cercopithecus pygerythrus*, *Cercopithecus aethiops*, *Papio anubis*, *Erythrocebus patas*, *Cercopithecus neglectus*, *Colobus guereza*, *Equus quagga*, *Traglaphus strepsiceros*, *Traglaphus imberbis*, *Traglaphus scriptus*, *Medagua guentheri*, *Sylvicapra gramma*, *Kobus ellipsiprymnus defessa*, *Syncerus caffer*, *Potamochoerus larvatus*, *Phacochoerus africanus*, *Hylochoerus meinertzhageni*, *Hystrix cristata*, *Orycteropus afer*, and *Phataginus temminckii smutus*. Seasonal variation in the number of species was not significant ($X^2=0.024$, $df=1$, $p>0.05$). Seasonal abundance was significant ($X^2=5.614$, $df=1$, $p<0.05$). Totally, 685 and 600 mammals were counted during wet and dry seasons, respectively. On habitat basis, 683 and 602 animals were recorded in forestland and wooded grassland habitats, respectively. The male to female aggregate sex ratio was 0.98:1.00 which was female-biased. However, species wise, female-biased, male-biased and 1:1 male to female sex ratio was recorded. Age structure comprised of the predominantly adult population and aggregate age ratio of adult to young was 1:0.74 and 1:0.57 during the wet and dry seasons, respectively. The highest species diversity ($H=2.53$) was recorded in the wooded grassland habitat. The local government should promote the study area and provide appropriate support for its conservation.

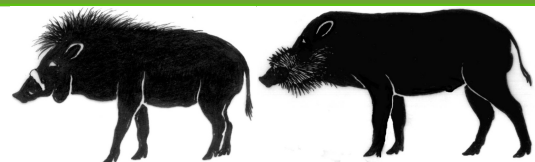
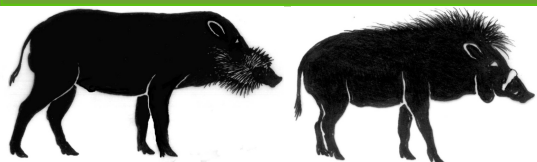
Distribution And Conservation Challenges Of Diurnal Large Mammals In Bayo Community Managed Forest, Salamago Woreda, South Omo Zone, Southern Ethiopia

Tamirat Haile, and Takele Serekebirhan 2023.

Journal of Zoological Research 1 (2):14-36 DOI:10.14302/issn.2694-2275.jzr-23-4483.

An ecological study on diurnal mammals was carried out in Bayo Community Managed Forest located in Salamago Woreda, South Omo Zone. The objective of the study was to investigate the distribution and conservation challenges of diurnal large mammals in the study area. Based on the habitat type and topography of the study area, total of 11 transect, i.e 7 in forestland, and 4 in Wooded Grassland were laid to collect the data. Besides direct methods, indirect methods such as faecal droppings, fresh tracks, carcass or shell count, den (burrow), hair, and digging were used. Questionnaire and focus group discussions were also used to assess anthropogenic threats in the study area. Data were analyzed using descriptive statistics, SPSS and QGIS software. A total of 20 species of diurnal large mammals belonging to six orders and eight families were identified. The species identified were *Cercopithecus pygerythrus*, *Cercopithecus aethiops*, *Papio anubis*, *Erythrocebus patas*, *Cercopithecus neglectus*, *Colobus guereza*, *Equus quagga*, *Traglaphus strepsiceros*, *Traglaphus imberbis*, *Traglaphus scriptus*, *Medagua guentheri*, *Sylvicapra gramma*, *Kobus ellipsiprymnus defessa*, *Syncerus caffer*, *Potamochoerus larvatus*, *Phacochoerus africanus*, *Hylochoerus meinertzhageni*, *Hystrix cristata*, *Orycteropus afer*, and *Phataginus temminckii smutus*. Seasonal variation in the between habitat types ($\chi^2 = 4.849$, $df=1$, $p<0.05$). Totally, 685 and 600 mammals were counted during wet and dry seasons, respectively. On habitat basis, 683 and 602 animals were recorded in forestland and wooded grassland habitats, respectively. Major threats in the study area include poaching, fire, grazing, fuelwood extraction, population growth, habitat modification, overharvesting of resources, and





invasive species. About 98.44% of respondents had a positive attitude towards Bayo Community Managed Forest. The interference of local community has had the impact on mammals species. Habitat based mammals management involving participation of Woreda and Zonal Government is recommended for sustainable. The local government should promote the study area and provide appropriate support for its conservation.

Partitioning the effects of habitat loss, hunting and climate change on the endangered Chacoan peccary

Torres, R., Kuemmerle, T., Baumann, M., Romero Muñoz, A., Altrichter, M., Boaglio, G. I. ... and A. Yanosky 2023

Diversity and Distributions, doi: <https://doi.org/10.1111/ddi.13701>

Aim: Land use change and overexploitation are major threats to biodiversity, and climate change will exert additional pressure in the 21st century. Although there are strong interactions between these threats, our understanding of the synergistic and compensatory effects on threatened species' range geography remains limited. Our aim was to disentangle the impact of habitat loss, hunting and climate change on species, using the example of the endangered Chacoan peccary (*Catagonus wagneri*). Location: Gran Chaco ecoregion in South America. Methods: Using a large occurrence database, we integrated a time-calibrated species distribution model with a hunting pressure model to reconstruct changes in the distribution of suitable peccary habitat between 1985 and 2015. We then used partitioning analysis to attribute the relative contribution of habitat change to land use conversion, climate change and varying hunting pressure. Results: Our results reveal widespread habitat deterioration, with only 11% of the habitat found in 2015 considered suitable and safe. Hunting pressure was the strongest single threat, yet most habitat deterioration (58%) was due to the combined, rather than individual, effects of the three drivers we assessed. Climate change would have led to a compensatory effect, increasing suitable habitat area, yet this effect was negated by the strongly negative and interacting threats of land use change and hunting. Main Conclusions: Our study reveals the central role of overexploitation, which is often neglected in biogeographic assessments, and suggests that addressing overexploitation has huge potential for increasing species' adaptive capacity in the face of climate and land use change. More generally, we highlight the importance of jointly assessing extinction drivers to understand how species might fare in the 21st century. Here, we provide a simple and transferable framework to determine the separate and joint effects of three main drivers of biodiversity loss.

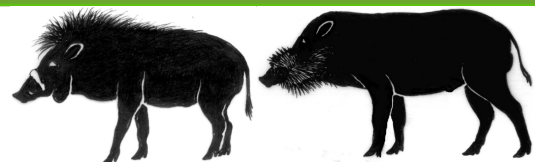
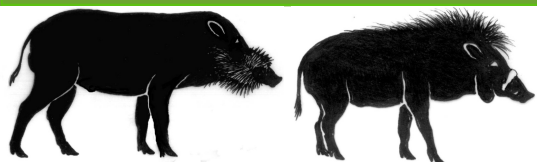
Uso de espacios naturales y antropizados por el pecarí de collar (*Dicotyles tajacu*) en la estación biológica La Selva, Costa Rica

Osorto-Núñez, M. H. and L. D. A. Alvarado 2023

Revista Mexicana de Mastozoología (Nueva Época), 13(1), 24-32, doi: <https://doi.org/10.22201/ie.20074484e.2023.13.1.383>

El objetivo de esta investigación fue analizar el uso de espacios naturales y antropizados por el pecarí de collar (*Dicotyles tajacu*) en la Estación Biológica La Selva (EBLS), Costa Rica. Se registraron grupos e individuos de pecaríes mediante observaciones directas e indirectas, contando un total 170 individuos adultos y 30 crías (media = 3.62, DS = 4.04). El uso del espacio a nivel de sitio difirió del uso esperado ($p < 0.000$, X^2 observado = 134.14, X^2 acumulado = 22.36). La prueba de bondad de ajuste de chi-cuadrado mostró una fuerte evidencia de que no





existe un uso proporcional con el área de las categorías ($X^2 = 832.30$, $df = 10$, $n = 76$, $P > 0.0001$). Los intervalos de confianza de Bonferroni (IC 95%) evidenciaron mayor proporción de uso observado con respecto al esperado para las categorías agroforestería abandonada y área con infraestructura. Estas áreas son manejadas por la administración de la EBLS y existen árboles frutales, huertos, construcciones y mayor intensidad de uso público, por lo que para los pecaríes representan zonas de alimentación, refugio y descanso.

Contribution to the knowledge on the diet of the collared peccary (*Dicotyles tajacu*) at the La Selva Biological Station, Costa Rica

Osorto-Nuñez, M. H., Alvarado, L. D. A., Romero, F. A. C. and F. H. G. Rodrigues 2023

Therya Notes, 4, 120-126, doi: https://doi.org/10.12933/therya_notes-23-117

La información disponible sobre la dieta del pecarí de collar (*Dicotyles tajacu*) en el neotrópico es escasa, aunque se sabe que los frutos de palma son reportados con frecuencia. El objetivo de esta investigación fue evaluar la dieta de los grupos de pecaríes de collar en la Estación Biológica La Selva (EBLS), Costa Rica. Entre julio y diciembre de 2021 se recorrieron 30 km por mes en los senderos de la EBLs. Mediante el método de observación directa se realizó un listado de especies de plantas consumidas por los pecaríes. Las muestras de las especies de plantas o frutos colectadas en campo se identificaron a nivel de familia, género y/o especie. La dieta del pecarí de collar en la EBLs estuvo conformada por 38 especies, pertenecientes a 18 familias. Las especies de la familia Arecaceae fueron las de mayor consumo. *Socratea exorrhiza*, *Ficus colubrinae*, *Dussia macrophyllata*, *Sacoglottis trichogyna*, *Iriartea deltoidea* y *Dipteryx panamensis* fueron las especies más consumidas. El componente de mayor importancia fueron los frutos. El modo de dispersión de la mayoría de las especies consumidas fue Endo-stricto. El 53 % de las especies de las plantas consumidas no presenta información sobre su categoría de conservación según la UICN. Dada la diversidad en la dieta del pecarí de collar, las acciones de conservación deben considerar la protección de bosques primarios como fuentes de alimento, así como proyectos de restauración de ecosistemas tropicales en función de promover especies de árboles que brindan frutos atractivos para los pecaríes.

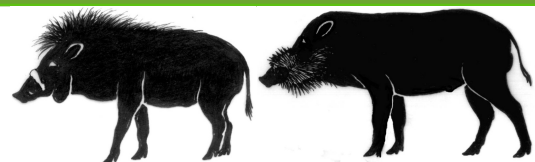
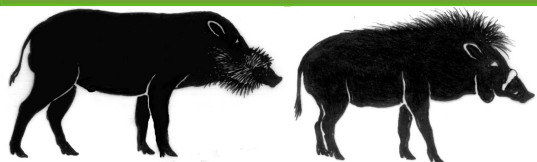
First record of the collared peccary *Dicotyles tajacu* (Artiodactyla, Tayassuidae), in the Gliptodonte locality, Villaflores municipality, Chiapas

Carbot-Chanona, G. and L. E. Gómez-Pérez 2023

Paleontología Mexicana, 12(2), 53-62, url: www.ojs-igl.unam.mx, <http://www.ojs-igl.unam.mx/index.php/Paleontologia/article/view/699>.

Tayassuidae (peccaries) is a family of artiodactyls exclusively of America, that was widely distributed in North America during the Pleistocene. Nevertheless, records of this family are scarce in Mexico. The only valid species reported from the Late Pleistocene in Mexico were *Platygonus compressus* and *Dicotyles tajacu*, based on a few specimens. In this study, we report a new peccary specimen from the Gliptodonte locality (Late Pleistocene, Rancholabrean NALMA), Villaflores municipality, in the southern State of Chiapas. The new specimen consists of a distal part of the left humerus, which shows morphological differences from other North American Pleistocene and recent peccaries (*Mylohyus*, *Platygonus*, and *Tayassu*), allowing positive identification of the collared peccary *D. tajacu*. Thus, a new record of the species for the State of Chiapas and the first record of the Gliptodonte locality in the municipality of Villaflores is added, expanding the distribution range of the species during the Late Pleistocene in Mexico.





Production of multimodal signals to assert social dominance in white-lipped peccary (*Tayassu pecari*)

Alencar Jr, R. N., Nogueira-Filho, S. L. and S. S. Nogueira 2023

Plos one, 18(2), e0280728, doi: <https://doi.org/10.1371/journal.pone.0280728>

In this study we aimed to examine whether the ‘redundancy’ (a backup function to ensure the signal transmission) or ‘multiple messages’ (sensory communication system in combination) hypothesis would explain the function of multimodal communication of white-lipped peccaries (*Tayassu pecari*–WLPs). We also aimed to assess the individual factors (the social rank and sex of the sender) influencing the production of, and responses to unimodal and multimodal signals. We determined the social rank of 21 WLPs living in two captive groups and quantified the production of unimodal and multimodal signals when displaying threatening and submissive behaviors. WLPs most often produce multimodal signals independent of a previous unimodal signal failure, which suggests that they were adding more information, such as the sender’s size, rather than merely increasing efficacy by engaging a different receiver’s sensory channel. There was no effect of the sender’s sex in the production of, and responses to, multimodal signals. However, the higher the sender’s social rank, the greater the production of multimodal signals when WLPs were displaying threatening behaviors; whereas the lower the sender’s social rank, the greater the production of multimodal signals when displaying submission behaviors. Multimodal signals elicited more non-aggressive responses than did the unimodal signals when displaying a threat. Moreover, the higher the sender’s social rank, the greater the occurrence of non-aggressive responses to multimodal signals when displaying a threat; whereas the opposite occurred when displaying submission. Our findings support the ‘multiple messages’ hypothesis to explain the function of multimodal signaling during agonistic interactions in WLPs. Additionally, both the production of, and responses to, multimodal signals are related to the sender’s social rank. These results allow us to suggest that the production of multimodal signals may have a key role in mitigating conflict and thus promoting group cohesion among white-lipped peccaries.

Impact of environmental variables on some reproductive metrics of white-lipped peccaries (*Tayassu pecari*) raised in Atlantic Forest of Brazil

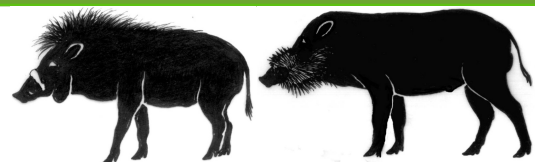
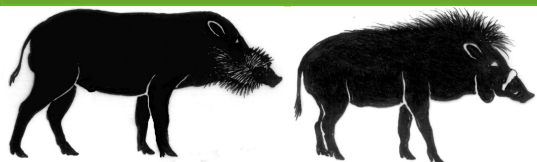
Barros, C. H., Santos, R. P., Machado, W. M., Santos, M. M., Souza-Junior, J. B., Matarazzo, S. V., ... and A. R. Silva 2023

Animal Reproduction Science, 252, 107230, doi:

<https://doi.org/10.1016/j.anireprosci.2023.107230>

Knowledge on male reproductive physiology is essential for the development of effective conservation strategies. This study investigated the influence of environmental variables on certain reproductive metrics in white-lipped peccaries (*Tayassu pecari*) raised in the Atlantic Forest. After anesthetization, testicular and cauda epididymis biometry were evaluated in nine adult male individuals subjected to electroejaculation. Semen was evaluated for volume, pH, concentration, total number of sperm, sperm morphology, membrane integrity, and kinematic parameters. Concurrently, environmental variables were collected from the day before, for the previous 14 days (estimated for sperm maturation in epididymis), and the period of 51–55 days (corresponding to the spermatogenic cycle) before semen collection. Overall, it was observed that rainfall is the most important environmental variable influencing the reproductive parameters of white-lipped peccaries, being positively correlated with the amplitude of lateral sperm head





displacement ($\rho = 0.62$, $P < 0.05$) and the appearance of proximal cytoplasmic droplets in sperm ($\rho = 0.62$, $P < 0.05$). In addition, the testicular biometry of the species is influenced by the set of environmental variables of air temperature, rainfall, and relative humidity ($\rho \geq 0.60$, $P < 0.05$). On the other hand, epididymal biometric data showed numerous correlations between cauda epididymis metrics and sperm parameters ($\rho = 0.68$, $P < 0.05$). This information will be useful to improving conservation strategies for these animals, contributing to their management in captivity and to reintroduction programs, especially in the Atlantic Forest where the species is declining.

Responses of *Hippopotamus amphibius* to environmental changes at Bui National Park, Ghana

Bempah, G., Wiafe, E. D., Nartey, M. A., Messenger, K. and C. Lu 2023

Acta Ecologica Sinica, 43(3), 469-479, doi: <https://doi.org/10.1016/j.chnaes.2022.02.003>

Many researchers have adopted the use of indicator species to detect changes in the environment and predict future ecological modifications. Irrespective of the popularity of indicator species concept among scientists in recent times, there is less studies on the use of mega semi-aquatic mammals as indicator species, especially in Africa. This study determined the ecological role of *Hippopotamus amphibius* and how the mammal respond to environmental changes in an aquatic ecosystem, focusing on changes in biological diversity (fish and phytoplankton) and environmental factors (temperature, pH, dissolved oxygen, conductivity, total dissolved solids, hydrogen isotope, and oxygen isotope) by comparing pools harboring *H. amphibius* and pools without *H. amphibius* at the Bui National Park, Ghana. The results show that *H. amphibius* play an important ecological role by indicating high productivity in aquatic ecosystem and serving as influencers of the aquatic food web at Bui National Park. The results found significantly higher concentrations of dissolved oxygen in *H. amphibius* pools than pools without *H. amphibius*. Significantly higher diversity of fish and phytoplankton species were recorded in pools with *H. amphibius*. Common fish species identified during this study include, *Oreochromis niloticus*, *Labeo coubie*, *Alestes dentex* and *Labeo senegalensis*. Phytoplankton communities were dominated by Chlorophyceae (37.26%), Cyanophyceae (25.21%), and Bacillariophyceae (21.53%). The study results also showed that *H. amphibius* are sensitive to changes in depth of water, preferring areas with shallow pools. Managerial options for *H. amphibius* populations require strong support because of their socio-ecological benefits including potential ecosystem effects, increasing fishing and tourism value at the Bui National Park.

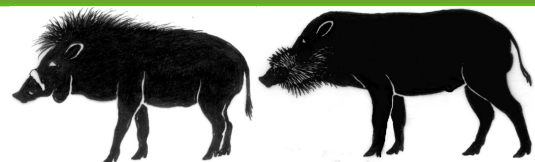
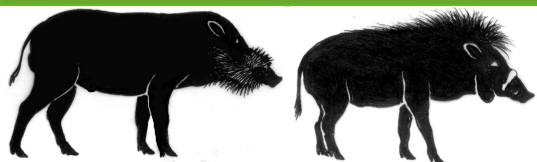
Economic consequence of human-hippopotamus (*Hippopotamus amphibious*) conflicts on farming Livelihood in rural Adamawa State, Nigeria

Lumbonyi, C. A., Michael, A., Lumbonyi, I. A. and P. G. Boni 2023

Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego, 23(1), doi: <https://doi.org/10.22630/PRS.2023.23.1.2>

Human-animal conflict is posing a severe threat to wildlife conservation as well as the long term viability of farming communities. This study assessed the economic consequence of human hippopotamus (*Hippopotamus amphibious*) conflicts on rural livelihoods in Adamawa state, Nigeria. The study had the following specific goals; describe the direct effects of Human Hippopotamus Conflict (HHC) on livelihoods in the study area, and estimate the agricultural economic losses incurred in the area as a result of HHC. A mixed research method was used to collect primary data from 371 crop farmers. The study relied on descriptive statistics in the





analysis of the data collected between February to May 2019. The study found that Groundnut, Cowpea, and maize were among the most severely damaged crops at their mid-stage of development based on land size. In terms of the monetary value of the damages, sweet potato is the most affected. The study concluded that farmers should work as a team and adopt measures like fencing, scare tactics, or deterrents that will minimize significant crop losses. Also, there is the need for local awareness on the importance of Hippopotamus conservation in the area.

Drivers of land use changes and impacts on human-hippos (*Hippopotamus amphibius*) interactions in villages adjacent to Lake Babati, Tanzania

N. E. Mmbaga 2023

Discover Environment, 1(1), 8, doi: <https://doi.org/10.1007/s44274-023-00008-y>

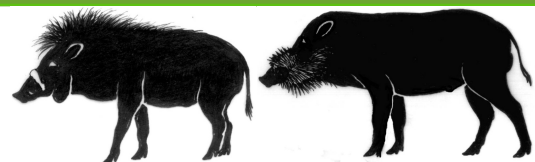
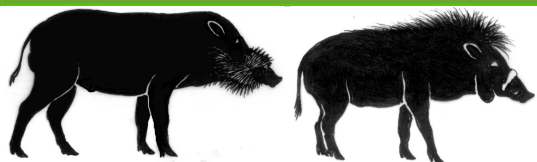
Hippopotamus (*Hippopotamus amphibius*) are victims of land use changes (LUC) due to their semi-aquatic nature. Although human–hippopotamus interactions (HHI) are known to exist in the area surrounding Lake Babati, nothing is known about the LUC in relation to the interactions. The study aimed at assessing the trend of LUC in the last 20 years in relation to time of establishing new settlement and farming seasons in relation to HHI, respondents' perceptions of HHI, and mitigation measures used by local people against Hippos adjacent Lake Babati. Remote sensing and GIS techniques, questionnaires and focused group discussions were used to assess human perceptions regarding trends of the LUC in the study area. LUC was monitored by using landsat images from the years 1999 and 2019. The findings indicate an increase in settlement while water, agroforestry, and seasonal agricultural lands were decreasing. The time respondents stayed in the village, farm size, and respondents' perception of HHI trends were observed to vary with the distance from the lake. The presence of LUC on adjacent Lake Babati jeopardized the ecological integrity of Hippos' habitat and increased tension and overlap between hippos' and human needs. The findings provide a baseline for managing HHI and recommend proper land use planning that prioritizes the use of alternative crops like fruit trees especially within 3 km from the lake. Human population and settlement expansion patterns should also be monitored in areas closer to the lake for sustaining wildlife conservation and livelihood development in Lake Babati and surrounding areas.

Status of Hippopotamus, *Hippopotamus Amphibius* L., in the River Sanaga of the Centre Region of Cameroon

Shidiki, A. A., Rosalie, T. M. and D. A. Ulrich 2023

In Sustainable Wildlife Management. IntechOpen, doi: <https://doi.org/10.5772/intechopen.106358>
Wildlife protection and management structures around the world have used protective enclaves often referred to as protected areas to limit pressure on biodiversity. No attention has been paid to species living in unprotected areas often known as free areas. The aim of this study is to contribute to the sustainable management of hippopotamus population in the river Sanaga that is facing threats of being extinct and to also provide information on their status to decision makers. The survey method used during this study was a total count that was carried out using several techniques including foot walk and waterway counts. The results revealed that four hippos were cited in two out of the seven villages in the area. A distance of 32 km was covered in the river. The site with the highest number of hippopotamus was in the village of Tsang with three hippos seen. The main threats to the survival of hippos are poaching, fishing, sand mining and crop farming along the river bank. To lessen these threats on the hippopotamus population,





sensitization and awareness campaigns are needed. It is recommended that a hippo sanctuary and a hippo friendly club be created in the study area.

Are hippos Africa's most influential megaherbivore? A review of ecosystem engineering by the semi-aquatic common hippopotamus

Voysey, M. D., de Bruyn, P. N. and A. B. Davies 2023

Biological Reviews, doi: <https://doi.org/10.1111/brv.12960>

Megaherbivores perform vital ecosystem engineering roles, and have their last remaining stronghold in Africa. Of Africa's remaining megaherbivores, the common hippopotamus (*Hippopotamus amphibius*) has received the least scientific and conservation attention, despite how influential their ecosystem engineering activities appear to be. Given the potentially crucial ecosystem engineering influence of hippos, as well as mounting conservation concerns threatening their long-term persistence, a review of the evidence for hippos being ecosystem engineers, and the effects of their engineering, is both timely and necessary. In this review, we assess, (i) aspects of hippo biology that underlie their unique ecosystem engineering potential; (ii) evaluate hippo ecological impacts in terrestrial and aquatic environments; (iii) compare the ecosystem engineering influence of hippos to other extant African megaherbivores; (iv) evaluate factors most critical to hippo conservation and ecosystem engineering; and (v) highlight future research directions and challenges that may yield new insights into the ecological role of hippos, and of megaherbivores more broadly. We find that a variety of key life-history traits determine the hippo's unique influence, including their semi-aquatic lifestyle, large body size, specialised gut anatomy, muzzle structure, small and partially webbed feet, and highly gregarious nature. On land, hippos create grazing lawns that contain distinct plant communities and alter fire spatial extent, which shapes woody plant demographics and might assist in maintaining fire-sensitive riverine vegetation. In water, hippos deposit nutrient-rich dung, stimulating aquatic food chains and altering water chemistry and quality, impacting a host of different organisms. Hippo trampling and wallowing alters geomorphological processes, widening riverbanks, creating new river channels, and forming gullies along well-utilised hippo paths. Taken together, we propose that these myriad impacts combine to make hippos Africa's most influential megaherbivore, specifically because of the high diversity and intensity of their ecological impacts compared with other megaherbivores, and because of their unique capacity to transfer nutrients across ecosystem boundaries, enriching both terrestrial and aquatic ecosystems. Nonetheless, water pollution and extraction for agriculture and industry, erratic rainfall patterns and human–hippo conflict, threaten hippo ecosystem engineering and persistence. Therefore, we encourage greater consideration of the unique role of hippos as ecosystem engineers when considering the functional importance of megafauna in African ecosystems, and increased attention to declining hippo habitat and populations, which if unchecked could change the way in which many African ecosystems function.

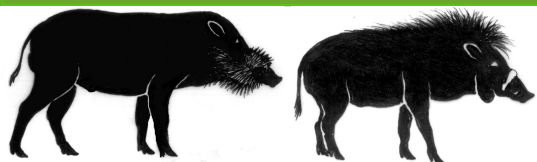
Activity and nocturnal home range size of male common hippopotamus in Kruger National Park, South Africa

Fritsch, C. J., Streicher, J. P. and C. T. Downs 2023

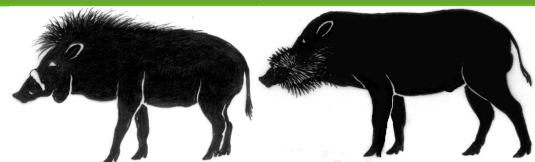
African Journal of Ecology, doi: <https://doi.org/10.1111/aje.13148>

The common hippopotamus (*Hippopotamus amphibius*) is a driver of ecological processes in African savannah aquatic and terrestrial ecosystems. Recent studies have highlighted the





New scientific articles



ecological impacts of hippos in these systems; however, these lack behavioural data to contextualise their ecological inputs. We fitted global positioning system (GPS) transmitter bracelets on male hippos ($n = 3$) in Kruger National Park, South Africa. The mean home range size for hippos using Adaptive Local Convex Hull (a-LoCoH) home range ($\sim 6 \text{ km}^2$) was smaller than previously documented. This study contributes baseline behavioural data for managing hippos in Kruger National Park and southern Africa.

Hippos alter their aggregations to mitigate density-dependent drought effects

Taillie, P. J., Hartfelder, J., Potash, A., Pienaar, D., Greaver, C., Viljoen, P., ... and R. A. McCleery 2023

Austral Ecology, doi: <https://doi.org/10.1111/aec.13317>

Megaherbivores play a critical role in the ecology of African savannas and grasslands. In addition, these systems are forecast to experience more frequent and severe droughts as a product of changes in the global climate. Thus, the continued conservation of megaherbivores and their associated ecosystems will require a better understanding of how megaherbivores respond to drought by shifting their movement, diet and social behaviour. We address this need by investigating the factors affecting changes in the abundance of common hippopotamus (*Hippopotamus amphibius*; hereafter: 'hippos') throughout the six major rivers of Kruger National Park, South Africa, during and following the severe drought of 2015/2016. Specifically, we aimed to understand the role of two environmental characteristics that have relevance to hippos and that changed in response to drought: vegetation condition and the extent of pooled surface water. In addition, we investigated the extent to which pre-drought density affected changes in hippo abundance. Although vegetation and daytime refugia both appeared to influence pre-drought hippo abundance, these factors were less important to the change in hippo abundance related to the drought. Instead, the response to drought was most strongly related to the pre-drought abundance of hippos, where river segments supporting more than 50 individuals prior to the drought in 2015 decreased by more than half on average. Furthermore, we show that the degree of aggregation decreased from 2015 to 2016 because of the drought, but then began to increase again as the rains returned in 2017. Our results suggest that in addition to the large pools that support large aggregations of hippos in typical years, additional smaller pools are likely important for accommodating this drought-induced dispersion. However, maintaining this distribution of pools will likely become more challenging as southern Africa's population and water demands increase.

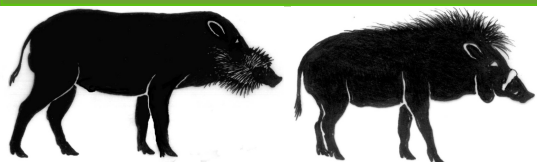
Rapid population growth and high management costs have created a narrow window for control of introduced hippos in Colombia

Subalusky, A. L., Sethi, S. A., Anderson, E. P., Jiménez, G., Echeverri-Lopez, D., García-Restrepo, S., ... and A. Rojas 2023

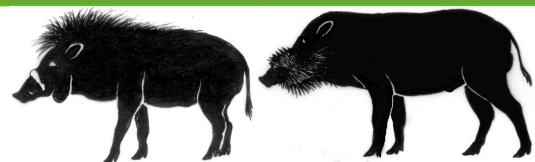
Scientific Reports, 13(1), 6193, doi: <https://doi.org/10.1038/s41598-023-33028-y>

The introduction of hippos into the wild in Colombia has been marked by their rapid population growth and widespread dispersal on the landscape, high financial costs of management, and conflicting social perspectives on their management and fate. Here we use population projection models to investigate the effectiveness and cost of management options under consideration for controlling introduced hippos. We estimate there are 91 hippos in the middle Magdalena River basin, Colombia, and the hippo population is growing at an estimated rate of 9.6% per year. At





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this rate, there will be 230 hippos by 2032 and over 1,000 by 2050. Applying the population control methods currently under consideration will cost at least 1–2 million USD to sufficiently decrease hippo population growth to achieve long-term removal, and depending on the management strategy selected, there may still be hippos on the landscape for 50–100 years. Delaying management actions for a single decade will increase minimum costs by a factor of 2.5, and some methods may become infeasible. Our approach illustrates the trade-offs inherent between cost and effort in managing introduced species, as well as the importance of acting quickly, especially when dealing with species with rapid population growth rates and potential for significant ecological and social impacts.

Diseases

Tools and opportunities for African swine fever control in wild boar and feral pigs: a review

Palencia, P., Blome, S., Brook, R. K., Ferroglio, E., Jo, Y. S., Linden, A., ... and C. Gortázar 2023
European Journal of Wildlife Research, 69(4), 69,
doi: <https://doi.org/10.1007/s10344-023-01696-w>

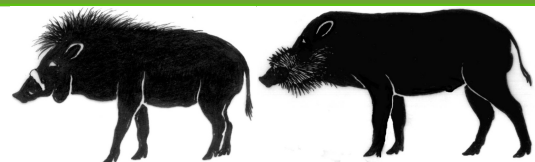
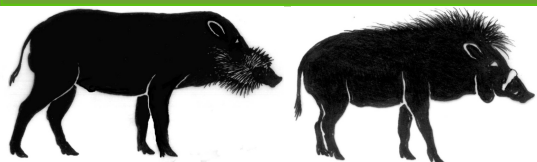
The native Eurasian wild boar (*Sus scrofa*) is a relevant wildlife host for African swine fever (ASF) virus, contributing to infection maintenance and spread and representing a challenge for disease control. Combining published scientific evidence with expert opinion, we provide an updated global overview of ASF control in wild boar and feral pigs in different epidemiological scenarios. We synthesize current knowledge on key background aspects of wild boar ecology and management and on ASF epidemiology in wild boar and their relative, the feral pig. We propose that establishing a proper surveillance and monitoring scheme is a requisite for disease control in wildlife and that ASF and wild boar should be monitored in an integrated way, considering the changes in the host population as well as the spatial spread and temporal distribution of disease indicators, to make possible a critical assessment of the impact of interventions. The main body of the manuscript reviews the intervention options and ASF control attempts and their outcomes in different epidemiological situations from peacetime to endemicity. Current ASF control in wild boar relies on three essential tools: carcass destruction, wild boar culling, and fencing. The experience gained since the onset of the ongoing ASF pandemic shows that certain combinations of interventions can slow down ASF spread and eventually succeed in ASF eradication in wild boar, at least after point introductions. Several strengths and weaknesses of these strategies are identified.

A questionnaire survey for the assessment of wild–domestic pig interactions in a context oedema disease outbreaks among wild boars (*Sus scrofa*) in South-Eastern France

Jori, F., Petit, G., Civil, N., Decors, A., Charrier, F., Casabianca, F. and V. Grosbois 2022
Transbound Emerg Dis 1-7

Pig outdoor farming is gaining popularity and commercial success in the European Union, and its expansion, together with an increasing wild boar population, facilitates interactions between domestic and wild suids. In the Southern French Department of Ardèche, several episodes of mass mortalities due to infection with an enteropathogenic strain of *Escherichia coli* causing oedema disease (OD) were reported in wild boar populations between 2013 and 2016. In order to investigate a potential link between those events and the frequency of interactions between wild boar and domestic pig, we analyzed regional vegetation and hunting bag data and implemented a





semi-structured questionnaire survey among a total of 30 outdoor pig farmers and 30 hunters distributed inside and outside the identified area of OD emergence. One third of interviewed farmers (11/30) had experienced intrusions of wild boars in domestic pig premises during the previous year. Similarly, 23% of interviewed hunters reported interactions between wild boar and feral free-ranging pigs in recent years, and 60% reported the observation of free-ranging pigs with a phenotypic feature of Vietnamese pot-bellied pigs (55%). Our analysis identified that in the OD emergence area, several factors could facilitate the transmission of pathogens between wild and domestic suids including a predominance of forested vegetation, a higher estimated wild boar density, weaker levels of farm biosecurity, a higher level of reported wild boar intrusions in pig farms and several reports of feral pot-bellied pig presence. Although our sample was limited, our study suggested a widespread occurrence of situations facilitating the transmission of pathogens between wild and domestic suids. Similar studies in other rural regions in the European Union are recommended, in order to promote preparedness for the emergence and circulation of shared swine pathogens.

Preliminary Study on Gastrointestinal Helminths in Warthogs (*Phacochoerus africanus*) at the Mole National Park, Ghana

Owusu, P. J, Oduro D, Duah-Quashie, N. O, Owusu E. H and G. Futagbi 2023.

West African Journal of Applied Ecology 31 (1): 13-22.

Most emerging human infectious diseases originated from wildlife. To find out if warthogs in Mole National Park harbour zoonotic parasites, a total of 39 warthog faecal droppings were sampled and examined. Zinc Sulphate Flootation technique was used in processing the samples for microscopic examination and quantification of parasite eggs. Out of the 39 warthog droppings, 95% were infected with one or more parasite species. At least seven genera of helminths were identified. Nearly 72% of the warthog droppings harboured *Strongyloides* sp and trichostrongyle-type. *Enterobius* sp. was found in 64.1% of the droppings. Other parasitic helminths identified such as *Ascaris* sp., *Taenia* sp., *Moniezia* sp., and *S. haematobium* occurred in less than 50% of the animals. Z-tests showed significant variations in prevalence among the various parasites ($p < 0.05$). Mostly, the level of infection ranged from moderate ($100 < \text{EPG} < 500$) to high ($\text{EPG} \geq 500$) loads of helminth eggs. Forty-two percent of the warthogs had three or more parasites. This study reveals some helminths that are harboured by the warthogs in the Mole National Park. The presence of zoonotic parasites such as *Ascaris* sp. and *Taenia* sp. in the warthogs is an indication of potential for transmission of zoonoses in the community.

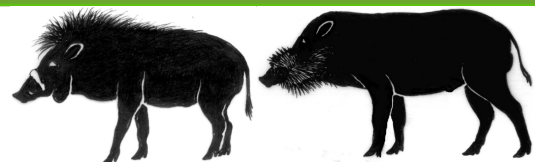
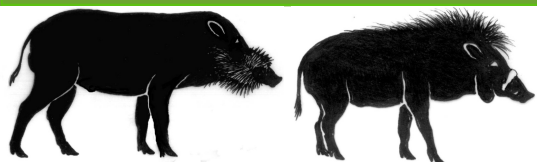
Comparative Genomic Analysis of Warthog and *Sus Scrofa* Identifies Adaptive Genes Associated with African Swine Fever

Wen Feng, Lei Zhou, Pengju Zhao, Heng Du, Chenguang Diao, Yu Zhang, Zhen Liu, Wenjiao Jin, Jian Yu, Jianlin Han, Okoth Edward, Mrode Raphael and Liu Jian-Feng 2023.

Biology 12: 1-17. DOI: <https://doi.org/10.3390/biology12071001>.

Background: As warthogs (*Phacochoerus africanus*) have innate immunity against African swine fever (ASF), it is critical to understand the evolutionary novelty of warthogs to explain their specific ASF resistance. Methods: Here, we present two completed new genomes of one warthog and one Kenyan domestic pig as fundamental genomic references to elucidate the genetic mechanisms of ASF tolerance. Results: Multiple genomic variations, including gene losses, independent contraction, and the expansion of specific gene families, likely molded the warthog





genome to adapt to the environment. Importantly, the analysis of the presence and absence of genomic sequences revealed that the DNA sequence of the warthog genome had an absence of the gene lactate dehydrogenase B (LDHB) on chromosome 2 compared with the reference genome. The overexpression and siRNA of LDHB inhibited the replication of the African swine fever virus. Combined with large-scale sequencing data from 42 pigs worldwide, the contraction and expansion of tripartite motif-containing (TRIM) gene families revealed that TRIM family genes in the warthog genome are potentially responsible for its tolerance to ASF. Conclusion: Our results will help improve the understanding of genetic resistance to ASF in pigs.

Faecal Microbiota Characterisation of *Potamochoerus porcus* Living in a Controlled Environment

Scarafile Donatella, Luise Diana, Motta Vincenzo, Spiezio Caterina, Modesto Monica, Mattia Porcu Marzia, Yitzhak Yadid, Correa Federico, Sandri Camillo, Trevisi Paolo and Paola Mattarelli 2023.

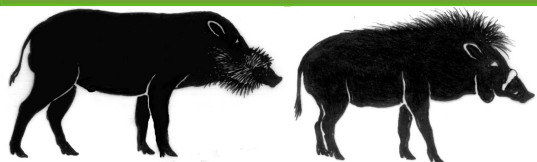
Microorganisms 11 (6): 1-15 DOI: <https://doi.org/10.3390/microorganisms11061542>.

Intestinal bacteria establish a specific relationship with the host animal, which causes the acquisition of gut microbiota with a unique composition classified as the enterotype. As the name suggests, the Red River Hog is a wild member of the pig family living in Africa, in particular through the West and Central African rainforest. To date, very few studies have analysed the gut microbiota of Red River Hogs (RRHs) both housed under controlled conditions and in wild habitats. This study analysed the intestinal microbiota and the distribution of Bifidobacterium species in five Red River Hog (RRH) individuals (four adults and one juvenile), hosted in two different modern zoological gardens (Parco Natura Viva, Verona, and Bioparco, Rome) with the aim of disentangling the possible effects of captive different lifestyle and host genetics. Faecal samples were collected and studied both for bifidobacterial counts and isolation by means of culture-dependent method and for total microbiota analysis through the high-quality sequences of the V3–V4 region of bacterial 16S rRNA. Results showed a host-specific bifidobacterial species distribution. Indeed, *B. boum* and *B. thermoacidophilum* were found only in Verona RRHs, whereas *B. porcinum* species were isolated only in Rome RRHs. These bifidobacterial species are also typical of pigs. Bifidobacterial counts were about 10⁶ CFU/g in faecal samples of all the individuals, with the only exception for the juvenile subject, showing 10⁷ CFU/g. As in human beings, in RRHs a higher count of bifidobacteria was also found in the young subject compared with adults. Furthermore, the microbiota of RRHs showed qualitative differences. Indeed, Firmicutes was found to be the dominant phylum in Verona RRHs whereas Bacteroidetes was the most represented in Roma RRHs. At order level, Oscillospirales and Spirochaetales were the most represented in Verona RRHs compared with Rome RRHs, where Bacteroidales dominated over the other taxa. Finally, at the family level, RRHs from the two sites showed the presence of the same families, but with different levels of abundance. Our results highlight that the intestinal microbiota seems to reflect the lifestyle (i.e., the diet), whereas age and host genetics are the driving factors for the bifidobacterial population.

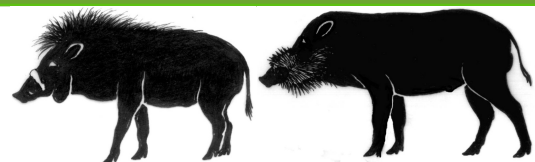
Reporte de *Pecari tajacu* y *Procyon lotor* con anomalías cromáticas en el Estado de Guerrero, México

Ruiz-Gutiérrez, F., Chávez, C., Hernández-Hernández, J. C., Torres-Bernal, R., Ruiz-Gutiérrez, B. O., Vázquez-Arroyo, E., ... and O. Samudio-Pineda 2023 Revista peruana de biología, 30(2),





New scientific articles



e24148-e24148, doi: <https://doi.org/10.15381/rpb.v30i2.24148>

Este trabajo documenta el primer registro de anomalías cromáticas en el pecarí de collar (*Pecari tajacu*) y el tercero en el mapache (*Procyon lotor*) para México. Los hallazgos se realizaron durante el monitoreo realizado entre el 2009 y el 2021, utilizando cámaras-trampa, principalmente en la ecorregión de la Sierra Madre del Sur del estado de Guerrero, México. *Procyon lotor* fue registrado entre el 5 de noviembre y el 1 de diciembre de 2019, en vegetación riparia de bosque tropical caducifolio (17°47'35"N, 98°39'59"W, 1134 m de altitud). Mientras que *Pecari tajacu* se registró el 7 de junio y el 22 de julio del 2021 en una brecha saca cosecha abandonada (17°38'12"N, 100°40'50"W; 1532 m de altitud).

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

The broad aim of these groups is to promote the longterm conservation of wild pigs, peccaries and hippos and, where possible, the recovery of their populations to viable levels.

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

