

Suiform Soundings

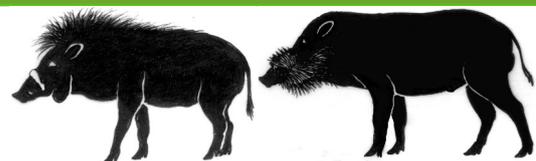
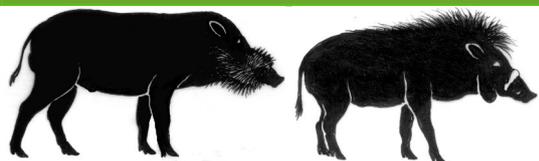


**Newsletter of the IUCN / SSC Wild Pig,
Peccary and Hippo Specialist Groups**



Volume 17(1)
September 2018
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://sites.google.com/site/wildpigspecialistgroup/iucnssc-wild-pig-specialist-group/suiform-soundings-2>

Editor in Chief: Thiemo Braasch

Managing Editor / Production Editor: Thiemo Braasch and Rafael Reyna

Handling Editor Portuguese Section: Alessandra Nava

Handling Editor Spanish Section: Rafael Reyna

Handling Editor French Section: Jean-Pierre d'Huart

Handling Editor Africa Section: Anne-Marie Stewart

Handling Editor Asian Section: Matthew Linkie

Editorial Advisor: Erik Meijaard

Contact address:

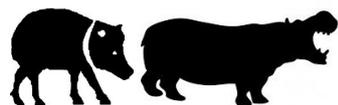
Thiemo Braasch

E-mail: salvanus@gmail.com

Photo front page:

Male Pygmy hog (*Porcula salvania*) in the Pygmy Conservation Breeding Center, Basistha, Assam, India. Photo: Thiemo Braasch.

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.



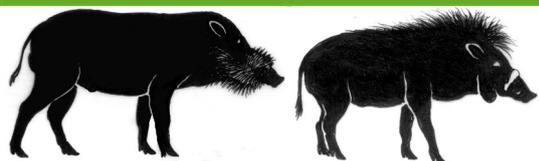
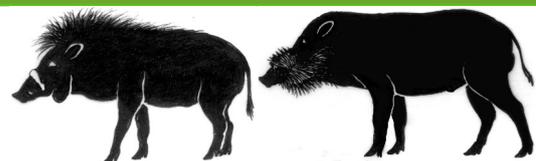
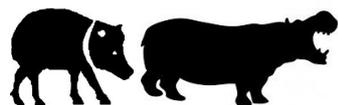
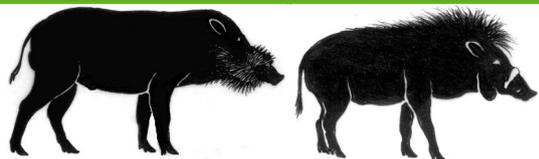


Table of Contents

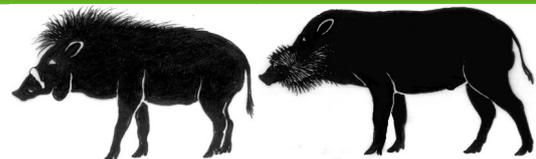


EDITORIAL <i>by Thiemo Braasch</i>	4
WPSG internal news <i>by Johanna Rode-Margono and Thiemo Braasch</i>	5
The future is burning brighter - the remarkable comeback of the Pygmy hog (<i>Porcula salvania</i>) <i>by Thiemo Braasch</i>	6
Some observations on wild boars (<i>Sus scrofa</i>) in the Western Anti-Atlas, Morocco <i>by Cornelius Schlawe</i>	14
Babirusa (<i>Babyrousa</i> spp.) on Buru and the Sula Islands, Maluku, Indonesia <i>by Alastair A. Macdonald, Victor Kailuhu and Meytty J. Pattikawa</i>	22
The return of White-lipped peccaries in two main protected areas of French Guiana: Update and insights into an uncommon population dynamics <i>by Cécile Richard-Hansen, Luc Ackermann, Rachel Berzins, Jennifer Devillechabrolle, Thibaut Foch, François Korysko and Raphaëlle Rinaldo</i>	37
Reproductive limitations following hybridization between wild and domestic <i>Sus scrofa</i> <i>by Sergey P. Knyazev and Sergey V. Nikitin</i>	41
NEW LITERATURE ON SUIFORMES	44
NEW BOOKS ABOUT SUIFORMES	87
ARTICLES IN THE NEWS	90





Editorial



Dear fellow reader,

I am glad to present you with the latest issue of Suiform Soundings.

Reading conservation and environmental news nowadays can be very frustrating - the ongoing destruction of rainforests due to palm oil plantations, the bushmeat crisis, the worsening situation of many species across the world ranging from the Vaquita in Mexico to elephants in Africa, Sumatran rhino in Indonesia and Malaysia or the global amphibian crisis, plus global climate change. Thus,

there may seem to be little hope for the future of many species, ecosystems and biodiversity in general.

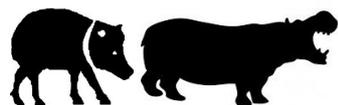
From time to time it is good to get a brighter view on species conservation. I recently read the book "Back from the Brink" written by Malcolm Smith¹ on success stories in species recovery ranging from the European Bison, Humpback Whale, Whooping Crane to the Large Blue Butterfly in England. The book is not only about species, it is also about the people, who are incredibly passionate and dedicate their lives to saving them. The author also mentions the Pygmy Hog as a species that could soon join the happy list of species back from the brink. The book was published 2015. Although there is still a long way to go for the 'Pygmy Hog Conservation Project' in Assam, India, it is becoming a success story in species conservation, including our Specialist Group.

In February this year, I visited the 'Pygmy Hog Conservation Project' and met Goutam Narayan and Parag Jyoti Deka, the founding director and the new director, respectively. It was a wonderful experience to talk with them about the conservation of Pygmy Hogs, to see their dedication, to feel their passion for the conservation of this species, to see them working in the two breeding centers in Basistha and Potasali and to observe Pygmy Hogs directly there.

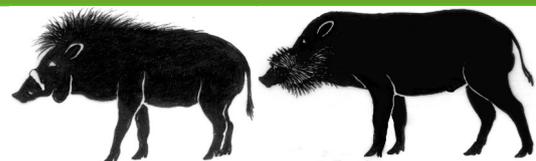
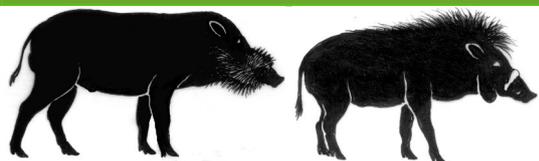
This issue of Suiform Sounding consists of an article on the 'Pygmy Hog Conservation Project'. We also present articles on babirusa from Buru and Sula Islands in Indonesia, wild boars in Morocco, reproductive limitations following hybridization between wild and domestic boars and an article about White-lipped Peccaries in two main protected areas of French Guiana. On behalf of the Wild Pig Specialist Group, I wish to thank the authors who have submitted articles and the editorial and review team who have helped me in preparing this issue of Suiform Soundings. I hope you enjoy reading it.

With warm regards,

Thiemo Braasch
Chief Editor Suiform Soundings



¹Malcolm Smith: Back from the Brink. 230 pages, 2015, Whittles Publishing, Dunbeath, UK



New Co-Chair of IUCN/SSC Wild Pig Specialist Group

In March 2018 I was appointed by the chair of the IUCN SSC as co-chair of the Wild Pig Specialist Group. I will assist Erik with running the SG and hope to help getting effective conservation planning and the resulting activities off the ground. Despite having started my career in primatology, I have taken a keen interest in wild pigs when I helped to conduct a project on Bawean warty pigs in 2014. Since then I have initiated and led projects on Javan warty pigs, been involved in the Global Species Management Plans for babirusa, and support the conservation of Visayan warty pigs on Negros island. Hopefully a project on Oliver's warty pig on Mindoro island will follow soon. These projects all tie in with my job as the Field Programme Coordinator for South East Asia at Chester Zoo, UK. I am looking very forward to working with the Specialist Group and all of you!

Johanna Rode-Margono
Co-Chair IUCN/SSC Wild Pig Specialist Group



Johanna Rode-Margono with the team of the Javan Species Recovery Programme (JaSpeR). Photo: J. Rode-Margono

IUCN/SSC Wild Pig Specialist Group website with extension

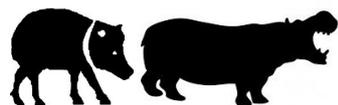
So far, the website of the IUCN/SSC Wild Pig Specialist Group consisted of species profiles of all wild pig species, information about this specialist group, news about wild pigs and all issues of Suiform Soundings. Suiform Soundings already covers news of three IUCN Specialist Groups. Now, the website has been extended on the IUCN/SSC Peccary Specialist Group and the IUCN/SSC Hippo Specialist Group. Therefore, species profiles of all three peccary species and the two hippo species can be found on this website and also news about these species and the specialist groups.

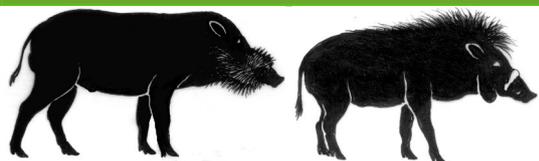
Go to
<https://sites.google.com/site/wildpigspecialistgroup/home>

and the included subpages.

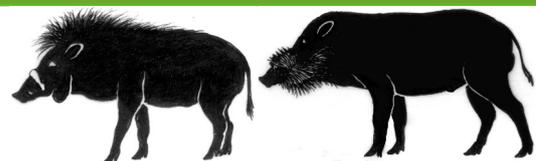
Thanks to Alexine Keuroghlian, Mariana Altrichter and Harald Beck from the IUCN/SSC Peccary Specialist Group and Beatrice Steck and Jan Pluháček from the Hippo Specialist Group for all the information and photos provided for the website extension!

Thiemo Braasch
Public Relations Officer IUCN/SSC Wild Pig Specialist Group





Ecology and Conservation



The future is burning brighter – the remarkably comeback of the Pygmy hog (*Porcula salvania*)

by Thiemo Braasch¹

¹IUCN/SSC Wild Pig Specialist Group, salvanius@gmail.com

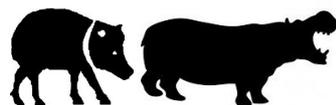
Preface

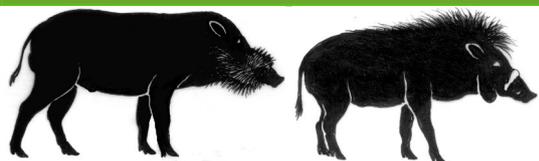
This article is in memoriam William Oliver. Due to his passion, dedication and endless efforts Pygmy hogs are still roaming through the grasslands of Manas National Park, are breeding in the Pygmy Hog Conservation Project in Basistha and Potasali and have been re-introduced to three different places in Assam. The following information were collected on a journey through Assam by the author in February this year.

Abstract

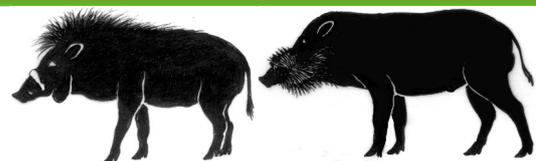
The Pygmy hog living on the floodplains of northern and north-eastern India is the smallest of all wild pig species of the world. Once considered to be extinct, then re-discovered, Pygmy hogs were tethering on the brink of extinction for decades until a conservation breeding project started in the 1990s. After more than two decades of conservation breeding and releases of Pygmy hogs at three locations in Assam the once dark prospective has turned brighter. Now, there seems to be a chance that Pygmy hogs will rewild the the terai grasslands of Assam and other northern Indian states and will survive together with other endangered species sharing the same habitat like hispid hares or Bengal Florican.

Fig. 1: Pygmy hog sow with juvenile in the Pygmy Hog Conservation Breeding Center in Basistha.
Photo: T. Braasch





Ecology and Conservation



Natural history

Pygmy hogs were first scientifically described as *Porcula salvania* by the British ethnographer Hodgson in the year 1847 from the “Tarai of Sikkim” with no further clarification of the place (Hodgson 1847). Sikkim actually has no terai habitat, but that specimen was from Duars (alluvial floodplains) in the Indian state of West Bengal, which shares a border with Sikkim and also has grassland (Pradhan & Meijaard 2018). Hodgson described the new species as “the size of a large Hare, and extremely resembles both in form and size a young pig of the ordinary wild kind of about a month old, except in its dark and unstriped pelage”. Later Garson (1883) amended to place it in the genus *Sus*. Only in 2007 the Pygmy hog was placed back in its own genus as proposed by Hodgson (1847) due to phylogenetic analysis using mitochondrial DNA.



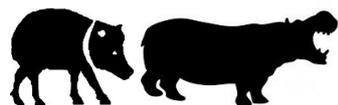
Fig. 2: Female Pygmy hog in Basistha. Photo: T. Braasch

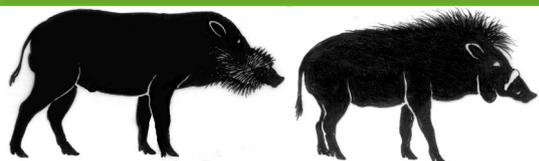
The approximate former distribution of the Pygmy Hog ranged from Uttar Pradesh in northern India and southern Nepal to southern Bhutan, northeast India and even the north-eastern tip of Bangladesh (Oliver & Deb Roy 1993). Nowadays, Pygmy hogs are restricted to the grasslands of the Himalayan foothills called terai and along the Brahmaputra valley (Narayan & Deka 2018). This habitat is home to and famous for big herbivores such as Asian elephants (*Elephas maximus*), Indian rhinos (*Rhinoceros unicornis*), Asian wild buffaloes (*Bubalus arnee*) but also other unique species like hispid hare (*Caprolagus*

hispidus) and Bengal Florican (*Houbaropsis bengalensis*). Pygmy hogs are the only suid species and one of few mammal species that build a nest daily or latest every second day throughout the year (Narayan & Deka 2018). The nest is made with leaves from thatches grasses.

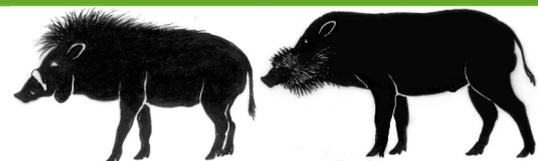
In 1964, E. P. Gee published a book about the wildlife of India and considered Pygmy hogs to be extinct! The Pygmy hog was thought to be gone! One main reason was the destruction of the terai grasslands starting in 1947. The area was split between India and Nepal and immigrants moved into the habitat and changed it to settlements and agricultural fields.

At this dark point Gerald Durrell, one of world’s most visionary conservationists, founder of Jersey Zoo and initiator of many successful conservation projects all around the world, entered into the stage. In 1970 he met John Tessier-Yandell, a tea planter from Assam and asked him to look for Pygmy hogs. Tessier-Yandell told his men to look for a small pig with the size of about 25 cm height. Just one year later, The manager at the Attareekhat Tea Estate was informed by his works of a small pig sold at the local market near Barnadi Wildlife Sanctuary (Tessier-Yandell 1971). During the next two weeks twelve Pygmy hogs were taken to Graves from ditches in tea gardens. The hogs had taken refuge there because of the burning of grassland as their natural habitat. The twelve Pygmy hogs were the founder of several conservation breeding attempts starting at the already mentioned tea estate in 1971, later also at Guwahati Zoo in Assam 1976 – 1989 and in Zurich Zoo in Switzerland 1976 – 1979 (with the last Pygmy hogs living out of Assam





Ecology and Conservation



there until at least July 1989, Braasch, pers. obs.). All these conservation breeding efforts and also in situ conservation activities in Orang National Park and Manas National Park had no or only little but definitely no long lasting success.

Durrell Wildlife Conservation Trust sent William Oliver to Assam in 1977. He traveled through the whole terai area searching for hogs but without any success. The reasons for the Pygmy hog's decline were habitat destruction and degradation due to the high pressure of human populations in the Pygmy hogs' habitat for settlements, agricultural fields livestock grazing, hunting and trapping. By 1995 the Pygmy hog was confirmed to be a "stuck species" (Deka, pers. comm.) - a species on the brink of extinction and seemingly without any bright future or any chance for longterm survival.



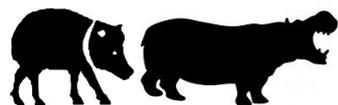
Fig. 3: The last remaining native habitat of Pygmy hogs in Manas National Park. Photo taken in the middle of the dry season in February. Photo: T. Braasch

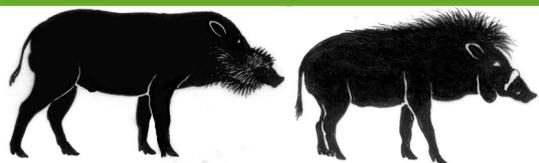
Conservation project

Gerald Durrell died in 1995. In the same year, the Pygmy Hog Conservation Program began. Goutam Narayan together with William Oliver and collaboration with the Assam government, the Jersey-based Durrell Wildlife Conservation Trust (DWCT), the Ministry of Environment, Forest & Climate Changes (Government of India), IUCN as well as local NGO EcoSystems India and Aaranyak.

The conservation project for the hogs is using three different approaches: 1. Habitat management for the last remaining population of Pygmy hogs in Manas National Park, 2. Habitat restoration and, 3. Ex situ conservation breeding of Pygmy hogs that makes soft releases of Pygmy hogs in suitable habitats in Northeast India Due to William Oliver's never ending patience and dedication after years of waiting finally the Indian government authorized the capture of Pygmy hogs in Manas National Park in 1996. The government only permitted to catch only a few Pygmy hogs. How can a conservation breeding project become successful with only few founders? The brilliant idea was to catch pregnant sows. The team was successful to catch two male hogs and four female hogs, of whom three were pregnant (Narayan & Deka 2018). The pregnant females gave offspring to three healthy litters and a total of 13 piglets seven male, six females, (all but one piglet) were reared successfully.

Having caught Pygmy hogs was just the beginning. The Pygmy hogs were taken to the conservation breeding center in Basistha near Guwahati. To breed Pygmy hogs successfully the biological, behavioral and ecological requirements of Pygmy hogs needed to be known: Pygmy hogs have four or five piglets once a year. They live in groups of four to six animals and make a well-camouflaged grass nest at least every second day (Narayan & Deka 2018). Pygmy hog's diet consists of roots, tubers, wild fruits, termites, eggs and earthworms (Narayan & Oliver 2015). By investigations of their last native habitat in Manas National Park William and Goutam knew that





Ecology and Conservation

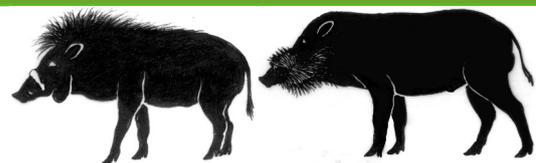


Fig. 4: Pre-release enclosures left and right of the path in Potasali.

Photo: T. Braasch

genetic diversity of the breeding population. A pre-release facility with big enclosures was set up at Potasali near to the Nameri National Park 2004. The facility consists of four large pre-release enclosures (two the size of 2400 m², two the size of 3200 m²). The hogs are kept with only minimal contact to keepers for five months prior to the release in the wild. The social breeding groups built in these enclosures consist of unrelated young hogs. The enclosures allow natural foraging and prepare the hogs for their independent lives and survival in the wild. According to behavioral observations Pygmy hogs become shy to humans, they are more active in these enclosures compared to the Pygmy hogs in breeding enclosures and remain in healthy conditions. Furthermore, they start to forage effectively and only a fourth of their diet consists of supplemented food.

Releases

Prior to the release of Pygmy hogs, the conservation project restored habitat at different places in Assam such as Orang National Park, Sonai Rupai Wildlife Sanctuary and Barnadi National Park. A focus also lied on the habitat in Manas National Park with the last original Pygmy hog population. The restoration work following recommendations for scientific management comprises control or even stop dry season grass burning, strict protection of the grassland against livestock grazing, thatch collection and hunting in the grassland. All these actions were

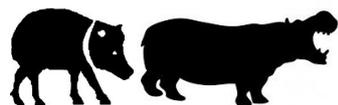
Pygmy hog enclosures need to have a lot of grass cover, where the pigs can build their nests, forage and hide and furthermore wallowing pools. To maintain a natural behavior the predictability of food was reduced and the time Pygmy hogs' time spent on foraging was increased.

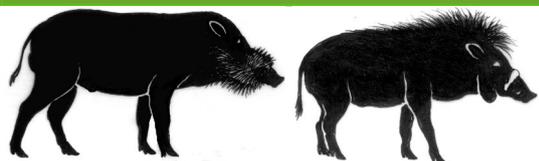
Two years after the first capture in 1996 there were already 35 Pygmy hogs in Basistha. In the year 2001 a wild rescued male Pygmy hog was taken to Basistha and joined the conservation breeding group. Furthermore, one male Pygmy hog and two females were caught in Manas National Park in 2013 to enrich the



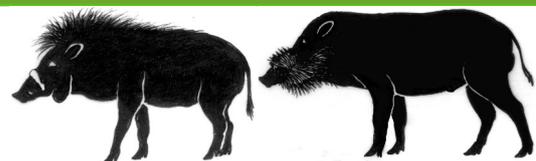
Fig. 5: A breeding pair of Pygmy hogs (male in the front) in Potasali.

Photo: T. Braasch





Ecology and Conservation



done with the help of local park staff. The awareness for the threats of the grasslands and their inhabitants has to be raised at governments, national park and forest authorities and the local people living near to the parks. For Manas National Park, the burning of old grass changed from early dry season (November – December) when Pygmy Hogs usually mate and from late dry season (March – May), which is the last stage for gestation for a hog, to mid part of the dry season (January – February). It became evident that it was also necessary to burn only parts of the grassland and leave areas of old grass patchily where Pygmy hogs can hide and build their nests. Fire lines between two grasslands avoid the burning of the whole area.



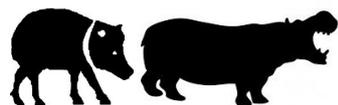
Fig. 6: The grassland habitat in Orang National Park, where Pygmy hogs have been released during the last years. Photo taken in the middle of the dry season in February. Photo: T. Braasch

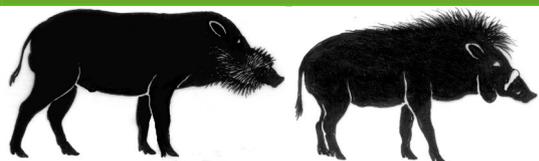
All releases follow a strict protocol: The hogs are taken to soft-release enclosures. There are observation platforms 30 to 50 m away from the enclosures, which is rigged with solar power fences to prevent the damage by wild elephants and as precautions against them and other large animals (Narayan & Deka 2018). The hogs are taken to the release sites in batches and are released at different locations with suitable habitat. The social groups are kept in separate soft-release enclosures. The feeding routine is resumed to use the release enclosures as baiting stations. After

Finally, the first Pygmy hogs releases took place in Sonai Rupai Wildlife Sanctuary. From 2008 to 2010 35 Pygmy hogs (18 males, 17 females) were released there in eight social groups. Between 2011 and 2015 56 hogs (26 males, 33 females) were released in 12 social groups in Orang National Park. The releases of Pygmy hogs in Barnadi National Park started in 2016 with three males and three females. and since then 22 hogs have been released there including six released Pygmy hogs this 2018 (three males, three females). In the year 2016 the 100th Pygmy hog was released into the wild (see also Suiform Soundings 15(1): 32-34).

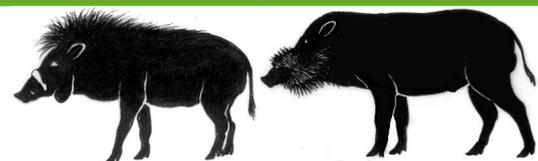


Fig. 7: Parag Jyoti Deka (left) discussing the fire regime of the grassland with staff of Orang National Park. Photo: T. Braasch





Ecology and Conservation



three days the hogs are allowed to enter the wild. On the release day two or three sections of the fence are removed and the hogs have to find their way out for their own (Narayan & Deka 2018).

After the release Pygmy hogs are directly monitored via the baiting stations were only delicacies for Pygmy hogs are presented and via radio telemetry. Camera traps were also carefully deployed close to the nest. The indirect monitoring comprises the search for forage marks, footprints, droppings, and active and old nests. All these collected information are mapped. There are hopeful monitoring observations (Deka, pers. comm.): Most of the released hogs remain within their social groups, some form new groups. They establish their groups 150 – 1500 m from the release site and keep moving every four weeks. There were signs of nest building, nest repairing, extensive forage. Most forage marks were found within 150 m distance to active nests. The maximum dispersal distance covered by the hogs or by hog groups was 3 km. Evidences for farrowing and breeding was found and even young hogs were found.

Pygmy hogs were recently covered in two movies: The species has a small part in Disney's latest version of "The Jungle Book" (2016). Furthermore, Daniel Craven from Durrell Wildlife Conservation Trust produced the documentary "Durrell's Underhogs" 2017.

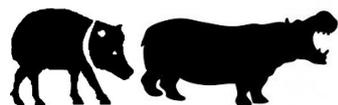


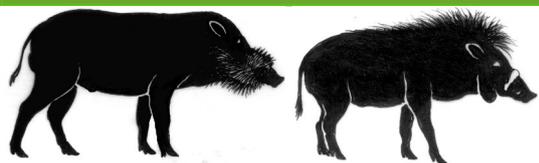
Fig. 8: Pygmy hog enclosures in Guwahati Zoo. Photo: T. Braasch

As on 31st July 2018 there are 91 Pygmy hogs in captivity (Deka, pers. comm.): two (one male, one female) in Guwahati Zoo, 49 hogs (24 males, 25 females) at the Pygmy Hog Research and Breeding Center at Basisitha, from which 19 hogs (eight males, 11 females) were born May to July this year, and 40 Pygmy hogs (18 males, 22 females) in the Pygmy Hog Release Center in Potasali. 18 of them (six males, twelve females) were born this year there.

In January this year Parag Jyoti Deka took over the responsibility from Goutam Narayan as project director. Parag has already

worked as veterinarian for the project since 1997. According to Parag Deka (pers. comm.) the next steps for the Pygmy Hog Conservation Project are to continue with the releases, to continue with habitat management and habitat restoration in Assam but also in areas west of this state, if suitable habitat is available. The project will also broaden its view to save the terai grassland ecosystem with its entire natural species like Indian one-horned rhinoceros (*Rhinoceros unicornis*), hispid hare (*Caprolagus hispidus*), Swamp deer (*Rucervus duvaucelii*), Bengal Florican (*Houbaropsis bengalensis*) and ground orchids and also the ecosystem services provided by this habitat.





Ecology and Conservation

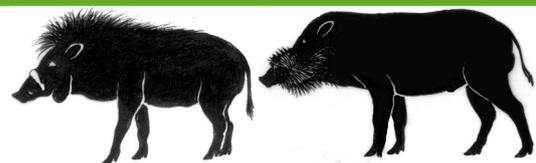


Fig. 8: Close-up view of a female Pygmy hog in Potasali.

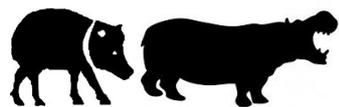
Photo: T. Braasch

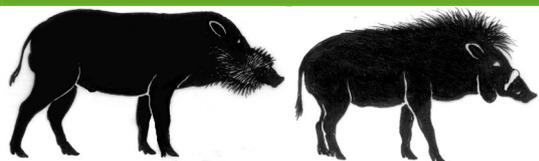
Outlook

The Pygmy hog's fate once had a dire future. Due to the passion and dedication of Gerald Durrell, William Oliver, Goutam Narayan, Parag Jyoti Deka and all their staff and assistants it has become brighter and looks much better than one decade ago. Unfortunately, William Oliver passed away 2014 and could only see the first successes of the conservation project. The Pygmy hog is still listed as critically endangered but there is reasonable hope that this cute pig will have its place on the grasslands of North-eastern India and possibly at some other places in Northern India together with all the other endangered species of this ecosystem.

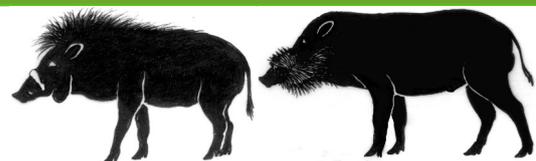


Fig. 9: Male Pygmy hog in Potasali. Photo: T. Braasch





Ecology and Conservation



Acknowledgments

The conservation project for the Pygmy hog has so far been supported by the European Commission; Darwin Initiative UK; Critical Ecosystem Partnership Fund; US Fish & Wildlife Service; IUCN Save Our Species; Zoological Society for the Conservation of Species and Populations, Germany; Peoples Trust for Endangered Species; Disney Conservation Fund; Assam Valley Wildlife Society; Mr. Jo Mayo, USA; Jayem & Clarkson Trust, Jersey.

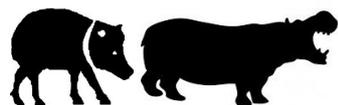
I want to thank my friends Goutam Narayan, Nandita Hazarika and Parag Jyoti Deka for their hospitality and for organizing a journey through Assam and Arunachal Pradesh in February this year for me to see the Pygmy hogs and other magnificent wildlife on this journey and for the wonderful time we spent together. I also want to thank my friend Ralf Lohe for his companionship during this journey.

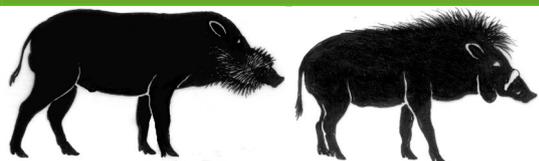
References

- Funk, S.M., Verma, S.K., Larson, G., Prasad, K., Singh, L., Narayan, G. and J.E. Fa 2007. The pygmy hog is a unique genus: 19th century taxonomists got it right first time round. *Molecular Phylogenetics and Evolution* 45(2): 427-436.
- Garson, J.G. 1883. Notes on the anatomy of the *Sus salvanius* (*Porcula salvania* Hodgson) . Part 1, external characters and visceral anatomy. *Proceedings of the Zoological Society of London XXVIII*: 413-418.
- Gee E.P. 1964. *Wildlife of India*. Collins Ltd., London, UK.
- Hodgson, B.H. 1947. On the new form of hog kind or Suidae. *Journal of the Asiatic society of Bengal XVI*: 423-428.
- Narayan, G. & P.J. Deka 2018. Pygmy Hog *Porcula salvania* (Hodgson, 1847). pp. 234-245. In: Melletti, M. & E. Meijaard (eds.): *Ecology, Conservation and Management of Wild Pigs and Peccaries*. Cambridge University Press, Cambridge, UK.
- Narayan, G. & W.L.R. Oliver 2015: Pygmy Hog *Porcula salvania*. pp. 129-145. In: Johnsingh, A.J.T. & N. Manjrekar (eds.) 2015. *Mammals of South Asia, Vol. 2.*, University Press, Hyderabad, India.
- Oliver, W.L.R. & S. Deb Roy, S. 1993. The pygmy hog (*Sus salvanius*). In: Oliver, W.L.R. (ed.): *Pigs, peccaries and hippos: status survey and conservation action plan*. Gland: IUCN, pp. 121-129
- Pradhan, J. & E. Meijaard 2018. Modelling Pygmy Hog Habitat to Inform Habitat Management. pp 291-298. In: Melletti, M. & E. Meijaard (eds.): *Ecology, Conservation and Management of Wild Pigs and Peccaries*. Cambridge University Press, Cambridge, UK.
- Tessier-Yandell, J. 1971. The pigmy hog. *Sus salvanius*. *Cheetal* 14(3): 23-28.

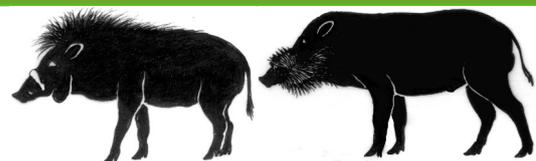


Fig. 10: After a long struggle the future for Pygmy hogs looks much brighter than two decades ago. Photo: T. Braasch





Ecology and Conservation



Some observations on wild boars (*Sus scrofa*) in the Western Anti-Atlas, Morocco

by Cornelius Schlawe

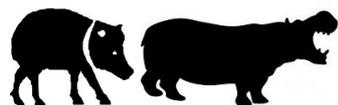
Wild Boars were observed in the Western Anti-Atlas, predominantly in and around the Jebel Lkest Massif (29°47'42"N, 9° 2'5"W). Observations took place in November 2016 (five days in the field), November 2017 (eighteen days in the field) and in late May through early July in 2018 (28 days in the field). None of the observations followed any systematic approach. However, in combination with interviews carried out among local citizens, some conclusions on behaviour, seasonal movements, and predation of wild boars in the region can be drawn. Conflicts with humans are described. Photographs were analysed for traits of the local animals.



Fig. 1: Adult sow investigates; Pink Rock-Roses (*Cistus creticus*). Photo taken on 1950 m a.s.l. in November. Photo: C. Schlawe

Climate, Vegetation and Topography

The Jebel Lkest Massif (max. altitude 2374 m) is exposed to humid air moving in from the Atlantic. The town of Tanalt, located in the north-western foothills of the Lkest Massif, receives 350mm precipitation annually, whereas mountainous regions to the East and South-east of the massif receive less than 200mm. Wild Boar populations are sustained throughout the region. Densities are positively related to precipitation, availability of shelter, and to access to cultivated land.





Ecology and Conservation

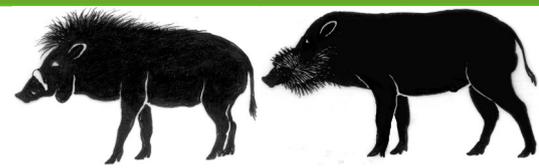


Fig. 2: Evergreen Oak (green), Pink Rock-Rose (reddish), Ségonne's genista (silvery). The brighter, more barren slopes in the back are frequently grazed by goats.
Photo taken on 2100 m a.s.l. in November. Photo: C. Schlawe

At altitudes between 1300 and 2374 meters, the landscape is dominated by sheer cliffs that carry multiple sloping plateaus of scrub and evergreen oak forest (*Quercus ilex*). The climate at these heights is cool and moist in the winter, warm and dry in summer. Scrub is dominated by rockroses (*Cistus creticus*, *Halimium antiatlanticum*), Ségonne's genista (*Teline segonnei*) and various herbal plants. Dwarf palm (*Chamaerops humilis*) and joint pine (*Ephedra fragilis*) are common on the drier southern slopes

between 1600 and 2100 m. Open soil is dominated by loose rock interspersed by annual plants (e.g. *Aristida adscensionis*, *Eryngium ilicifolium*, *Galium setaceum*). Above 1800 m, single juniper trees (*Juniperus thurifera*) stand exposed on rocky ledges. Plateaus are accessible to wildlife through sloping corridors between cliffs.

Nomads mainly use the less forested eastern portions of the Lkest Massif as pasture for their livestock, predominantly goats. One winter habitation consisting of a few simple buildings exists at 1930 m. Its vicinity is overgrazed. Plateaus in the West of the Lkest Massif are less affected by grazing and appeared to support a higher density of boars.

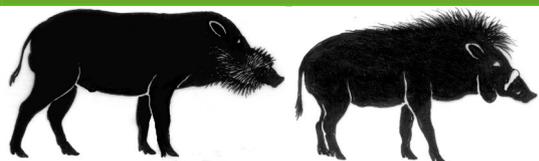
Few natural springs occur outside anthropogenic environments. They are found below cliff faces or in depressions. Virtually all of these fall dry latest by August. Moist soils around creek beds or springs may harbour oleander (*Nerium oleander*), fig trees (*Ficus carica*), reeds (*Phragmites australis*), or sedges (*Carex halleriana*).

Below 1200 m, argan trees (*Argania spinosa*) are the predominant tree. Winters are mild, summers hot and dry. The terrain is rocky. Succulents such as *Euphorbia officinarum* occur. Some seasonally flooded valleys here contain pockets of perennial water where reeds (*Phragmites australis*) thrive.

Traits

The local subspecies *Sus scrofa algirus* is considered to be one of the smallest with a maximum weight below 100 kg. In the field animals not only appeared smaller overall but more narrow-bodied than those from e.g. Central Europe. This is certainly partly due to differing thickness of coat and of subcutaneous fat. However, the narrow appearance might further result from skeletal traits.





Ecology and Conservation

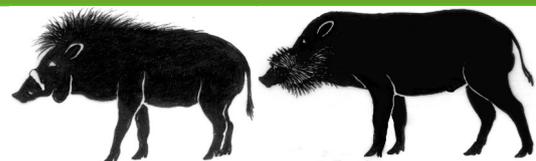


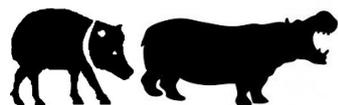
Fig. 3: Potent male that possesses no developed tusks; formerly cultivated fields, Ammeln Valley, Photo taken on 900 m a.s.l. in November.
Photo: C. Schlawe

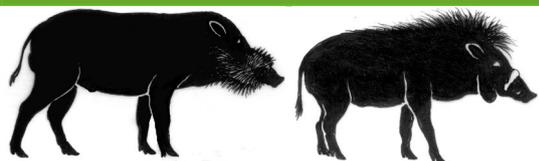
Coat colour is dark-greyish to brownish, interspersed with brighter bristles. Wear and bleach of different generations of hair play into a mixed appearance. The lower lateral portions of all legs are blackish-brown. Most individuals show whitish cheek-spots and labial corners which are separated by a darker section that is only interspersed by whitish bristles. Many have a pronounced light “moustache”, consisting of the aforementioned bright labial corners and a rostrally connecting greyish bridge. Most individuals have a rufous-brownish hood that may appear greyish in some potentially older individuals. The hood is connected by colour and extension to the longer bristles of the mane. The throat is greyish in most individuals. Grey may extend through the upper breast unto the inside of the forelegs (basal medial). The inside of the hindlegs and the abdominal portion is brighter as well. The degree of expression among all these brighter marks or sections is correlated to some degree. In their extremes they seemed more pronounced in females. Certainly females appeared more contrasty on average.

The sides of the upper neck just behind the ears and below is almost naked throughout the year. Ears are relatively large. Ears and tail are only sparsely haired. Some potent males do not show any tusks and this might apply to some fully adult males as well.

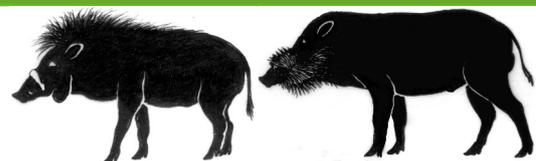
Behaviour

The local wild boars exploit a wide range of habitats from semi-desertic to mountainous. It can





Ecology and Conservation



only be speculated whether some family groups by tradition are better adapted to the moister and cooler heights above 1400m and others to the more deserty environments which are predominant at lower altitudes. Likewise, any local individual might be equally acquainted with either of these environments. Most likely, the truth lies somewhere in between and males may differ from females.



Fig. 4: Courtship. Female left, male right. Photo taken on 1950 m a.s.l. in November.

Photo: C. Schlawe

There likely is no fixed genetic adaptation to any of these particular environments. Rather, group tradition, available safety areas, and seasonal exploitability will determine feeding strategies. While each animal in theory has a generalist's capacity at birth, it will automatically be pressured into adopting a perhaps less generalistic lifestyle — most likely that of its mother and her affiliates. In that fashion, this universalist animal with its high cognitive capacities might exploit resources more efficiently.

Above 1600 m, when acorns were available in November, wild boars were encountered almost daily in the late afternoon. Presumably they were so obvious at this hour because they had just left their shelters and intended to make headway towards certain food sources and rutting grounds. Both shelter and food mainly seemed located in patches of evergreen oak forest (*Quercus ilex*) above 1800m. The boars were most often seen from 16.00 through sunset at 17.30 and until night fell. Less often they were observed in the mornings and never between 10.00 and 16.00. Occasionally they were seen descending towards villages located at 1400m, where they are known to raid crops at night throughout the year. They were also observed penetrating into moist valley floors above 1600m where they entered sedges and reeds in search of food. Direct observation of feeding included the consumption of acorns and reed shoots.

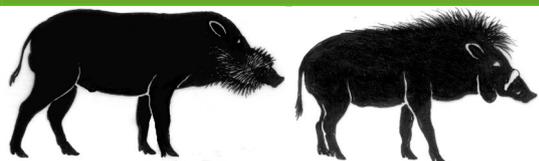
In the adjoining Ammeln Valley, at an altitude of 900 m, boar groups were scanning cultivations at the same time of the year. Here wild boars feed mainly on crops, fruits, nuts, insects



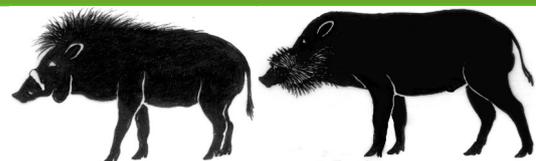
Fig. 5: Immatures searching for acorns. Photo taken on 1950 m a.s.l. in November.

Photo: C. Schlawe





Ecology and Conservation



and reed. According to locals, they not only eat the fruits of the argan trees but also crack the nuts — apparently the only native vertebrate other than rodents to be able to do this. It was possible to track and follow the movements of one particular lowland group on two occasions for two hours. Shelters were established in dense bush under palm and argan trees in between fields. It is possible that this group was local and specialized in the exploitation of cultivated lowlands. It may have remained separated from boars of the mountains during November 2016 and beyond. But this is a matter of speculation.

Despite the ongoing hunting season, most individuals reacted very composed when they noticed humans. In part this may be explained by the fact that wild boars in Morocco are only very rarely and illegally hunted for meat. Further, the ongoing rut seemed to make both sexes less attentive and more tolerant of human presence. Mothers guiding juveniles were clearly more alert than other mature individuals. They left an area as soon as they scented or heard humans.

Activity and predation

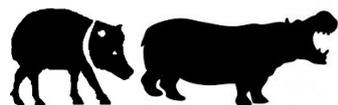
In late spring and summer activity seemed to be strictly nocturnal. No boars were seen then during hours of daylight, dusk or dawn. Instead, four observations took place during night drives, including two mothers with piglets. Additionally, wild boars were regularly heard when they were moving through plantations at an altitude of 1600 m at night. This shift towards nocturnal activity and elusiveness during summer is probably related to high susceptibility of piglets to predation by dogs during the day. Dogs were numerous and roamed freely around villages throughout the year.

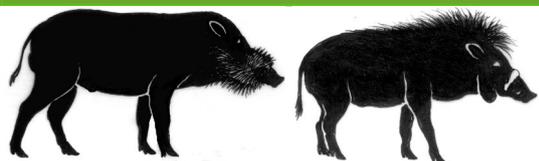
This interpretation is corroborated by locals. According to them, individual dogs which are underfed specialize in hunting piglets. Some may even take juveniles or engage in a communal hunt on sows. Since the African Golden Jackal (*Canis anthus*) is nowhere common and extinct in many regions of the country, dogs can be regarded as the main predator of wild boars in Morocco.

Other variables may favour nocturnal foraging during summer; boars may avoid the daytime heat or farmers who defend their ripening crops. In autumn, most piglets have grown considerably and therefore have become less susceptible to predation. Large piglets were regularly seen guided by their mothers during hours of daylight. However, two mothers with little piglets that were born late in year were also observed during evening hours in autumn. This does not necessarily contradict the interpretation, since foraging is a socially induced behaviour.

Seasonal movements

A seasonal movement became obvious when the higher portions above 1800 m were revisited in late spring and summer and boars were virtually absent. This was indicated by the sheer lack of encounters at formerly heavily frequented sites. More significant, no fresh signs of digging or tracks were found. On trails where in autumn boar tracks had clearly dominated, in summer only tracks of Cuvier's gazelle (*Gazella cuvieri*) or Barbary sheep (*Ammotragus lervia*) were found. During Ramadan few if any people entered the mountains. Yet the existing human tracks were never crossed by boar but regularly by gazelles. Instead, wild boars were relatively common at night around villages and cultivated land below 1800 m.





Ecology and Conservation

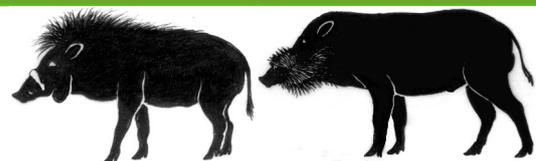


Fig. 6: Sow and piglet ascending at sunset. Photo taken on 2050 m a.s.l. in November..

Photo: C. Schlawe

The described seasonal movement indicates the importance of acorns to the boars' diet. Against expectation, choice of height and seasonal temperatures were inversely related. The animals are both tolerant against temporarily cold conditions at greater heights in winter and against very hot conditions at lower altitudes in summer. The energetically rich acorns which are only found above 1600m in autumn and winter seem to trigger these movements. This interpretation was supported by locals.

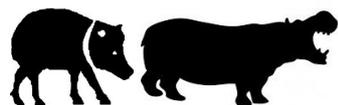
No field excursions were undertaken during truly cold or very dry periods. During rare snowfalls, wild boars will most likely desert the mountains. One such snowfall took place in March 2018. According to locals, the Lkest Massif was covered in snow for a week at altitudes above 1200 m, the first proper snow since the 1980s. This may have had some influence on the animals' distribution even until the subsequent summer.

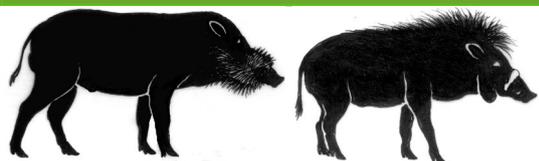
Further, a cull organized by the Department of Water and Forest during the winter months may have had an influence on the presence of boar in the higher regions. Most likely the cull took place near known boar shelters between 1000 m and 1600 m. Unfortunately, it was not possible to obtain information on exactly where or when the cull had taken place nor on how many animals had been killed.

Conflict with humans

Villages with their neighbouring fields and plantations are found in favourable locations up to 1700m. Planted trees here include almond, olive, fig and quince. Fig opuntia have been spreading on nearby slopes. Crops include barley and potatoes. Wild boars raid crops wherever they become available and cause great damage to the local harvest. Dogs are running loose which possibly helps to deter boars from entering fields at night (see "predation").

According to locals, four serious incidents have been reported around the Lkest Massif in recent years in which herb collecting women and men were attacked and wounded by wild boars, mostly by mothers guiding piglets when they were encountered in dense shrub. One of these incidents was fatal, two victims remained impaired, one of them wheelchair-bound.





Ecology and Conservation

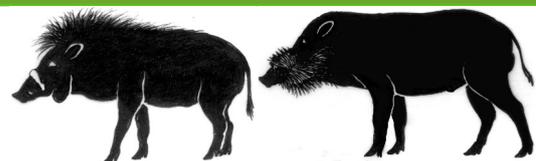
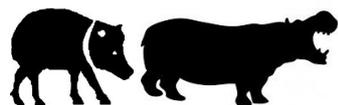


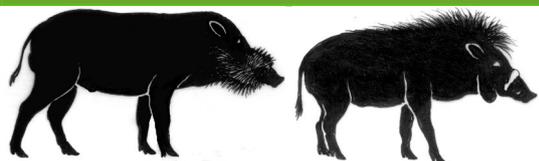
Fig. 7: Nomad winter habitation. Photo taken on 1930 m a.s.l. in November. Photo: C. Schlawe

For all these reasons villagers are repeatedly calling the Department of Water and Forest to cull wild boars, which apparently had been much rarer before the 1990s. The reported increase of the wild boar population coincided with a period of droughts and subsequent emigration. Young men are moving to larger cities to find work and most fields are neither cultivated nor watered any longer. At large locals are very tolerant of wild boars and have come to accept their presence.

Poaching

Despite the fact that Morocco is an Islamic country, there is a small illegal market for boar meat. The Lkest Massif is a focal area for poachers. These are mainly middle class or rich men from cities such as Agadir, Tifnite or Tafraoute. While poaching parties are a disturbance to wild boars in the region of Lkest, here they will only rarely target one. If so, it is presumably for pleasure and not for consumption. Instead they target Barbary Sheep (*Ammotragus lervia*), Cuvier's Gazelle (*Gazella cuvieri*), Cape Hare (*Lepus capensis*), Barbary Partridge (*Alectoris barbara*) and the locally rare, periodically extinct African Golden Jackal (*Canis anthus*). Poaching expeditions on foot are often executed during hunting season from October to December under the pretext of the seasonally legal partridge hunt. Throughout the year, poachers execute night drives along the tarred roads between the small towns of Tanalt and Ida Ougnidif where they employ spotlights.





Ecology and Conservation

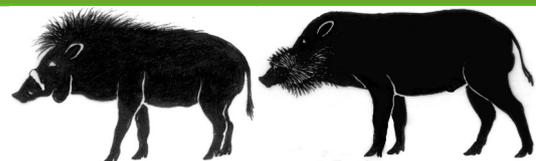


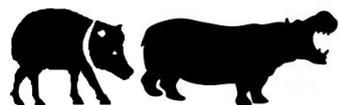
Fig. 8. Courtship. Male left, female right. Photo taken on 1950 m a.s.l. in November.

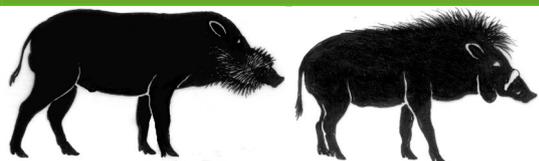
Photo: C. Schlawe

According to locals, none of these poachers lives in villages around the Lkest Massif, as no one here owns a rifle. People are generally poorer and most do not dare to disrespect the law. The few local poachers are unarmed and focus on trapping species such as porcupine (*Hystrix cristata*), hoopoe (*Upupa epops*), and ravens (*Corvus corax*), which they sell to witchdoctors further North. These species have become rare in Morocco as a consequence of poaching.

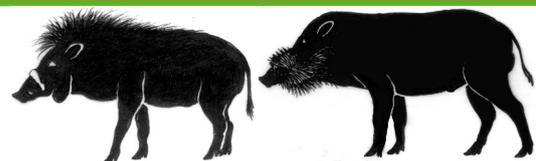
Supplementing literature

- Alport, E. A. 1964. The Ammeln. The Journal of the Royal Anthropological Institute of Great Britain and Ireland, 94(2): 160-171.
- Boumendjel, F. Z., Hajji, G. E. M., Valqui, J., & Bouslama, Z. 2016. The Hunting Trends of Wild Boar (*Sus scrofa*) Hunters in Northeastern Algeria. Wildlife Biology in Practice 12(2).
- Cuzin, Fabrice. 2003. Les grands mammifères du Maroc méridional (Haut Atlas, Anti Atlas et Sahara): distribution, écologie et conservation. Doct.dissertation. Université Montpellier II.
- Cuzin, F., Bergier, P., & Thevenot, M. 2011. Les observations de Sangliers *Sus scrofa* dans le Sahara Atlantique marocain. Sahara, 11: 3.
- Fernández-Llario, P., & Mateos-Quesada, P. 2005. Influence of rainfall on the breeding biology of wild boar (*Sus scrofa*) in a Mediterranean ecosystem. FOLIA ZOOLOGICA-PRAHA, 54(3): 240.
- Hajji, G. E. M., & Zachos, F. E. 2011. Mitochondrial and nuclear DNA analyses reveal pronounced genetic structuring in Tunisian wild boar *Sus scrofa*. European Journal of Wildlife Research, 57(3): 449-456.
- Keuling, O., Podgórski, T., Monaco, A., Melletti, M., Merta, D., Albrycht, M., . . . Gongora, J. 2017. Eurasian Wild Boar *Sus scrofa* (Linnaeus, 1758). Pp. 202-233 in: M. Melletti & E. Meijaard (eds.), Ecology, Conservation and Management of Wild Pigs and Peccaries. Cambridge University Press, Cambridge.
- Msanda F, El Aboudi A, Peltier JP. 2002. Originalite de la flore et de la vegetation de l'Anti-Atlas sud-occidental (Maroc). Feddes Repertorium: Zeitschrift für botanische Taxonomie und Geobotanik 113(78): 603-615.





Ecology and Conservation



Babirusa (*Babyrousa* spp.) on Buru and the Sula Islands, Maluku, Indonesia

by Alastair A. Macdonald¹, Victor Kailuhu² and Meytty J. Pattikawa²

¹Royal (Dick) School of Veterinary Studies, The University of Edinburgh, Easter Bush Campus, Midlothian EH25 9RG, Scotland, Alastair.Macdonald@ed.ac.uk

²MY Tours & Travel, Ambon, Maluku, Indonesia

Abstract

Babirusa (*Babyrousa* spp.) are present on Buru and the Sula Islands of Taliabu and Mangole, but no longer on the island of Sanana. The babirusa on Taliabu exhibit skin and hair colour variation. The young animals of both sexes have black to dark reddish hair colour whereas older female animals were routinely reported to be white or grey in colour; males were said to be white, or black, or yellowish black in colour. Their numbers have significantly reduced during the life-times of current Taliabu residents, from 'plentiful' to 'rarely seen'. Commercial timber extraction has changed the Taliabu and Mangole landscapes with the removal of large numbers of mature *Shorea* spp. trees. Babirusa appear to rely on the fruit production of these and other large tree species for food supplies during pregnancy and lactation. This period was said to extend until July. Local differences in the words used to describe babirusa suggest further professional research of animal and plant nomenclature on Buru and the Sula Islands may reveal hidden aspects of inter-island human movement.

Introduction

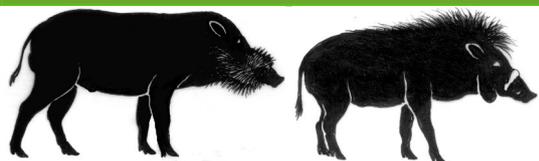
The Sula Islands are part of the Maluku archipelago in east Indonesia. They are situated to the north-west of Buru (Figure 1). To the west of them lie the Banggai Islands, and west again, across the Peleng Strait, lies the eastern peninsula of Sulawesi. The three largest Sula Islands are Taliabu (301600 ha), Mangole (129900 ha) and Sanana (52400 ha). These accommodate three designated Nature Reserves: on Pulau Sehu (1250 ha), in the sea off north Taliabu including Pulau Yenga and Pulau Kaibihu (70,000 ha) and Pulau Lifamatola (1691 ha). Although few foreigners have been drawn to the Sula Islands, it was known to Europeans for over three centuries that the babirusa (*Babyrousa* sp.) lived there as well as on Buru Island (Valentijn 1726; Deninger, 1910).

Perhaps the first publication of an image of a babirusa on the Sula Islands is that of a young animal (Figure 2) photographed on Sanana in the grounds of the Dutch administrators (van Hulstijn, 1918). Earlier in the 1900s a pair of young babirusa had been brought from the Sula Islands to Amsterdam zoo (Anonymous, 1916; Mohr, 1960). Since then only scattered pieces of information about babirusa on the Sula Islands have been published. They have mainly come from administrators, visiting anthropologists, linguists and ornithologists (van Hulstijn, 1918;



Fig. 1: Geography of Ambon, Buru, Sula Islands and East Sulawesi. Source: Wikipedia





Ecology and Conservation

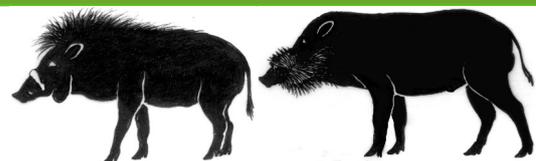


Fig. 2: Young babirusa in the Sanana administration compound (van Hulstijn, 1918).

Fortgens, 1921; Collins, 1989; Davidson et al, 1993; Verbelen, 2003; Eaton and Hutchinson, 2015). Several contributions have also come from mammalogists (Patry, 1992; Flannery, 1995; Mustari, 2009). A summary of available information concerning the biology of the Moluccan babirusa *Babyrusa babyrussa* (Linnaeus, 1758) was recently published by Sheherazade & Mochamad Indrawan (2018). Additional observations, describing the biology and distribution of babirusa on Buru, were recently published by Tjiu and Macdonald, (2016) and Macdonald and Pattikawa (2017a, b).

The population of east Buru is mixed Christian and Muslim. The human population on the Sula Islands is largely Muslim. However, as with central Buru there are also indigenous people. One of our correspondents, Mr T (56 years old), said that there were originally three tribes on Taliabu: the Mangee in the west of the island, who he said no longer exist as such; the Kadai who are spread all over Taliabu, and the Siboyo who are from the southern central parts of Taliabu.

The aim of the visit was to gather as much local information about the babirusa and other wild pigs on the Sula Islands, and where-ever possible, to add to our understanding of their biology and distribution there.

Materials and Methods

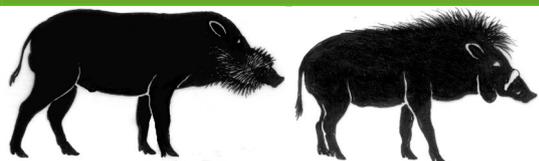
Two visits were made to the Sula Islands. The first 'scoping' visit was made between 7 and 22 June 2017. At that time the weather was very unfavourable, with high winds and heavy rain making travel and investigation difficult. The second visit was made to Buru and the Sula Islands between 30 May and 23 June 2018; the weather this time was much better. Information about the local botany and mammalian zoology was gathered during general conversations with local people everywhere we went. We also took four Browning Recon Force Advantage trail cameras (Cameras 1-4) and one Browning Recon Force Extreme trail camera (Camera 5) with us in 2018.

Buru

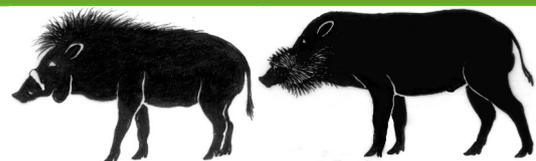
We first went to Buru (Figure 1) and took the ferry from Namlea to Kaiyeli. We walked 12 km east of Kaiyeli into the hills. There we placed Camera 1 where two wildlife paths met. The location of Camera 2 was nearby, down river about 500 m. Camera 5 was taken about 11 km south-east of Kaiyeli into the hills and placed on a pathway containing babirusa footprints. All three cameras were about 60-100 m above sea level.

We placed Camera 3 in the forest on the east side of Sehu Island about 30 minutes walk from the beach. Camera 4 was placed in the hills about 14km NNE of Bobong.





Ecology and Conservation



Observations were made as we sailed up the east coast of the island Sanana to the town of Sanana (Figure 3) where a boat connection was fortuitously at the quay. We transferred and sailed north and then westwards along the south coast of Mangole to the village of Pasipa (Figure 4). Darkness prevented any more coast watching and the boat travelled north between the islands of Mangole and Taliabu and then westwards again along the north coast of the latter to Jorioga village (Figure 4), where it stopped until dawn. Observations of the coastal geography continued along the rest of the north and west coasts of Taliabu until the boat docked in Bobong, on the island's south-west corner (Figure 4).



Fig. 3: The town of Sanana and surrounding landscape.
Source: Landsat/ Copernicus satellite



Fig. 4: Map of Taliabu with the villages mentioned in the text.
Source: Landsat/ Copernicus satellite

Results

Buru

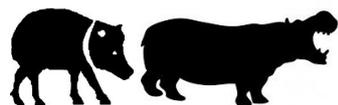
Cameras 1 was in place for 20 days and recorded wild pig movement. On the 12th June a sub-adult male, an adult female wild and two juvenile (*Sus*) pigs were photographed (Figure 5). They were grey in colour and had black manes on their head and neck. Body hair appeared to be short. Earlier that afternoon a group of seven wild (*Sus*) pigs had also been photographed in the same location. Shortly after daybreak on the 5th June, a solitary young female babirusa was recorded, and then later that afternoon a group of two adult babirusa females, two juveniles and an adult male walked along the same path (Figure 6). The adults were grey in colour, had relatively short

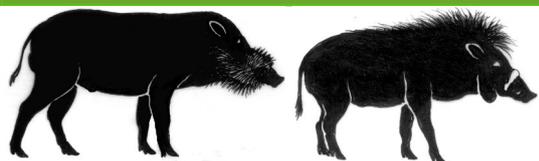


Fig. 5: Trail-camera image of adult female and sub-adult male *Sus* pigs. Photo: A. A. Macdonald

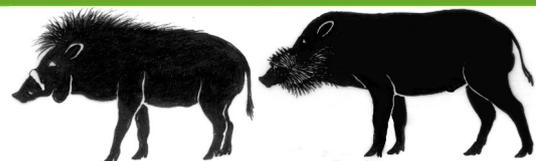


Fig. 6: Trail camera image of male, two juvenile and two adult female babirusa (*Babyrusa* sp.). Photo: A. A. Macdonald





Ecology and Conservation



hair and appeared to have come from partial immersion in water or a wallow. The lower half of the face and nose of the adult male were also wet. The two young babirusa were black in colour, also with fairly short hair. The adult male was seen to briefly wipe the side of his face against the lower trunk of a young tree as he passed (Figure 7).

Sanana Island

The wild suid remaining on Sanana is the wild (*Sus* sp.) pig, referred to locally as Haitamina. In Mangon village the wild (*Sus*) pig was described by fish seller, Pak AK (48 years) as being dangerous and caused damage to crops. In Wailau village the babirusa was recognised by farmer Pak F (32 years) but was said to be a mystic animal. Ibu UB (83 years) remembered an elderly relative telling her about the babirusa when she was a girl in Face village (now part of Sanana town, Figure 3), but she had never seen one. She had forgotten the local word they had earlier used for babirusa.

Mangole Island

A group of men from Pasipa Island, between Mangole and Taliabu (Figure 4), reported that although none of them had seen babirusa they knew about it from stories from their parents. It had grey or white skin, with not much hair. Now that there are more Muslims on Mangole the babirusa is not as frequently seen. An elderly gentleman from Mangole, spoken to at the harbour in Sanana town, said that his parents had told him about babirusa on Mangole but he had never seen one. He lived in a fishing village and said that all the villages on the south coast were populated by people with the Muslim faith. Mr E in Sanana town said that timber extraction from Mangole had gone on for most of his life, but had stopped in 2009. Babirusa may be found in the forested hills.

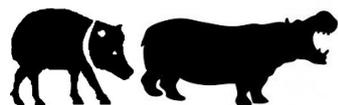
Taliabu Island

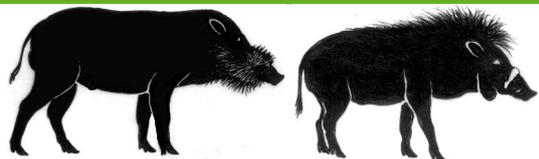
The tale of the origin of the babirusa was recounted by Pak T from the small village of Lankuba on Sehu Island. The babirusa had originally come to Sehu island by falling as an adult animal from 'Heaven' [Khayangan]. The local people said that this was one reason why the babirusa on that island always walk with their heads held down; 'they cannot look up to the sky'. [Thus they were never said to stand on their hind limbs as that would make them look at the sky.] It was said that the body of the [newly descended] babirusa was firm but weak. Yellowish-coloured left-over food was found in its stomach. Pak R, from south Taliabu, told a similar story, except that the food found in the stomach was yellow rice.

Ibu E (46 years) from Sofan (Figure 4) said that the babirusa had softer skin and meat than the wild pig. She said that the animal is still hunted there, but it is now 18 years ago since she last

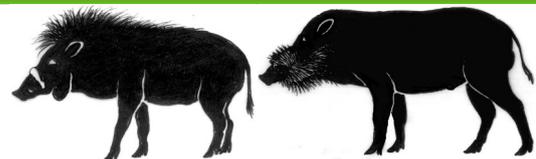


Fig. 7: Trail camera image of an adult male babirusa (*Babyrousa* sp.) face-rubbing a tree trunk: Photo: A. A. Macdonald





Ecology and Conservation



saw one. There is also the story that one was kept as a pet in the same village about a generation ago. Pak IW (49 years) from Tabona village (Figure 4) reported that babirusa are still hunted by the indigenous people, and that the skin has a brownish to grey colour.

At Loseng village a man, married to a lady from Arkadai village (Figure 4), said that babirusa were regularly hunted by the men there and that there were many babirusa. A boatman from Arkadai said that three of his friends are indigenous people and that they hunted babirusa. He said that they call the babirusa piglet Tagaligu baredek and the young male babirusa with curled teeth Laco. Baredek = black. Pak S (71 years), from Bobong town, said that the local name for babirusa was Yaba tu [real pig] (Yaba = pig; tu = real). He said that the wild (*Sus*) pig was referred to as Yaba bredek. More detailed lists of terms relating to the babirusa were recorded from small villages later (see below).

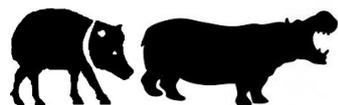
The man from Arkadai said that the babirusa does less harm than the wild (*Sus*) pig because it runs away when it sees humans; the wild (*Sus*) pig will attack people. One man said that it is easy to control the male babirusa when it is trapped, by holding onto its upper (maxillary) canine teeth. Conversely, it is not so easy to hold onto the female as she will wriggle quite actively; there is no comparable 'hand hold' on her, and so the female more often escapes. Females that are caught are therefore rapidly tied up with rattan (see Figure 10 below).

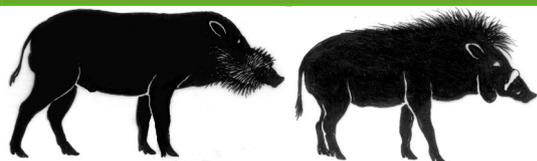
Mantarara is a Christian village and it was said that there are many there who hunt for a living. This could not be personally confirmed, however.

In Bobong we talked to Ibu A (73 years) whose husband had been a school teacher. They had travelled to many places on Taliabu and she said that most people knew about the babirusa. She remembered seeing one being brought to the village on the shoulders on a man, and its skin was grey and the hair was shorter than of the wild (*Sus*) pig. Pak S said that at his wife's village, Sumbong, Pak P kept a babirusa as a pet. It only ate clean food and did not dig in the ground. It ate fruits. The villagers kept it in a cave and it wandered freely around the village like a dog. Pak S said that the skin was smooth and soft. Pak A (23 years) said that babirusa come to the beach to eat crabs.

On Sehu Island (Figure 4) a local lady with two small girls said that the babirusa skin was soft, like that of the dugong (*Dugong dugong*) and coloured brownish like that of the water buffalo (*Bubalus bubalis*). It is found in groups of up to 3 and has 1-2 piglets. When it fights with dogs it only attacks their lower body. Pak T said that the babirusa can dive and stay under the surface of the water for a long time (up to one hour!) to avoid hunters. Pak A (25 years) also said this, and said that it was to avoid the hunters' dogs.

In late June a pregnant female was hunted by Pak A and the two piglets inside her were said to be without hair. However, both male and female piglets up to about two months of age are said to have reddish-brown hair. Young adult females were said to have a white chest and a white stripe on their head, and a grey coloured back. The old female is said to be white in colour. Adult male babirusa are described as black-yellowish in colour with smooth hair. Their hair is mostly on their head and shoulders; very old adult males have hardly any hair left.





Ecology and Conservation

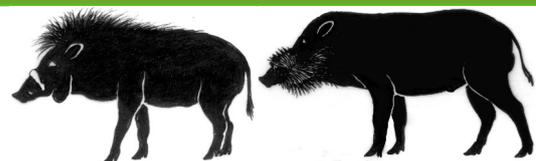


Fig. 8: Nest of leaves and small branches found on Sehu Island. Photo: A. Kapitan

Sleeping nests are reportedly made from leaves and branches cut off low-lying leafy plants (Figure 8).

Food plants are said to include the Hosa (*Castanopsis buruensis*). This tall tree produces small hazel-nut sized seeds inside a very spiky pericarp (Figure 9). Although small in size the nut's endosperm appeared to be energy-rich [its texture and taste were a bit like those of the Canari (*Canarium indicum*)]. We saw many on the ground in June. This was said to be a preferred food of the babirusa, and on Taliabu the babirusa were said (by Mr CF) to be trapped specifically around this tree. The seeds of the red and white Meranti trees (*Shorea* spp) are also eaten, as are the seeds of the Katoan tree (scientific name not known). Ta meking (scientific name not known) is the local name for another fruiting tree growing in the forest locally. There are three plants with the name Galoba, the first of which is the same as on Buru and Seram (*Hornstedtia rumphii*). The next has a 'tennis-ball' sized fruit (scientific name not known), and

the third has a larger fruit (scientific name not known). Neither of these latter two fruits was seen. Caladi hutan (*Homalomena alba*) leaves are also available, as is the vegetable called Haku (*Alsophylla glauca*). We noted that Figs (*Ficus* spp.), called Samuyu locally, were fruiting in June 2018.

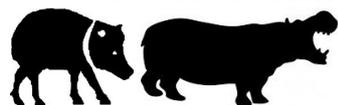
The babirusa vocalises when looking for food, making a rapidly repeated ka-ka-ka-ka-ka sound which guides the hunters in that direction. It was a sound typical of the babirusa, they said.

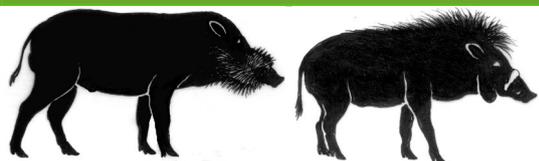


Fig. 9: Leaf, open seed, nut and pericarp of Hosa (*Castanopsis buruensis*). Photo: M. J. Pattikawa

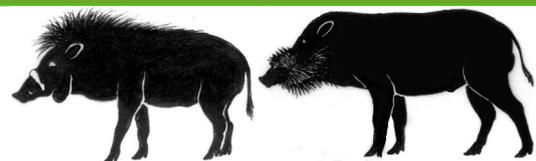
The babirusa have never been seen standing on their hind limbs by the local people. There were also no reports of their agonistic behaviour. Although Pak A said that he had never seen small trees where the babirusa had worn away the bark, the older Pak T said that there were many on Sehu Island. He said that they were used to sharpen the (canine) teeth of the babirusa.

The season of babirusa reproduction in west Taliabu was said to be during the 'west wind' season (October to March) and to extend through May until July. This coincided with the availability of tree seeds such as the Hosa (Figure 9). Babirusa were said to get fatter at this time of year. Pak T





Ecology and Conservation



said that the fat on its body was yellow in colour and comprised up to seven layers. No specific sounds related to mating behaviour was reported locally by people who hunted with dogs.

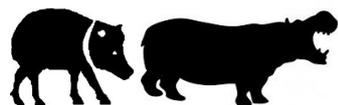
Ibu N (54 years) said that her aunt had kept an adult male babirusa as a pet in the old village of Langkuba on Sehu Island. Ibu N had subsequently had two babirusa herself. The first was a reddish-coloured female found as a piglet. It became a long-term household pet and followed her around everywhere. Sadly, it was eventually killed by a village dog. The second piglet was said to have been a black-coloured male babirusa found at Fandasan village on Sehu Island. In 1988 Ibu N took it from Sehu Island to Wayo village on Taliabu, but after one month in her care it had not been tamed like the first one, and it ran away.

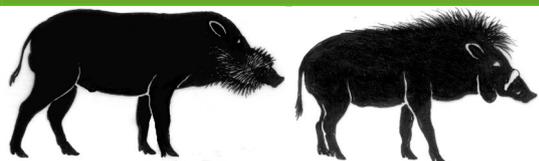
One of the dogs in a hill village North-east of Bobong caught a juvenile female babirusa (crown-rump length = 50 cm) on the morning of the 18th June, the day we were leaving Taliabu (Figure 10). She had 1 cm long black hair on most of her body with a few pale-coloured hairs ventrally. The dorsal skin colour was dark with a pale stripe apparent over the thoracic and abdominal vertebrae, accentuated by pale-coloured hairs (Figure 10b). The skin ventrally over the head, neck, thorax, lower fore-limbs, abdomen, medial hind-limbs and caudally was pale in colour.



Fig. 10: Juvenile babirusa (*Babyrousa* sp.) from west Taliabu: (a) left lateral view of the head and shoulders; (b) the skin and hair along the dorsal surface (Tail to left, head to right). Photos: A. A. Macdonald

We also obtained copies of six photographs of a young adult male babirusa killed on the 20th August 2017 near Ratahaya village by one of the dogs belonging to Pak LK (30 years) (Figure 5). The dog was white in colour and had been attacked by the babirusa and killed by puncture wounds to its lungs; the babirusa was itself killed by the same dog. It is generally recognised that babirusa will specifically attack white-coloured dogs; most dogs that hunters use are pale brown in colour. The babirusa was pale brown-skinned over its head and fore quarters and grey-brown on its hind quarters (Figure 11a,b). Hair colour was orange-brown over its head and shoulders, and an orange-brown stripe ran along the dorsum as far as the pelvis. The hair colour on either side of this stripe was mixed black and orange-brown, becoming increasingly orange-brown over the thorax and dark grey over the upper abdomen and thighs. The ventral surfaces appeared orange-brown. The hair of its head and shoulders was short (ca. 1 cm), but longer than elsewhere on its body (< 0.5 cm) (Figure 12). The snout had few hairs. The maxillary canine teeth showed rubbing-wear on their lateral surfaces (Figure 13a,b).





Ecology and Conservation

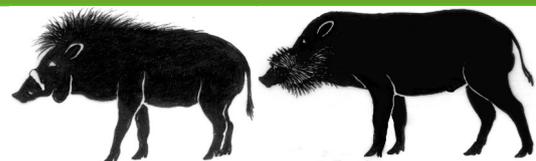


Fig. 11: Adult male babirusa (*Babryrousa* sp.) from west Taliabu: (a) Cranial view of the b) caudal view. Photos: A. Kapitan

died. The assigned cause was because the new owner had not carried it so that its face looked down (see 'origin story' above). Pak LT said that a long time ago, before so many people had come to Taliabu, he had seen babirusa come down to the beach and drink sea water.

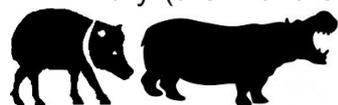
Pak R said that the babirusa had 5-6 'body layers', its flesh was 'thick' and that the fat was yellowish in colour. The hair of the babirusa was very smooth. He said that the reason why the meat smells better than that of the wild (*Sus*) pig was because the babirusa ate nicely-smelling fruit. Pak R also said that the food eaten by babirusa included wild durian (*Durio* spp.) [Mposa = Hosa] and the leaves of wild Siri. He also said that the young shoots of a wild [ubi-like] root plant were eaten by babirusa. Pak LT said the the babirusa will use its fore feet to scratch at the sandy soil to get access to the young shoots. Pak R also said that very old female babirusa could have maxillary canine teeth.

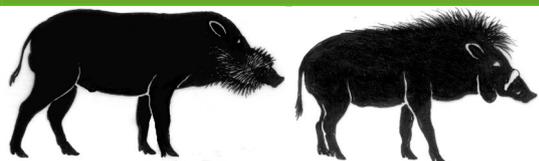
Pak BL (40 years) was born and raised in Ratahaya village, West Taliabu (Figure 4). When he was a boy the babirusa used to freely walk close to his (then) small village. He said that the babirusa are fat at this time of year (June) because they are eating the fruit of the large timber trees (*Shorea* spp). When the 'west season' comes, the sea is calm, there is less wind and it is dry (the months of October to March). The body of the babirusa becomes thinner at that time of

Pak LK, from Kilo village in south Taliabu (Figure 4), said that there are babirusa there, but they are now quite far from the villages. He said that the food they ate was the same as in west Taliabu. Pak R, also from Kilo village, said that he had known a man who kept two black-coloured babirusa as pets for a long time. However, they eventually ran away. This was confirmed by the school teacher from South Maluku, Pak LT (60 years), who had been assigned to various villages in Taliabu during his 30 years before retirement. Pak LT said that the pet babirusa would always eventually run away. Pak LT had himself had a babirusa piglet as a pet, but gave it to someone who asked for it. Sadly, despite good care, the piglet soon

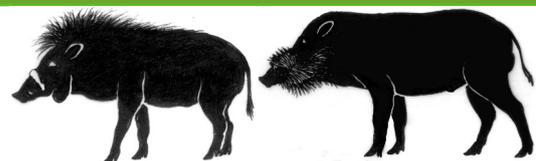


Fig. 12: Right lateral view of the head of the adult male babirusa (*Babryrousa* sp.) from west Taliabu in Fig. 9. Photo: S. Dagaso





Ecology and Conservation



year because there is less food available. The babirusa then eat worms [invertebrates]. He had never seen babirusa fight, but he had heard them make a soft cry when they appeared to be competing with one another for food.

Many correspondents made comments about the much changed, and reduced predictability, of the local weather; we experienced two radically different weather patterns in 2017 and 2018 during the same calendar period of the year (May-June).

Language results

The following words describing the babirusa were collected in the small village of Lankuba on Sehu Island:

Tagasa = babirusa piglets up to about two months of age. Both males and females have reddish-brown hair.

Tutu = subadult male babirusa.

Paka koyong = adult male babirusa.

Fulung butu haya = very old adult male babirusa which has hardly any hair left.

Paka koyong lanki and Paka koyong rata are even older adult male babirusa.

Kalahang mania = female babirusa which has produced young, and has a white strip on her head. and a white chest. Her back is grey in colour.

Tina hete = old female babirusa which is white in colour.

Wai yuyu = maxillary canine tooth of babirusa.

Ngeo = mandibular canine tooth of babirusa.

Jomong = babirusa sleeping nest.

The following words describing the babirusa were collected from Pak BL in Ratahaya village on west Taliabu:

Sumbada = juvenile male babirusa piglet with teeth pushing up under the skin. The skin colour is brownish like that of the water buffalo, and with not much hair.

Bubung kepoa = juvenile male babirusa with teeth through the skin about 80 mm. Skin colour is still like that of the water buffalo.

Tutu = subadult male babirusa with curled teeth. Skin dark with a white stripe on the forehead and down the spine.

Paka koyong = mature adult male babirusa with white skin.

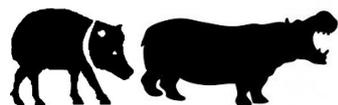
Kelahang maniang = adult female babirusa with white chest. No canine teeth.

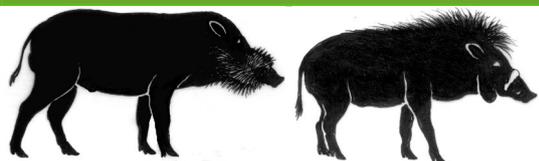
Bohi = adult female babirusa with white skin all over.



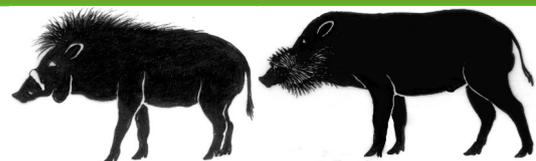
Fig. 13: (a) Left and (b) Right maxillary canine teeth of the adult male babirusa (*Babyrousa* sp.) from west Taliabu in Fig. 9.

Photos: A. A. Macdonald





Ecology and Conservation



Tina hete = old female babirusa.
Ntuka = pregnant female babirusa.

Another correspondent, CF, in Bobong town reported:

Tutu = mature adult male babirusa.

Welu = juvenile male babirusa.

Tina hete ntuka = pregnant female babirusa.

The skulls of three male and one old female babirusa from west Taliabu were examined and photographed (Figure 14). The mandible of an additional adult male was also photographed. The maxillary teeth of the males showed wear on their lateral surfaces.



Fig. 14. Skull of an old female babirusa (*Babirusa* sp.) from west

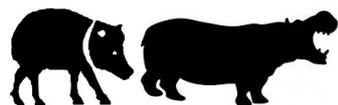
Taliabu. Photo: M. J. Pattikawa

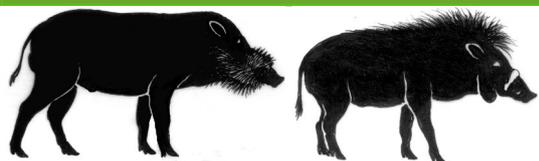
Discussion

The results of this study have added to the information currently available about the babirusa on Buru, and of the Sula Islands, mainly those on Taliabu. Initial views of the three Sula islands from the sea suggested that although the land around villages had been cleared for tree and other crop production, there appeared to be areas of habitat suitable for babirusa. These were generally at higher altitudes, on both Taliabu and Mangole, but were not on Sanana Island (Figure 3). Flannery (1995) reported that his

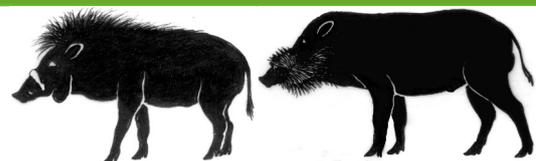
correspondents were unanimous that the babirusa did not occur on Sanana - and as far as they knew had never occurred there. It was also soon clear from our visits to Sanana that local memories of the babirusa had largely disappeared following the extirpation of the animal. Bishop Sol of Ambon had earlier indicated (personal communication, 1986) that he had been presented with 'the mandible of the last babirusa on Sanana'. Local people indicated that with the forest largely removed from that island, attention was being more focused on produce from the sea.

The two species of wild pigs on Taliabu are hunted with dogs. Some trapping is also being carried out. The impact of hunting on the wild population of both pig species was once deemed to be relatively slight, but within the last 40 years was seen to have been variable (Davidson et al, 1993; current study). However, tree cutting for timber production has reportedly had a widespread and significant impact on the distribution of forest cover (Davidson et al, 1993, 1995; current study). Indeed the scale of the timber extraction over the last 60 years might be best estimated after analyses of a large number of black and white aerial photographs of the Sula Islands that were taken by the United States Navy between 1944 and 1948 (Keogh, 1995). These are catalogued as I.E. 3 (231 photos of Taliabu and Mangole, not dated, altitude 17,000 ft), and I.E.22 (351 photos of Taliabu, Mangole and Sanana, 1948, altitude 26,000 ft) in the Hamilton Library of the University of Hawai'i, Manoa. No comparable aerial photographs of Buru appear to have been made (or to have survived storage). In addition, Pak S (27 years), who lives in North Taliabu, said that the arrival of many people of Muslim faith meant that the local interest in babirusa had been





Ecology and Conservation

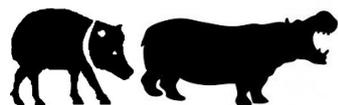


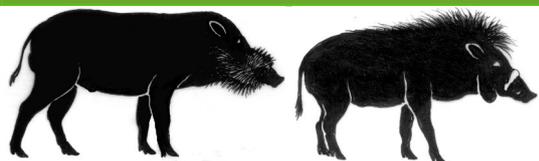
much reduced. As a result, not so many pigs were being seen in the villages. Formally forested land around these expanded and new villages has now been converted to fruit and spice tree crops as well as vegetable gardens. We noted that the mountain people continue to occasionally take babirusa when they hunt for the more commonly available wild (*Sus*) pig.

A number of our correspondents on Taliabu reported individual experiences of babirusa being kept as house pets. Davidson et al (1993) had also reported one. Historically there have been reports of babirusa from Buru being kept as pets (Macdonald and Pattikawa, 2017b), as well as tales of inter-island gift-giving of babirusa by officials. Our recent evidence of the inter-island transport of a young male babirusa, which then escaped while on Taliabu corresponded to the suggestion by van Hulstijn (1918) that babirusa may have been brought to the Sula Islands by human beings. The reports that several of the recently-known 'pet babirusa' had subsequently escaped into the forest contributed to the impression that the genetic make-up of the Sula Island babirusa may be quite variable. This would appear to be supported by the reported variation in adult babirusa skin and hair colour; from white through yellowish and reddish brown to black. It would also seem that this variation may be partially sex-linked, with adult females often described as white or grey, and adult males coloured from white through yellow-brown to black. Young babirusa were noted to be dark in colour (Figures 2 & 10). There is currently considerable fluidity of human population movement from East Sulawesi and the Banggai islands to the Sula Islands. This is not new; there is published evidence of a large population movement from Ternate to the Sula Islands in 1650, for example (van Hulstijn, 1918).

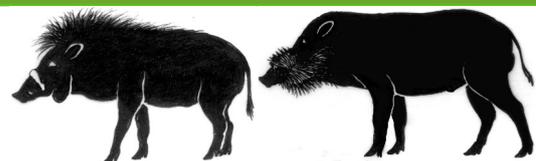
This study added to our knowledge of babirusa on Buru (Macdonald and Pattikawa, 2017b). There is now more evidence that the adult babirusa found in east Buru are grey in colour (Figure 6). We have also learned that the young babirusa are dark/black haired (Figure 6). This discovery helps to explain the confusion shown to us last year by some wild (*Sus*) pig hunters contracted to remove crop-raiding 'black pigs'. The differences in hair length of the wild (*Sus*) pigs seen this year (Figure 5) compared with those seen last year suggested that this may represent evidence of significant cross-breeding of domestic, feral and wild *Sus* pigs sometime in the past. The video pictures also suggested that the adult male babirusa on Buru may employ 'ploughing' and 'tree marking' behaviours to communicate his presence to other male babirusa (Leus et al, 1996; Macdonald, 2016).

This study also revealed various different aspects of the biology of the babirusa on Buru and west Taliabu Island. It demonstrated the appearance of young and adult babirusa (Figures 10 & 11). Although there appeared to be some similarities in appearance between the young babirusa of Buru and Taliabu (Figures 6 & 10), there was also some evidence of differences; these were particularly obvious in the appearance of adult babirusa (Figures 6 & 11). The available evidence was suggestive that the pregnancy and birth of young babirusa were timed to coincide with the availability of energy-rich food resources (e.g. Hosa fruit). This corresponded to the earlier findings from Buru (Macdonald and Pattikawa, 2017b). Some of the food plants on Taliabu used by babirusa were also found on Buru (e.g. Meranti, *Shorea* spp. & Hosa *Castanopsis buruensis*). This is an area of botanical and seed [nutrient] composition research worthy of very much more detailed and rigorous investigation. Many of the plants used as food by the babirusa on the Buru and Sula Islands have necessarily remained unstudied and unreported. This was due to the





Ecology and Conservation



specific and restricted time of year (May-June) for the current cursory visits. Co-ordinated zoological and botanical investigation of each of the islands at other times of year would add considerably to an understanding of the annual pattern of babirusa food-plant and nutrient availability. Patterns of change in local weather would also be worthy of study in this connection. Similarly, close study of the babirusa on the Sula Islands would yield more comparative information about other aspects of their biology, such as their agonistic behaviour (Macdonald et al, 1993) and the construction of sleeping nests (Ito et al, in press).

Almost no information was gathered about the biology of babirusa on Mangole Island. This was largely due to the vague nature of inter-village boat accessibility on the island and the consequential relative lack of access to appropriate correspondents. It had earlier been reported that the people on that island preferred to hunt for deer, both for their skins and their meat, which they relished (van Hulstijn, 1918). Flannery (1995) indicated that he had been told that babirusa were abundant on Lifamatola, the island to the east of Mangole. Maurice Patry, having been similarly advised, had visited the island but found no babirusa there (Patry, 1992). Currently the coastal population of Mangoli is largely of the Muslim faith.

Local Taliabu knowledge of babirusa behaviour appeared to be restricted by the manner in which wild pigs were hunted on Taliabu. The accompaniment of dogs during hunts precluded the observation of several behavioural characteristics of babirusa known from those on other islands (Macdonald and Pattikawa, 2017b; Macdonald, 2018). The babirusa on Taliabu ran away as soon as they heard the dogs barking. Absence of dogs has enabled the hunter/observer to get somewhat closer to the animal. For example, one young adult male babirusa, white in colour and about 0.75m tall at the shoulder, was seen by Davidson et al (1993, 1995) in montane forest, 850m above Menanga village, about half way along the north of Taliabu (Figure 5). Verbelen (2003) likewise saw an adult male babirusa in the forest above Menanga village. Nevertheless, the wear patterns found on the maxillary teeth of the adult male skulls were consistent with marking behaviour on trees (Macdonald, 2016; Macdonald and Pattikawa, 2017b). Tree abrasion was reported to us, and this was recognised locally as due to 'tooth sharpening' behaviour.

We are not competent to analyse in detail the linguistics of the babirusa-related words we have assembled. Grimes (1991) defined the dialects spoken on Taliabu as Padang (Samada), Mananga and Mangei (Mange'e, Mange, Mang, Soboyo, Sobojo). It seemed relevant to bring together here as much of this type of Taliabu-based information as possible. Collins (1989) recorded a number of the words that were associated with the babirusa and used by the people living about half way along the south of Taliabu, in the Soboyo-speaking region (van Hulstijn, 1918).

Guan = babirusa (in general)

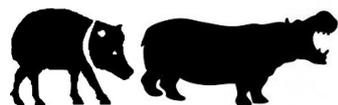
Tagaligu baredek = juvenile male with no maxillary canine teeth showing.

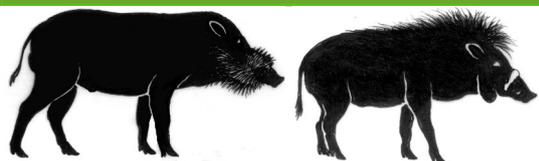
Sun fuku = young male with maxillary canine teeth almost through the skin.

Bubun gapuak = young male with maxillary canine teeth just through the skin.

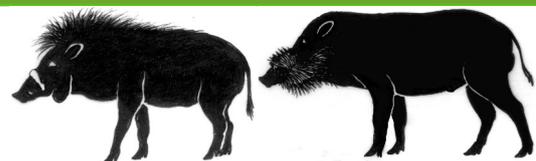
Lakon = adult male with maxillary canine teeth curled over the nose.

Sipan = mature adult male with maxillary teeth extended almost to the eye.





Ecology and Conservation



This small collection referred only to the male babirusa. The term Tagaligu baredek was also used by the men from Arkadai. Their word 'Lako' was comparable to Lakon reported by Collins (1989).

We noted that our collection of words from West Taliabu and the small island of Sehu were very different from those those gathered from the south of Taliabu island. It was also note-worthy that some of the Sehu Island words were not mentioned by our correspondents on the western part of Taliabu, and visa-versa. Although the people on Sehu Island were recognised by van Hulstijn (1918) as being distinct from those on neighbouring west Taliabu, the word differences we recorded were more probably due to random variation in the word collection process.

Earlier, Davidson et al (1993) had kindly gathered for us the 'babirusa terminology' encountered during their bird studies on Taliabu. They collected the following:

Bubung kepoa = infant male.

Kofa koantang = juvenile male with small straight teeth.

Tutu = male with short curved teeth.

Pakikoyong = young sub-adult male.

Sepang = adult male with long curved teeth.

Wela = adult male with maxillary canine teeth that cross over the snout.

Getipu haya = infant female.

Takalibu brede = juvenile female.

Kalaha menia = subadult female.

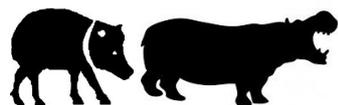
Mbohe = adult female after first pregnancy.

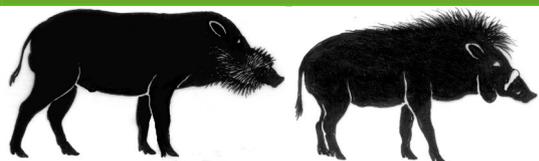
Mbohe ntuka = pregnant female.

Tinahete = mature or old female.

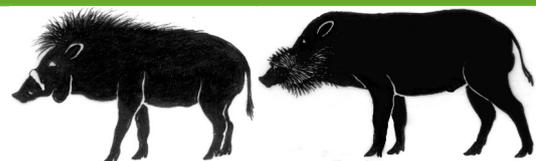
Their bird studies took them to five locations on Taliabu including Sehu and West Taliabu (Davidson et al, 1993, 1995). However, most of their time was spent at or in the hills, south-east of their Menanga base on the north of the island (Figure 2), with only short periods of time spent elsewhere including Hol Kemuning and Tubang in north and more easterly Taliabu. Although it is not clear where each word was collected, none of them were the same as those we collected in West Taliabu. However, the word Sepang did correspond to the Siboyo word Sipan, describing a mature adult male babirusa (Collins, 1989). It is therefore conceivable that there may be other Siboyo words in the collection made by Davidson et al (1993).

It would be of interest to us for others (linguists?) to explore the regional variation in words used to describe plants and animals (specifically the babirusa) in the local environments of the Sula and Buru Islands. It seemed possible to us that these words might be either locally created, retained in their locality, or older imported words that reflected movement of specific groups of people into specific, segregated localities. Our present lack of access to published language resources prevented us from exploring this topic further. We noted that the language used on the south coast of Mangole Island and the north of Sanana Island had been designated as Mangoli (Grimes & Grimes, 1983). We felt sure that there is likely to be comparable lists of words describing babirusa on Mangole Island equivalent to but possibly different from those found on





Ecology and Conservation



Taliabu, and that these may still remain in current usage. Sadly, however, it is highly likely that the words for babirusa, once used regularly on Sanana Island, may now be remembered by only a few of its older inhabitants, and that these may be about to be lost forever.

Conclusions

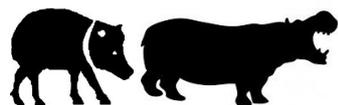
The brief visits made to Buru and Taliabu in 2017 and 2018 were sufficiently long to obtain a preliminary 'glimpse' of the accessibility, geography, weather, vegetation and zoology of these islands. It also enabled us to experience the generous hospitality of their people and learn something of their languages. Personal experience of, and information about the babirusa was gathered from correspondents living on Buru, Sanana, Mangole, Taliabu and Sehu Islands, with most knowledge coming from Buru, Taliabu and Sehu Islands. Personal contact, favourable weather and frequency of boat connections regulated where and when widely spaced places on these islands could be visited. It was recognised that much more remained to be learned by well organised scientific visits to various locations on Buru, Mangole and Taliabu Islands, if spread over longer periods of time and throughout the year. The substantial removal of mature timber trees from Taliabu over the last 40 years, plus the more recent and focal increases in the human population have significantly reduced the appropriate habitat available for babirusa. Both processes are forecast to continue for the next five to ten years.

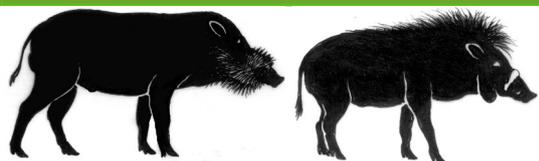
Acknowledgements

We gratefully thank all respondents from Buru and the Sula Islands that gave us encouragement, guidance, information, stories, accommodation, food, shelter and friendship during our travels. In particular 'pak Tita, 'pak Tude and 'pak Amos and their families were very hospitable and kind to us. The professional trail camera advice and support of 'Naturespy.org' Llangollen, Wales was very helpful indeed. Likewise, the supportive encouragement and technical expertise provided by Keith, Mark and Michel at 'Apple' on Princes Street, Edinburgh contributed to the success of the visit. We acknowledge with thanks the following organisations for their financial support: the Centre for the Conservation of Tropical Ungulates (CCTU); The Development Trust of the University of Edinburgh; the Community College Initiative Program of the USA (to MJP) and the Balloch Trust.

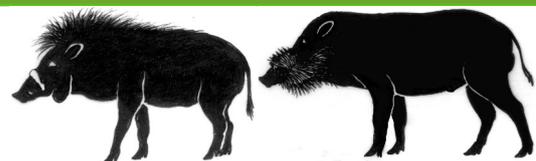
References

- Anonymous, 1916. Tijdschrift 'De Prins'. 2 September 1916. Uitgeverij N.J. Boon, Amsterdam.
- Collins, J. 1989. Notes on the language of Taliabo. *Oceanic Linguistics* 28: 75-95.
- Dammerman, K.W. 1929. Fauna Buruana; Mammalia, *Treubia*, 7, supplement 4, 149-164.
- Davidson, P.J., Lucking, R.S., Stones, A.S., Bean, N.J., Raharjaransari, H. and Banjaransari, H. 1993. Report on an ornithological survey of Taliabu, Indonesia with notes on the babirusa pig. University of East Anglia, pp. 49-51.
- Davidson, P.J., Stones, A.S. and Lucking, R.S. 1995. The conservation status of key bird species on Taliabu and the Sula Islands, Indonesia. *Bird Conservation International*, 5, 1-20.
- Deninger, K. 1910. Uber Babyrusa. *Berichte der Naturforschenden Gesellschaft zu Freiburg i. Br.* 18, 1-22.
- Eaton JD, and Hutchinson RO. 2015. Surveys on Buru and Taliabu fail to reveal sign of babirusa. *Suiform Soundings* 14:27.
- Flannery, T. 1995. *Mammals of the south-west Pacific and Moluccan islands*. Reed: Chatswood,

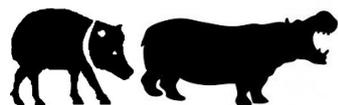


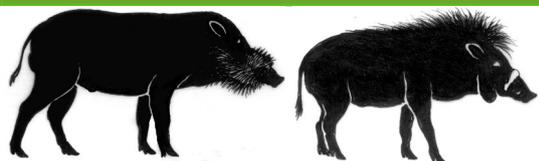


Ecology and Conservation

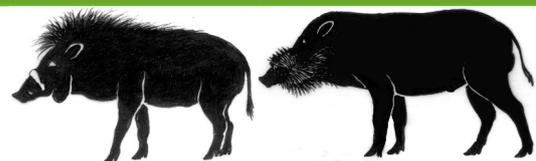


- New South Wales, pp:181-182.
- Fortgens, J. 1921. Bijdrage tot de kennis van het Sobojo: eiland Taliabo, Soela-Groep. Koninklijk Instituut voor Taal-, Land-, en Volkenkunde van Nederlandsch-Indie. Martinus Nijhoff. 's Gravenhage.
- Grimes, C & Grimes, B.D. 1983. Mangole. [MQC]. ethnologue.com, Indonesia, Maluku.
- Grimes, C. 1991. Taliabu. [TLV]. ethnologue.com, Indonesia, Maluku.
- Ito, M. & Melletti, M. 2018. Togian babirusa *Babyrousa togeanensis*. In (M. Melletti & E. Meijaard, Eds). Ecology, conservation and management of wild pigs and peccaries. Cambridge University Press: Cambridge, 76-84.
- Ito, M., Macdonald, A.A., Leus, K., Balik, I.W., Arimbawa, I.W.G.B. & Atmaja, I.D.G.A. Nesting behaviour of Sulawesi babirusa (*Babyrousa celebensis*). Japanese Journal of Zoo and Wildlife Medicine, (in press).
- Keogh, W.J. 1995. Historical aerial photographs of Maluku. Cakalele, 6, 93-102.
- Leus, K., Bland, K.P., Dhont, A.A. & Macdonald, A.A 1996. Ploughing behaviour of the babirusa (*Babyrousa babyrussa*) suggests a scent-marking function. Journal of Zoology, 238, 209-219.
- Macdonald, A.A. 2016. Erosion of canine teeth in babirusa (genus *Babyrousa*). Comptes Rendus Biologies, 340, 271-278.
- Macdonald, A.A. 2018. Sulawesi Babirusa *Babyrousa celebensis* (Deninger, 1909). Chapter 6, In (M. Melletti & E. Meijaard, Eds). Ecology, conservation and management of wild pigs and peccaries. Cambridge University Press: Cambridge, 76-84.
- Macdonald, A.A., Bowles, D., Bell, J. & Leus, K. 1993. Agonistic behaviour in captive babirusa (*Babyrousa babyrussa*). Zeitschrift fur Säugetierkunde, 58, 18-30.
- Macdonald, A.A., Leus, K. & Hoare, H. 2016. Maxillary canine tooth growth in babirusa (*Babyrousa* spp). Journal of Zoo and Aquarium Research, 4, 22-29.
- Macdonald, A.A. & Pattikawa, M.J. 2017a. There's a babirusa under my bed. iScot, July, 60-65.
- Macdonald, A.A. & Pattikawa, M.J. 2017b. Babirusa and other pigs on Buru Island, Maluku, Indonesia – new findings. Suiform Soundings, 16, 5-18.
- Macdonald, A.A. & Shaw, D. 2018. Maxillary tooth growth in the adult male babirusa (genus *Babyrousa*). Comptes Rendus Biologies, 341, 235-244.
- Mohr, E. 1960. Wilde Schweine. Neue Brehm-Bücherei no. 247. Wittenberg-Lutherstadt: Ziemsen Verlag.
- Mustari, H. 2009. Personal communication.
- Patry, M. 1992. Personal communication.
- Sheherazade, E. H. & Mochamad Indrawan 2018. Moluccan babirusa *Babyrousa babyrussa* (Linnaeus, 1758). In (M. Melletti & E. Meijaard, Eds). Ecology, conservation and management of wild pigs and peccaries. Cambridge University Press: Cambridge, 70-75.
- Tjiu, B. & Macdonald, A.A. 2016. Babirusa (*Babyrousa babyrussa*) on Buru island. Suiform Soundings, 15, 20-26.
- Valentijn, F. (1726) Oud en nieuw Oost-Indie. J. van Braam: Dordrecht/ Amsterdam 5: 268-269.
- Van Hulstijn, P. 1918. Memorie over de Soela-eilanden. Mededeelingen van het Bureau voor de Bestuurszaken der Buitenbezittingen bewerkt door het Encyclopaedisch Bureau. XV. Weltevreden: N.V. Boekhandel Visser & Co.
- Verbelen, F. 2003. Short communication: Babirusa sightings on Taliabu and Buru. Asian Wild Pig News, 3, 13.





Ecology and Conservation



The return of White-lipped peccaries in two main protected areas of French Guiana: Update and insights into an uncommon population dynamics

by Cécile Richard-Hansen¹, Luc Ackermann², Rachel Berzins³, Jennifer Devillechabrolle²,
Thibaut Foch², Bertrand Goguillon⁴, François Korysko³, Raphaëlle Rinaldo⁴

¹O NCFS, UMR EcoFoG (AgroParisTech, Cirad, CNRS, INRA, Université des Antilles, Université de Guyane) - Campus agronomique- BP316
97379 Kourou Cedex – French Guiana, France

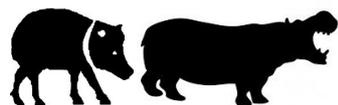
²ONF-Sylvétude. Réserve de Montabo BP87002. 97307 Cayenne Cedex -French Guiana, France

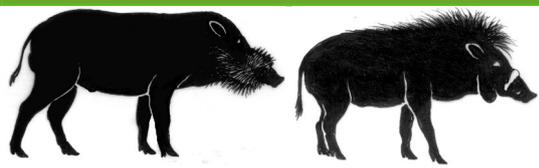
³ONCFS – Kourou, French Guiana, France

⁴Parc amazonien de Guyane. - 1 rue Lederson 97354 Remire-Montjoly French Guiana, France

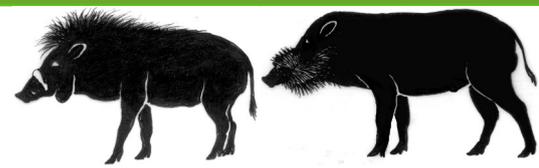
White-lipped peccaries (thereafter WLP or white lips) probably have the most original social and demographical parameters of Neotropical large mammals. Since researchers across South and Central America began to systematically monitor large vertebrate populations, they recorded what most indigenous populations seem to know from a long time (Grenand, 1993): white-lipped peccaries are very unpredictable. They can be very numerous and roam in large herds over vast territories, and more or less suddenly vanish from the forest, to reappear after a while. Such demographic fluctuations were noted in many places across their distribution range, yet specialists still wonder about causes and mechanism involved in the process (Beck et al., 2017). Many testimonies come from precise localities, protected areas or autochthonous hunting territories, and lack a wider scale overview. In French Guiana, we could document a large-scale occurrence of this disappearance phenomenon, across several years (2003-2013) and more than 80 000 square kilometers (Richard-Hansen et al, 2014). At the date the paper was published, we were suspecting a new population increase tendency, initiated in 2013-14. Four years later, we wanted here to add some new elements in this story, to help scientific community to better document and understand the whole process. This note presents some new complementary data from two National Reserves located in central French Guiana in remote and undisturbed forests, showing how white lipped peccaries recently recolonized them after a disappearance period of several years.

The Nouragues National Reserve exists since 1995, and hosts since 1986 two scientific stations in which scientists come from around the world to study a preserved Neotropical rainforest ecosystem. Observation effort is almost permanent, particularly in the study area around two permanent camps, by researchers, field assistants and technical staff. According to the “observations book” of the older scientific camp, White-lipped peccaries were frequently observed in years 1996-1997, although considered as “uncommon” because of their wide-ranging patterns (Bongers et al. 2001). The last observation was recorded in August 2002. From 2006 to 2009, extensive camera trapping annual surveys were undertaken in the area, for tapir densities studies (Tobler et al., 2014). Among 3642 independent capture events of 26 identified species, no pictures of white-lipped peccaries were recorded during the 17 424 camera-days, distributed over the four study years. For the last eight years, no systematical survey was conducted, but the whole staff was aware of the white lips issue, and observations became so exceptional that any encounter would have been reported. A first alert came from the boat driver who transports people to the scientific stations several times a week, and who reported a white lips’ group





Ecology and Conservation



observed crossing the river in March 2011 (Motor, pers. comm.). This was however an isolated event, as no more groups were sighted during following years. Five years later, another boat driver reported two observations of WLP groups crossing the river 50 kilometers away the reserve, in March and August 2016 (Agaci Doutra de Souza, pers. comm., Fig. 1). However, the very first reports of group sighting within the main study area occurred on February and March 2018, confirming their come back in the core area, from where they were absent since 2002 (Andrius Pašukonis, pers. comm.).

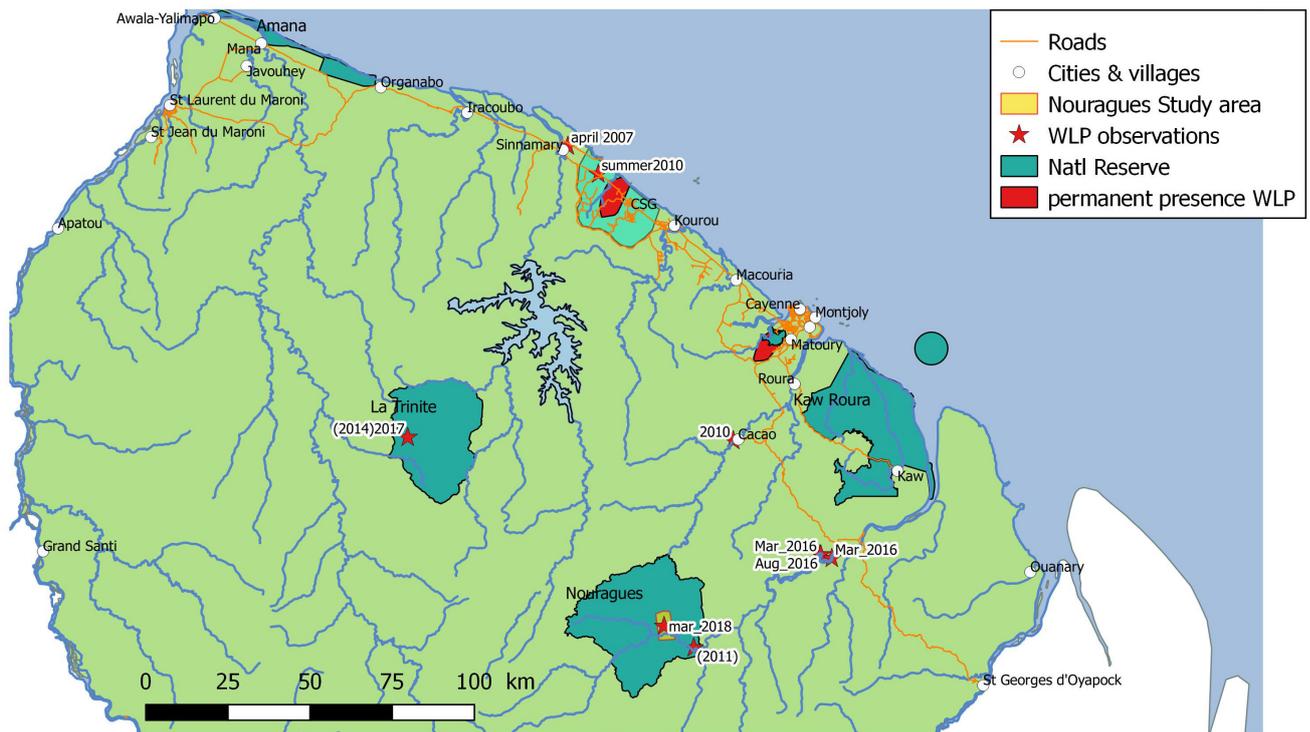
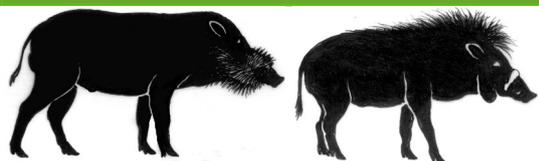


Fig. 1: Locations of new observations of White-lipped peccaries in two main National Reserves of central French Guiana (“La Trinité” and “Les Nouragues”) and of few previous occurrences during the low-density period (2004-2010).

The National Reserve “La Trinité” was created in 1996, and is also located in undisturbed and remote forest area, a hundred of km northeastern from Nouragues (Fig. 1). As for Nouragues Reserve, the only way to reach it is by boat or helicopter, and there is no human settlement 80km around. There is no permanent research station, but field trips are regularly conducted since 1999, for various ecological-monitoring programs. Large group of WLP were noted in 1999 and 2001, but no observation was recorded later (field trips in 2002 and 2003, and annually between 2008 and 2013). Two isolated individuals were noted in 2014, no one in 2015, a dead one in 2016, and then observations went more common from 2017.

The general survey across the country identified the beginning of the decreasing of population around 2003 (Richard-Hansen et al., 2014), and the lower levels around 2007-2009. During that time, very few observations were reported from all around the country, including by hunters of autochthonous communities of the most remote localities (pers. unpublished ata). However, a few groups subsisted here and there, as we recorded harvests of a few WLP in 4 occasions out of 328 hunting trips in 2007 (1% vs. 34% of hunting trips with WLP harvest recorded in 2000-2001)





Ecology and Conservation

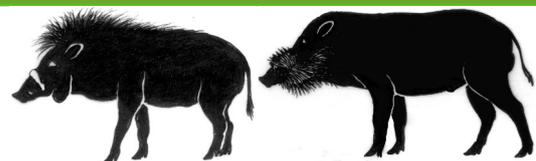


Fig. 2: Camera trap pictures of White-lipped peccaries in the study areas. Photos: ONCFS/CNES

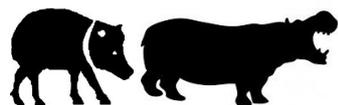
in a systematic hunting survey in the western part of the country. In the same year in the northern coastal area, 70 individuals were killed by hunters in one day (unpublished data, Fig. 1). From 2009-2010, opportunistic observations began to increase in the northern part, often reporting a large number of babies in the herds (Alexandre Renaudier, Vincent Ruffray, pers. comm.). However, in the southern most remote areas, WLP remained very rare at this time, as attested by their low killing rate recorded by the National Park's hunting monitoring (<1% of total number of preys harvested by traditional subsistence hunters, vs. 30% in 2001). During years 2015-2017, within another new systematic hunting survey conducted in the northern part of the country, WLP represented around 6% of total preys recorded.

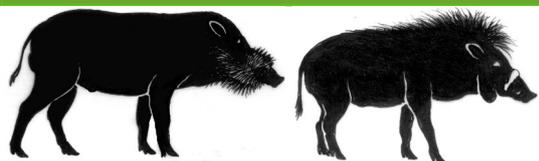
Recording oral testimonies and informal data, we think that WLP never disappeared from two small protected areas in the northern part of the country, the Réserve Nationale du Mont Grand Matoury, and the Centre spatial Guyanais (CSG, Fig. 1). Two WLP groups from these areas are presently GPS-tracked from 2014 (Richard-Hansen et al., in press).

It is strange to note that those two refuges areas are located near the most industrialized and inhabited parts of French Guiana (the European Space Center, the main city and international airport), while the most remote and preserved forests in National Reserves experienced long disappearance periods. Although some illegal goldmining and poaching occur near the reserves, these observations tend to prove that hunting/human pressure alone cannot explain the population crash observed in French Guiana.

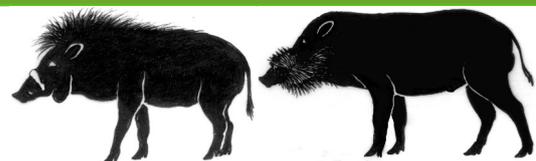
These observations also confirm the cyclical pattern of abundance of the species, over large scale. This behavior was known from autochthonous populations, who reported drastic decrease of WLP hunting in years 1980-1985, (or 1990 according to the place) in French Guiana. Shamans used to be consulted and practiced magical ceremonies "to make them come back" (Grenand 1993). Population recoveries of White-lipped peccaries were also observed in 2016 at Iguazu National Park, after 20 years of absence (Brocardo et al., 2017), and in Cosha Cashu Biological station, after 12 years (Silman et al., 2003).

In French Guiana, in both National Reserves, the disappearance and the comeback seem to occur relatively rapidly, while the global phenomenon at the country scale is more gradual, over a few years. The general comeback is also confirmed by the increase of the proportions of WLP in hunting bags from 2016-2017 hunting surveys (10-11% of mammals hunted, against less than 1% in 2007). It is still unclear if the progressive spread of the species across the whole French Guiana comes from very small remaining groups disseminated everywhere, or from more long





Ecology and Conservation



distance and progressive dispersal from very few groups in few refuge areas. Genetic analyses have indicated that WLP can maintain gene flow up to 80 km (Biondo et al., 2011), and long moves are sometimes observed (Reyna-Hurtado et al. 2012). The two herds currently monitored display a great geographic stability for 4 years (Richard-Hansen et al., in press), but part of them could have dispersed without being detected.

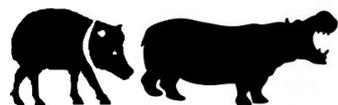
Long term monitoring and coordination between all the environmental managers over the whole country (ONCFS, National Park, National Reserves, NGOs) allows us to have a better overview of the temporal and spatial processes both at local and regional scales. International cooperation will be the next step to enlarge the analysis across the whole distribution area (Fragoso & et al., in prep). Understanding these cyclic changes in this species remains one of the fascinating mysteries that this interesting species is hiding from us.

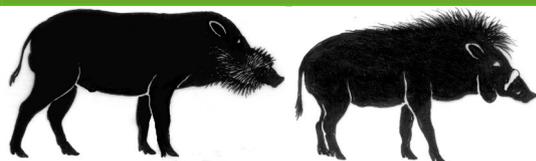
Acknowledgements

We acknowledge all people who helped and participated in fieldwork, line transect or hunting surveys, and to all volunteers sharing their observations, and to Rafael Reyna-Hurtado for comments on early draft.

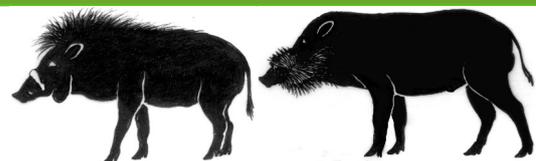
References

- Beck H, Keuroghlian A, Reyna-Hurtado R, Altricher M and Gongora J. 2017. White-lipped Peccary *Tayassu pecari* (Link, 1795). In: Melletti M, Meijaard E (eds) Ecology, Conservation and Management of Wild Pigs and Peccaries. Cambridge University Press, pp 265-276.
- Biondo C, Keuroghlian A, Gongora J and Miyaki CY. 2011. Population genetic structure and dispersal in white-lipped peccaries (*Tayassu pecari*) from the Brazilian Pantanal. *J Mammal* 92 (2):267-274.
- Brocardo CR, Silva MXd, Delgado LE and Galetti M. 2017. White-lipped peccaries are recorded at Iguazu National Park after 20 years. *Mammalia* 81 (5):519-522.
- Fragoso J et al. in prep. Mysterious disappearances of a large mammal in Neotropical forests.
- Grenand P. 1993. Fruits, animals and people: hunting and fishing strategies of the Wayãpi of Amazonia. In: Tropical forests, people and food: biocultural interactions and applications, vol 13. Unesco and the Parthenon Publishing group, New York, pp 425-434
- Reyna-Hurtado R, Chapman CA, Calme S, Pedersen E.J. 2012. Searching in heterogeneous and limiting environments: foraging strategies of white-lipped peccaries (*Tayassu pecari*). *Journal of Mammalogy* 93 (1):124-133
- Richard-Hansen C, Berzins R, Petit M, Rux O, Goguillon B and Clément L. in press. Movements of white-lipped Peccary in French Guiana. In: Reyna-Hurtado R, Chapman CA (eds) Movement Ecology of Neotropical Forest Mammals. Springer,
- Richard-Hansen C, Khazraie K, Surugue N, LeNoc M and Grenand F. 2014. Long-term fluctuations of white-lipped peccary populations in French Guiana. *Mammalia* 218 (3):291-301.
- Silman MR, Terborgh JW and Kiltie RA. 2003. Population regulation of a dominant rain forest Tree by a major seed predator. *Ecology* 84 (2):431-438.
- Tobler MW, Hibert F, Debeir L and Richard-Hansen C. 2014. Estimates of density and sustainable harvest of the lowland tapir *Tapirus terrestris* in the Amazon of French Guiana using a Bayesian spatially explicit capture–recapture model. *Oryx* 48 (3):217-221.





Physiology and Genetics



Reproductive limitations following hybridization between wild and domestic *Sus scrofa*

by Sergey P. Knyazev¹ and Sergey V. Nikitin²

¹Novosibirsk State Agrarian University, Novosibirsk, Russia, knyser@rambler.ru

²Institute of Cytology and Genetics, Siberian Division of Russian Academy of Sciences, Novosibirsk, Russia, nsv1956@mail.ru

Sus scrofa L. as a single zoological species has two modern distinct forms, Wild Boar and domestic pig. The differences were created through domestication of domestic pig with individual psycho-types as a first target of selection (Nikitin et al, 2014; Nikitin and Knyazev, 2015). Animals with a disposition to symbiosis with humans were initially selected as the base for domestication. In the beginning of the domestication process the survival strategies of wild and domestic forms were mutually exclusive, because non-escaped wild individuals were human prey; i.e. wild animals had to keep away from people, while domestic forms had to stay close to survive. This mechanism created a genetic base of reproductive division (without absolute isolation) of these two forms.

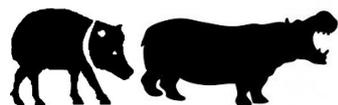
Here we investigate the hybrid dysgenesis that occurs as a result of hybridization between wild boars and domestic pigs which was studied in Novosibirsk, Russia, during the 1980s (Knyazev and Tikhonov, 1982). Earlier we published our data of pre- and postnatal fertility and mortality among offspring of backcrosses between Wild Boars of two geographically remote subspecies *S. s. scrofa* (European Wild Boar from Belovezhskaya Pushcha, a national park in Belarus) and *S. s. nigripes* (Middle-Asian Wild Boar from Kyrgyzstan, some 5,000 km east of the former location) with domestic Landrace sows during a few serial generations of experimental hybridization in Siberia (Knyazev and Nikitin, 2004; Nikitin and Knyazev, 2015).

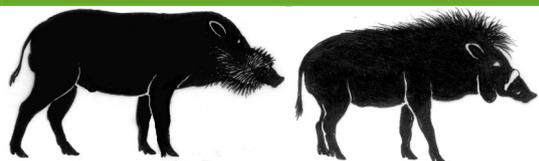
Table 1 shows data concerning the number of new-born living piglets and the number of surviving piglets up to weaning at 2 months old per each litter for serial generations of Wild Boar x Landrace backcrosses and among Landrace pure bred pigs breeding as a control.

The data indicate mass deaths of F1 hybrid piglets between farrowing and weaning at 2 months old: mortality rates were 0.820 - 0.910 for F1 hybrid litters in comparison with only 0.172 among domestic piglets. Therefore, the number of weaning piglets per litter was only 2.23 – 1.39 for F1 hybrids from two subspecies.

Table 1. The viability of piglets from hybridization between Wild Boars and domestic pigs in comparison with pure-bred Landrace domestic pigs.

Forms of ancestors	Backcrosses generations					
	F ₁	F _{2a}	F _{3a}	F _{4a}	F _{5a}	F _{6a}
Number of litters						
<i>Sus scrofa nigripes</i>	8	12	12	28	35	25
<i>Sus scrofa scrofa</i>	11	11	7	10	24	7
Landrace domestic pig (control)	280					
Total number of piglets						
<i>Sus scrofa nigripes</i>	99	157	136	351	415	264
<i>Sus scrofa scrofa</i>	170	125	83	126	278	90
Landrace domestic pig (control)	3139					
Mean number of piglets born per litter						
<i>Sus scrofa nigripes</i>	12.38 ±0.89	13.08 ±0.58	11.33 ±0.97	12.54 ±0.53	11.86 ±0.40	10.56 ±0.35
<i>Sus scrofa scrofa</i>	15.46 ±0.65	11.36 ±1.05	11.86 ±0.51	12.60 ±0.98	11.58 ±0.49	12.86 ±0.55
Landrace domestic pig	11.21±0.16					
Share of piglets stillborn and dead before weaning						
<i>Sus scrofa nigripes</i>	0.820 ±0.039	0.331 ±0.038	0.267 ±0.038	0.235 ±0.023	0.260 ±0.022	0.161 ±0.023
<i>Sus scrofa scrofa</i>	0.910 ±0.022	0.454 ±0.045	0.515 ±0.055	0.291 ±0.040	0.234 ±0.025	0.297 ±0.048
Landrace domestic pig	0.172±0.007					
Mean number of piglets per litter at weaning = = Mean number of piglets born per litter × Share of piglets stillborn and dead before weaning						
<i>Sus scrofa nigripes</i>	2.23	8.75	8.30	9.59	8.78	8.86
<i>Sus scrofa scrofa</i>	1.39	6.21	5.75	8.93	8.87	9.04
Landrace domestic pig	9.28					





Physiology and Genetics

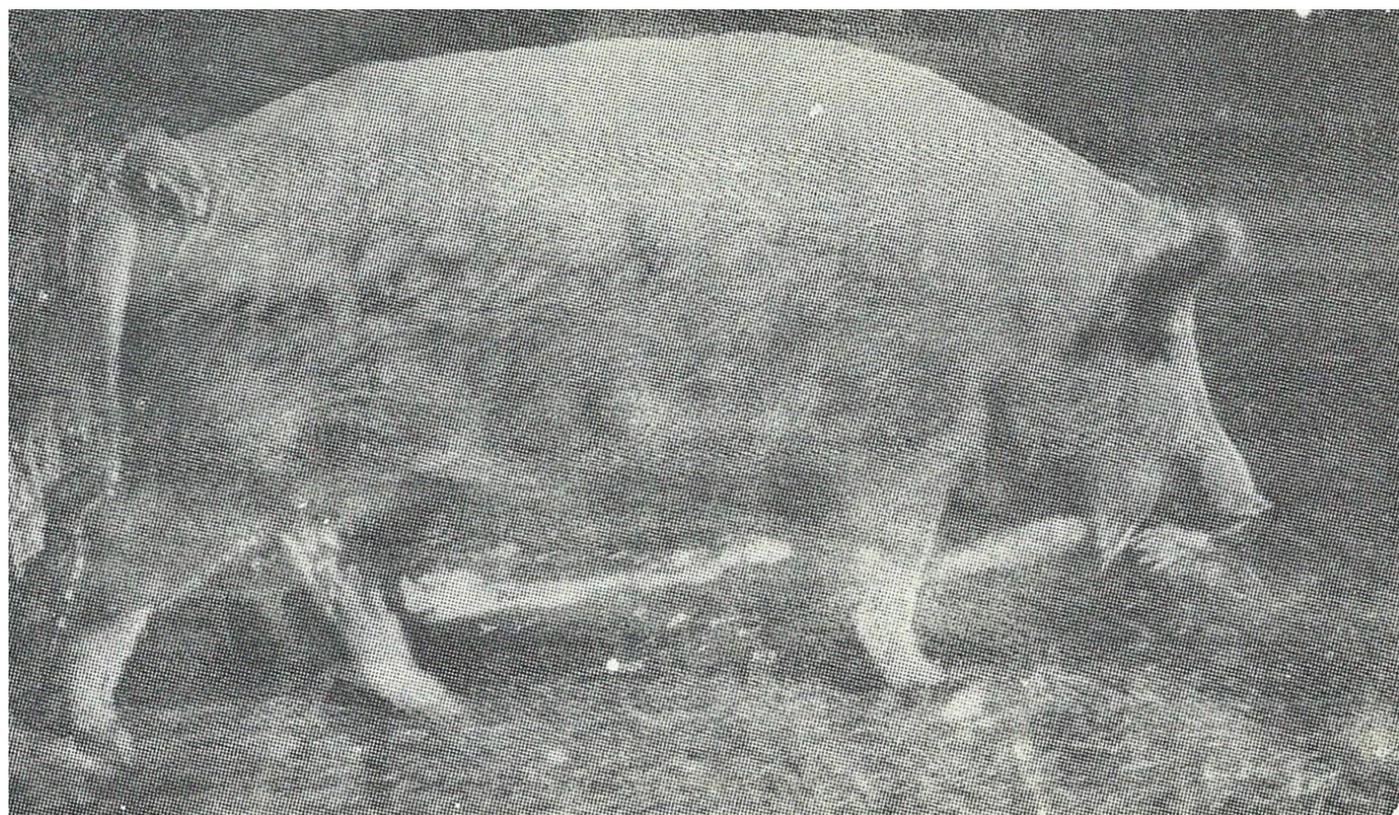
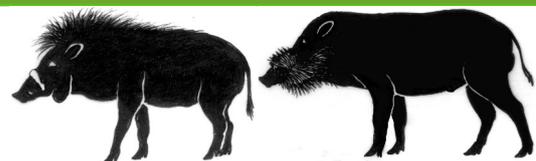


Fig. 1: F1 hybrid *scrofa nigripes* with landrace pig.

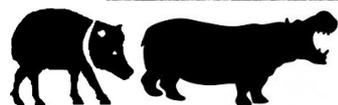
For subsequent generations of backcrosses (hybrid males x domestic sows) piglet mortality decreased but the rates differed between hybrids from *S. s. scrofa* and *S. s. nigripes*. For hybrids from a Middle-Asian Wild Boar ancestor (*S. s. nigripes*), the number of surviving piglets from birth to weaning for F2B (F1 x Landrace) and later generations of such backcrosses, differed only marginally compared to the control. But the survival rates of F2B and F3B hybrids from European

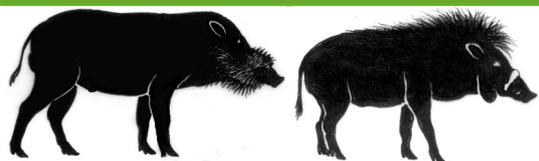
Wild Boar ancestor (*S. s. scrofa*) were intermediate between F1 and the control; only for F4B hybrids the number of piglets per litter surviving to weaning approached those of the control (pure bred Landrace pigs).

A sufficiently large decrease of the number of surviving offspring up to weaning amongst litters from mating of wild and domestic forms of *Sus scrofa* in the comparison with a control have been obtained. The

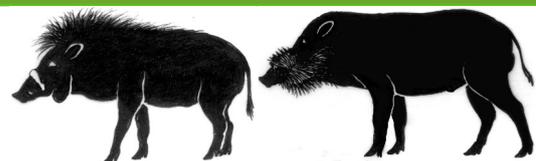


Fig. 2: F1 hybrid *scrofa scrofa* with landrace.





Physiology and Genetics



observed F1 hybrid dysgenesis may be a one of the manifestations of the mechanism of incomplete (partial) reproductive isolation (or limitation) between wild and domestic forms of *Sus scrofa*. This limitation is uni-directional – from wild boars to domestic pigs and was conditioned to the specific genotypic environment created by artificial human selection during domestication and formation of breeds. It is interesting to note that



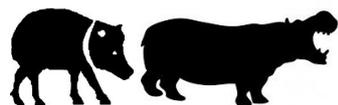
Fig. 3. F4 Hybrid.

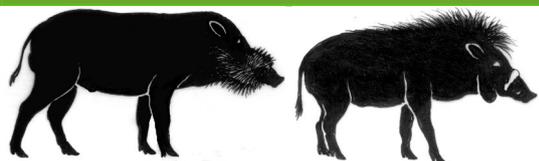
such limitation does not occur in the opposite direction. We believe that longer hybrid dysgenesis among progeny of European Wild Boar subspecies (who had more high chance to mate with domestic pigs during their domestication) rather than Middle Asian Wild Boar may be considered as evidence of stronger reproductive isolation (at early postnatal ontogenesis) between *S. s. scrofa* and domestic pig in the comparison with *S. s. nigripes*. We note that similar differences between subspecies of Wild Boars were observed in our previous studies by means of serum allotypes polymorphisms (Nikitin et al., 2006), and these differences may relate to those found in the current study.

This work was supported by Russian State task (project № 0324-2018-0016).

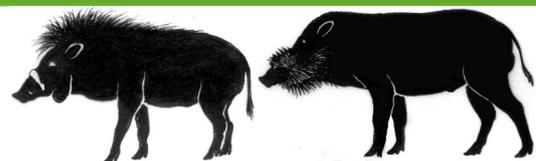
References

- Knyazev S.P. and V.N. Tikhonov 1982. Immunogenetic analysis of allotypes of hybrids under distant hybridization between wild and domestic pigs // *Izvestia Sibirskogo Otdelenia Akademii Nauk SSSR. Seria Biologicheskych Nauk. Vyp. 3. Pp. 119-125 (In Russ.)*.
- Knyazev S.P. and S.V. Nikitin 2004. Phylogenesis and taxonomic relationships between intraspecies forms of *Sus scrofa* (SUIDAE) // (In Russ.). *Zoologicheskij Zhurnal. № 1. Pp. 105-118.*
- Nikitin S.V., Knyazev S.P., Nikolaev A.G. et al. 2006. Diversity of Wild and Domestic Pig Populations Estimated by a Set of Serum Allotypes // *Russian Journal of Genetics. Vol. 42. No. 3. P. 317-326.*
- Nikitin S.V., Knyazev S.P. and K.S. Shatokhin 2014. Miniature Pigs of ICG as a Model Object for Morphogenetic Research // *Russian Journal of Genetics: Applied Research. V. 4. No. 6. P. 511–522.*
- Nikitin S.V. and S.P. Knyazev 2015. Selection and Adaptation at domestic pigs populations (In Russ.; Отбор и адаптация в популяциях домашних свиней. Saarbrücken. Lambert Academy Publishing (LAP). 221 p.





New literature on Suiformes



Veterinary, Genetic and Physiological Studies

Physicochemical parameters of selected internal organs of fattening pigs and wild boars.

Babicz, M., Kropiwiiec-Domanska, K., Szyndler-Nedza, M., Grzebalska, A.M., Luszczewska-Sierakowska, I., Wawrzyniak, A., Halabis, M.

Annals of Animal Science, 18(2): 575-591. doi:10.1515/aoas-2017-0041

The objective of the study was to analyse selected physical properties and chemical indicators of internal organs obtained from fattening pigs and Central European wild boars (*Sus scrofa scrofa*). Each group consisted of 12 animals. The tongue, heart, lungs, liver and kidneys were examined for physical properties, basic chemical composition, macro- and micromineral content, and fatty acid profile. The atherogenic index (AI) and the thrombogenic index (TI) were also determined. Pig offal was found to be a rich source of protein and collagen, and to contain large amounts of potassium and sodium. Liver had a high content of iron, zinc, and manganese. Pig liver and wild boar heart were characterised by favourable PUFA/SFA ratios (above 0.4%). In addition, the content of neutral and hypocholesterolemic acids (DFA) and hypercholesterolemic acids (OFA) in pig offal was comparable to that in pig meat. The results presented in this study provide an extensive evaluation of the nutritional quality of pig offal, which allows an increase in the scope of its use in the food industry, among others for production of offal products, including traditional and regional products that are increasingly demanded by consumers.

Faecal *Escherichia coli* as biological indicator of spatial interaction between domestic pigs and wild boar (*Sus scrofa*) in Corsica.

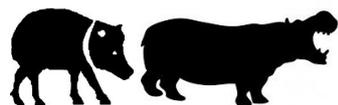
Barth, S.A., Blome, S., Cornelis, D., Pietschmann, J., Laval, M., Maestrini, O., . . . Jori, F.

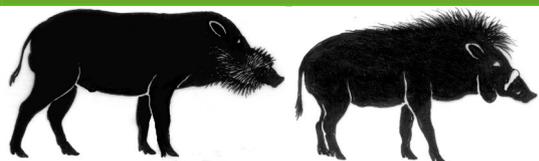
Transboundary and Emerging Diseases, 65(3): 746-757. doi:10.1111/tbed.12799

On the Mediterranean island of Corsica, cohabitation between sympatric domestic pigs and Eurasian wild boar (*Sus scrofa*) is common and widespread and can facilitate the maintenance and dissemination of several pathogens detrimental for the pig industry or human health. In this study, we monitored a population of free-ranging domestic pigs reared in extensive conditions within a 800-ha property located in Central Corsica which was frequently visited by a sympatric population of wild boar between 2013 and 2015. We used GPS collars to assess evidence of a spatially shared environment. Subsequently, we analysed by PFGE of XbaI-restricted DNA if those populations shared faecal *Escherichia coli* clones that would indicate contact and compared these results with those collected in a distant (separated by at least 50km) population of wild boar used as control. Results showed that one of eight wild boars sampled in the study area shed *E.coli* XbaI clones identical to clones isolated from domestic pig sounders from the farm, while wild boar populations sampled in distant parts of the study area shared no identical clone with the domestic pigs monitored. Interestingly, within the sampled pigs, two identical clones were found in 2013 and in 2015, indicating a long-time persisting colonization type. Although the method of isolation of *E.coli* and PFGE typing of the isolates requires intensive laboratory work, it is applicable under field conditions to monitor potential infectious contacts. It also provides evidence of exchange of microorganisms between sympatric domestic pigs and wild boar populations.

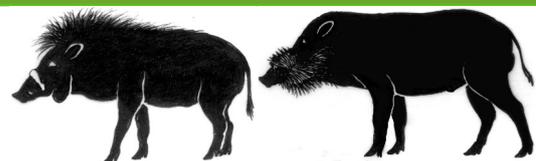
Zoonotic pathogens from feral swine that pose a significant threat to public health.

Brown, V. R., Bowen, R.A., Bosco-Lauth, A.M.





New literature on Suiformes



Transboundary and Emerging Diseases, 65(3): 649-659. doi:10.1111/tbed.12820

The natural fecundity of suids, great ability to adapt to new habitats and desire for local hunting opportunities leading to translocation of feral pigs to regions where they are not yet established have all been instrumental in the home range expansion of feral swine. Feral swine populations in the United States continue to expand, wreaking havoc on agricultural lands, further compromising threatened and endangered species, and posing a microbiological threat to humans, domestic livestock and companion animals. This manuscript thoroughly reviews zoonotic diseases of concern including brucellosis, bovine tuberculosis, leptospirosis, enteric pathogens, both *Salmonella* spp. and shiga toxin-producing *Escherichia coli*, and hepatitis E. These pathogens are not a comprehensive list of microbes that are capable of infecting both humans and feral swine, but rather have been selected as they are known to infect US feral swine, direct transmission between wild suids and humans has previously been documented, or they have been shown to be readily transmitted during processing or consumption of feral swine pork. Humans that interact directly or indirectly with feral swine are at much higher risk for the development of a number of zoonotic pathogens. Numerous case reports document transmission events from feral swine and wild boar to humans, and the resulting diseases may be mild and self-limiting, chronic or fatal. Individuals that interact with feral swine should take preventative measures to minimize the risk of disease transmission and all meat should be thoroughly cooked. Additionally, public health campaigns to increase knowledge of the risks associated with feral swine are imperative.

Frequent infection of wild boar with atypical porcine pestivirus (APPV).

Cagatay, G.N., Antos, A., Meyer, D., Maistrelli, C., Keuling, O., Becher, P., Postel, A.
Transboundary and Emerging Diseases, 65(4): 1087-1093. doi:10.1111/tbed.12854

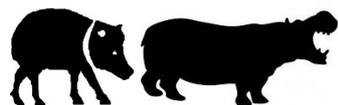
The recently identified atypical porcine pestivirus (APPV) was demonstrated to be the causative agent of the neurological disorder congenital tremor in newborn piglets. Despite its relevance and wide distribution in domestic pigs, so far nothing is known about the situation in wild boar, representing an important wild animal reservoir for the related classical swine fever virus. In this study, 456 wild boar serum samples obtained from northern Germany were investigated for the presence of APPV genomes and virus-specific antibodies. Results of real-time RT-PCR analyses revealed a genome detection rate of 19%. Subsequent genetic characterization of APPV (n=12) from different hunting areas demonstrated close genetic relationship and, with exception of APPV from one location, displayed less than 3.3% differences in the analysed partial NS3 encoding region. Furthermore, indirect E-rns ELISA revealed an antibody detection rate of approx. 52%, being in line with the high number of viremic wild boar. Analysis of fifteen wild boar samples from the Republic of Serbia by E-rns antibody ELISA provided evidence that APPV is also abundant in wild boar populations outside Germany. High number of genome and seropositive animals suggest that wild boar may serve as an important virus reservoir for APPV.

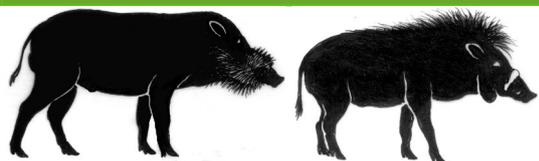
Fecal shedding of *Campylobacter jejuni* and *Campylobacter coli* among feral pigs in Texas.

Cummings, K.J., Rodriguez-Rivera, L.D., McNeely, I., Suchodolski, J.S., Mesenbrink, B.T., Leland, B.R., Bodenchuk, M.J.

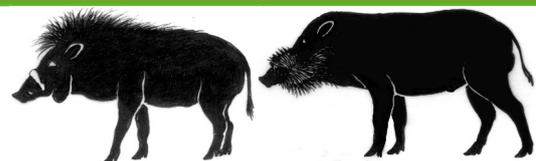
Zoonoses and Public Health, 65(1): 215-217. doi:10.1111/zph.12390

The population and range of feral pigs in the United States are rapidly expanding, yet key knowledge gaps exist regarding their role in the ecology and transmission of foodborne pathogens. Our objectives were to estimate the prevalence of *Campylobacter jejuni* and





New literature on Suiformes



Campylobacter coli shedding among feral pigs throughout Texas and to identify risk factors for positive status. Faecal samples were collected from feral pigs in Texas from February 2014 through May 2015, and target organisms were detected using PCR assays. The prevalence of *C. jejuni* shedding was 1.6% (6/370), and the prevalence of *C. coli* shedding was 3.5% (13/370). *C. coli* shedding was significantly more common ($p=.008$) among female pigs than among male pigs. Feral pigs may represent a source of human campylobacteriosis.

Impact of piglet oral vaccination against tuberculosis in endemic free-ranging wild boar populations.

Diez-Delgado, I., Sevilla, I.A., Romero, B., Tanner, E., Barasona, J.A., White, A.R., . . . Gortazar, C.

Preventive Veterinary Medicine, 155: 11-20. doi:10.1016/j.prevetmed.2018.04.002

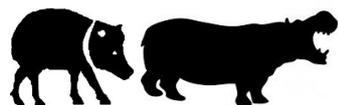
The Eurasian wild boar (*Sus scrofa*) is the main wild reservoir of the *Mycobacterium tuberculosis* complex in Mediterranean woodlands and a key risk factor for cattle tuberculosis (TB) breakdowns. Wild boar vaccination therefore has the potential to be a valuable tool for TB control. We tested two orally delivered vaccines, heat inactivated *Mycobacterium bovis* (IV) and BCG, in four sites (two per vaccine type: one Managed and one Natural or unmanaged) during four years. TB was also monitored in 15 unvaccinated sites (spatial control), as well as in all sites from one year prior to intervention (temporal control). The rationale is that by vaccinating 2-6 month old wild boar piglets we can reduce disease at the population level during the study period. This is achievable due to the fast turnover of wild boar populations. Vaccine baits were deployed using selective piglet feeders and this method proved highly successful with uptake rates of 50 to 74% in Natural sites and 89 to 92% in Managed sites. This is relevant for the potential delivery of vaccines to control other diseases, too. Local wild boar TB prevalence at the beginning of the study was already high ranging from 50 to 100%. TB prevalence increased in unvaccinated sites (6%), while a significant decline occurred in the Managed IV site (34%). Changes recorded in the remaining sites were not significant. The short-term impact of vaccination observed in the field was complemented by mathematical modelling, representative of the field system, which examined the long-term impact and showed that vaccination of piglets reduced prevalence and increased abundance at the population level. We conclude that IV could become part of integrated TB control schemes, although its application must be tailored for each specific site.

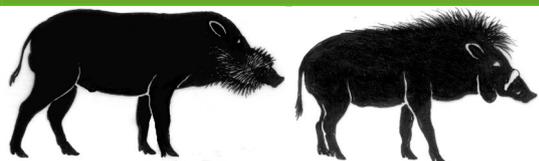
High domestic pig contribution to the local gene pool of free-living European wild boar: a case study in Poland.

Dzialuk, A., Zastempowska, E., Skrzewski, R., Twaruzek, M., Grajewski, J.

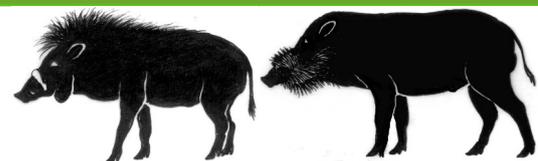
Mammal Research, 63(1): 65-71. doi:10.1007/s13364-017-0331-3

Rates of hybridization between wild and domesticated animals appear to be increasing worldwide. Recent results suggest that genetic introgression from domestic swine into European wild boar is much more common in local populations than expected, based on pan-European studies. Thus, we screened the genetic purity of 265 free-living wild boars from two hunting areas in Poland by genotyping the melanocortin receptor 1 gene (MC1R) for polymorphism. Unexpectedly, high numbers of individuals with domestic genes (24%) were identified. This suggests that mixed ancestry may be common in Polish wild boar. Among admixed individuals, backcrosses with domestic pig and/or introgressed wild boars were detected (2%). Multiple commercial domestic pig breeds are possibly involved in the introgression observed in the study





New literature on Suiformes



populations. In addition, the absence of significant differences in the frequency of wild-type allele among two hunting areas suggests high dispersal of individuals and gene flow among populations. We conclude that further study is needed to better understand the mechanisms and sources of introgression in wild boars in Poland.

Urban Wild Boars and Risk for Zoonotic *Streptococcus suis*, Spain.

Fernandez-Aguilar, X., Gottschalk, M., Aragon, V., Camara, J., Ardanuy, C., Velarde, R., . . . Cabezon, O.

Emerging Infectious Diseases, 24(6): 1083-1086. doi:10.3201/eid2406.171271

Urban wild boars (*Sus scrofa*) from Barcelona, Spain, harbor great diversity of *Streptococcus suis* strains, including strains with the cps2 gene and with the same molecular profile as local human cases. The increasing trend of potential effective contacts for *S. suis* transmission is of public health concern.

Seasonality of the reproduction of wild boars in the Lublin Upland and weight characteristics of their carcasses.

Flis, M., Grela, E. R., Gugala, D., Rataj, B.

Medycyna Weterynaryjna-Veterinary Medicine-Science and Practice, 74(7): 477-480.

doi:10.21521/mw.6018

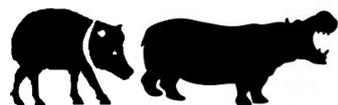
The purpose of the study was to assess the seasonality of wild boar reproduction and the weight of wild boar carcasses obtained in the hunting district of Lublin in the years 2012-2017. The study was based on the measurement of the weight of wild boar carcasses obtained by hunting and delivered to collection centres or kept by hunters for their own use. The animals were weighed upon evisceration. After determining the weight of the carcass, the age of the animal was determined on the basis of the growth and replacement of particular groups of deciduous teeth by permanent teeth as well as changes in the permanent dentition of the mandible. The seasonality of reproduction was then assessed on the basis of the estimated age and the length of pregnancy. The results show clear disturbances in reproductive seasonality. Less than 40% of farrowings occurred in the hitherto typical period, that is, in March and April. In fact, the farrowings took place in all months of the year, with the fewest in January and September. Body mass increased in the individual's life, thus the highest growth rate of over 400% occurred in the youngest wild boars. The carcass weights in particular age groups (piglets, yearlings, 2-year-olds and older) were significantly higher than those recorded elsewhere in Poland. The piglets weighed on average 37.0 kg, yearlings 65.5 kg, and the oldest group 100.3 kg. The results show that the improvement in habitat conditions, combined with progressive climate changes, results in an earlier somatic and sexual maturation. This, in turn, results in higher reproduction rates and a dynamic population growth, leading to greater damage caused by this species in field crops.

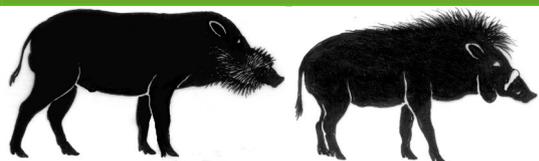
First report of wild boar susceptibility to Porcine circovirus type 3: High prevalence in the Colli Euganei Regional Park (Italy) in the absence of clinical signs.

Franzo, G., Tucciarone, C.M., Drigo, M., Cecchinato, M., Martini, M., Mondin, A., & Menandro, M.L.

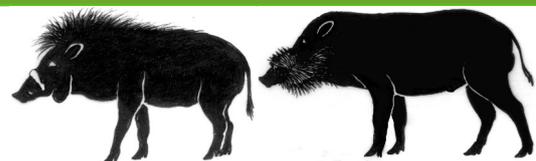
Transboundary and Emerging Diseases, 65(4), 957-962. doi:10.1111/tbed.12905

The genus Circovirus includes one of the most relevant infectious agents affecting domestic pigs, Porcine circovirus type 2 (PCV-2). The wild boar susceptibility to this pathogen has also been





New literature on Suiformes



demonstrated although the actual epidemiological role of wild populations is still debated. In recent times, a new circovirus, Porcine circovirus type 3 (PCV-3), has been discovered and reported in the presence of several clinical conditions. However, no information is currently available about PCV-3 circulation and prevalence in wild boar. To fill this gap, 187 wild boar serum samples were collected in the Colli Euganei Regional Park (Northern Italy) and screened for PCV-3, demonstrating a high viral prevalence (approximately 30%). No gender differences were demonstrated while a lower infection prevalence was observed in animals younger than 12 months compared to older ones, differently from what described in commercial pigs. Almost all sampled animals were in good health conditions and no association was proven between PCV-3 status and clinical syndromes in wild animals. The genetic characterization of selected strains enlightened a relevant variability and the absence of closely related strains originating from domestic pigs. Therefore, the observed scenario is suggestive of multiple introductions from other wild or domestic swine populations followed by prolonged circulation and independent evolution. Worldwide, this study reports for the first time the high susceptibility of the wild boar to PCV-3 infection. The high prevalence and the absence of association with clinical signs support the marginal role of this virus in the wild boar population ecology. However, its epidemiological role as reservoir endangering commercial swine cannot be excluded and will require further investigations.

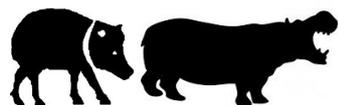
The effect of age on the fatty acids composition in wild boar (*Sus scrofa*) hunted in the southwest region of Slovakia.

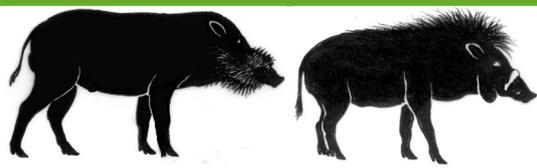
Galik, B., Smehyl, P., Gasparik, J., Candrak, J., Jahnatek, A., Biro, D., . . . Simko, M.
Acta Veterinaria Brno, 87(1): 85-+. doi:10.2754/avb201887010085

The aim of the study was to analyse the fatty acid profile of wild boar (*Sus scrofa*) meat. The samples were obtained from the mountain Tribec (southwest part of the Slovak Republic). A total of 36 samples in 3 age categories of meat were analysed. The effect of age on the intramuscular (IMF) fat content was analysed. The highest ($P < 0.05$) IMF content was found in the samples from the youngest animals (18.07%), the lowest ($P < 0.05$) in the sub-adult animals. Significant ($P < 0.05$) differences were found in palmitic acid (C16:0). Significant decrease of heptadecanoic acid (C17:0) as an effect of age was analysed in the samples. Of the important fatty acids, the most abundant in all age categories of wild boar were oleic (C18:1 cis 9), palmitic (C16:0), and linoleic acid (C18:2 cis n6). Differences in the content of mentioned acids were significant ($P < 0.05$). In α -linolenic and ω -linoleic acids, non-significant ($P > 0.05$) differences were detected. Significant differences ($P < 0.05$) between age categories were found in cis-11-eicosenoic (C20:1 n9) and cis-11,14-eicosadienoic acids (C20:2 n6). Significant differences ($P < 0.05$) were found in PUFA (polyunsaturated fatty acids), MUFA (monounsaturated fatty acids), and SFA (saturated fatty acids) concentrations. The highest PUFA content was typical for the samples from the oldest animals, MUFA from the sub-adults, and SFA from the youngest wild boar. More significant results were observed in the normalized data with the factor component scores. The wild boar fatty acid profile is significantly affected by age.

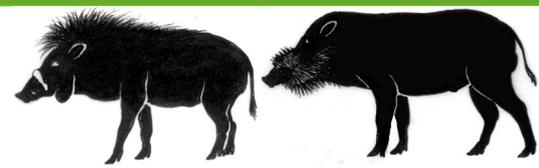
Occurrence of selected zoonotic food-borne parasites and first molecular identification of *Alaria alata* in wild boars (*Sus scrofa*) in Italy.

Gazzonis, A.L., Villa, L., Riehn, K., Hamedy, A., Minazzi, S., Olivieri, E., . . . Manfredi, M.T.
Parasitology Research, 117(7): 2207-2215. doi:10.1007/s00436-018-5908-5





New literature on Suiformes



Wild boar is a source of human infections with zoonotic pathogens, including food-borne parasites. With the aim of a characterization of the human exposure risk, a survey on wild boars intended for human consumption was planned, selecting three pathogens, *Toxoplasma gondii*, *Alaria alata*, and *Trichinella* spp., as markers of meat infection. Diaphragm muscle samples from 100 wild boars hunted in Piedmont region (Northern Italy) in two hunting seasons (2015-2016) were collected. Concerning *T. gondii*, a combined approach of antibody detection and molecular techniques with genotyping was performed. For the detection of *A. alata* and *Trichinella* spp., the larva migration technique and the magnetic stirrer method were employed, respectively; in addition, molecular confirmation of the morphological identification of the recovered specimen was performed. Anti-*T. gondii* antibodies were found in meat juice samples (43.3%) and *T. gondii* DNA (type II) was detected in three animals (7.1%) out of 42 seropositive examined. In none of the sampled wild boars (0%), *Trichinella* spp. larvae were found, whereas one animal (1%) scored positive to *A. alata mesocercariae*. The molecular diagnosis proved the morphological identification of the trematode. This is the first finding of *A. alata* in Italian wild boar population. The present study confirmed the role of wild boars as a source of parasitic zoonotic diseases and thus the risk derived for humans posed by the consumption of game meat. Considering the zoonotic implications, the results underline the importance of monitoring and surveillance of zoonotic parasites in Italian wild boar populations.

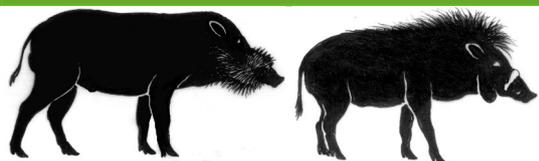
Histology confirms that macroscopic evaluation of ovaries is a valid method for the assessment of the reproductive status in wild boar.

Gethoffer, F., Pfarrer, C., Siebert, U.

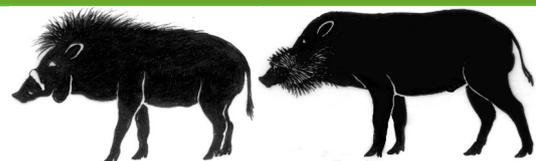
Theriogenology: 113, 192-196. doi:10.1016/j.theriogenology.2018.02.019

Research on reproduction and fertility is an essential fundament of management strategies in European wild boar. Concerning the examination of the reproductive tract, methods still lack conformity and comparability. So far the reproductive status of female wild boar has been assessed by ovarian macroscopic examination. In order to find out if this is a valid method, 21 ovaries of 8-34 months old animals covering (early) follicular phase and cyclic inactivity were evaluated microscopically. Number and dimension of follicles as well as the occurrence of atretic follicles were compared and related to age, weight, ovary weight and size of ovary. For this study, 21 ovaries of the right side of each animal were weighed and measured. The diameter of the functional bodies was measured and functional bodies were counted. Size of ovary was calculated by length*width*height (cm³). Macroscopically, follicles were classified into four categories by diameter: F1 (0.2-0.3 cm), F2 (0.4-0.5 cm), F3 (0.6-0.8 cm) and F4 (0.9-1.3 cm). Microscopically, antral follicles of every 10th slice per section of each ovary were counted and classified into three categories by diameter: F0 (≥ 2 mm), FS (1-2 mm) and FXS (≤ 1 mm). In follicles with a diameter greater than 2 mm (F0), length and width were measured from the beginning of theca interna. Results showed that age and weight of wild boars were highly correlated (cor = 0.845, $p < 0.001$). Wild boar of higher age and weight showed higher ovary weight, but this was not significant ($p = 0.135$ (age), $p = 0.329$ (weight)). Although the number of macroscopically seen follicles differed widely by animal, microscopically only one ovary showed only small tertiary follicles. Animals with bigger follicles showed a significantly ($p = 0.006$) smaller number of small and smallest tertiary follicles. The number of tertiary follicles (F0) was not significantly influenced by age or carcass weight ($p = 0.460$, 0.159). Older and heavier animals showed significantly less FX and FXS ($p < 0.001$). Comparison of the follicular composition of





New literature on Suiformes



young wild boar ovaries with domestic pig research allows the conclusion that assessment of cyclic activity and near puberty is possible. However, due to the fact that puberty is a long term biological progress, defining the time of sexual maturity will always be an estimate. Nevertheless, microscopic examination confirmed the macroscopic findings, including follicular dimensions and developmental stage allowing the conclusion that macroscopic evaluation of ovarian functional bodies in wild boar is an easy and reliable way to assess reproductive performance.

Occurrence of *Salmonella enterica*, *Brucella suis* Biovar 2 and *Corynebacterium ulcerans* in free-living wild boars (*Sus scrofa*) in Austria.

Glawischnig, W., Hofer, E., Posch, R., Sailer, A., Revilla-Fernandez, S., Kornschöber, C., . . . Schmoll, F.

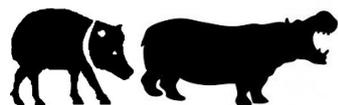
Wiener Tierärztliche Monatsschrift, 105(1-2): 33-40

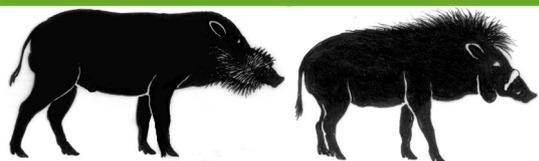
Introduction Wild boars (*Sus scrofa*) can act as a reservoir for several infectious diseases of economic and zoonotic importance. In the present study, 490 tonsils and 228 mandibular lymph nodes from wild boars of different ages and sexes, shot during the 2011-2012 hunting season in the federal provinces of Lower Austria, Burgenland, Upper Austria and Styria, were investigated for the presence of *Salmonella enterica*, *Brucella* spp., *Corynebacterium* spp. and other pathogenic bacteria. Materials and methods Laboratory testing of tonsils was carried out according to OIE, Manual of diagnostic tests and vaccines for terrestrial animals, Chapter 2.9.8., Salmonellosis and ISO 6579:2002/Amd 1:2007 (Annex D). *Salmonella* serovars were established by slide agglutination tests using both polyvalent and specific sera against somatic (O) and flagellar (H) antigens according to the White-Kauffmann-Le Minor scheme. *Brucellae* were isolated from mandibular lymph nodes using 10 % sheep blood Columbia agar and a selective supplement incubated at 37 degrees C in ambient air. The isolates were phenotyped using standard methods. Molecular identification was performed with the INGene Bruce-ladder suis kit. Isolation and identification of other pathogens was performed using standard bacteriological methods, API (R) 20 Strep, API (R) Coryne, MALDI-TOF MS and 16S rDNA partial gene sequencing. Results The examination of the tonsils from 55 animals (11.2 %) revealed an infection with *Salmonella enterica*. *Salmonella* Choleraesuis could be identified in 35 animals (7.2 %). Five wild boars (1.0 %) were infected with *Salmonella* Hessarek four with *Salmonella* Typhimurium (0.8 %). The following serotypes were found in single animals: *Salmonella* Abony, *Salmonella* Thompson, *Salmonella enterica* subsp. *salamae*, *Salmonella enterica* subsp. *diarizonae* and one monophasic strain group B and C1. *Brucella suis* biovar 2 was isolated from twelve wild boars from eight districts in three federal states. *Corynebacterium ulcerans* (26 isolates), *Streptococcus porcinus* (23 isolates), *Rhodococcus equi* (three isolates) and *Actinomyces hyovaginalis* (one isolate) were cultured from lymph node-abscesses. Conclusions There is a potential risk of spillover of *Salmonella enterica*, *Brucella suis* biovar 2 and *Corynebacterium ulcerans* from wild boars to domestic pigs or humans. The results show the importance of monitoring the wild boar population on a national level to gain valid data on endemic pathogens that can affect humans as well as domestic animals.

First Serological Evidence on Endemicity of HEV Infection in Wild Boar (*Sus scrofa*) Populations from Portugal.

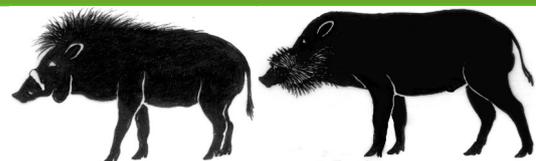
Goncalves, D., Pereira-Vaz, J., Duque, V., Bandeira, V., Fonseca, C., Donato, A., . . . Matos, A.M. *Virologica Sinica*, 33(2): 197-200. doi:10.1007/s12250-018-0008-3

No abstract.





New literature on Suiformes



Seroprevalence of *Brucella suis* in eastern Latvian wild boars (*Sus scrofa*).

Grantina-levina, L., Avsejenko, J., Cvetkova, S., Krastina, D., Streikisa, M., Steingolde, Z., . . . Rodze, I.

Acta Veterinaria Scandinavica, 60. doi:10.1186/s13028-018-0373-9

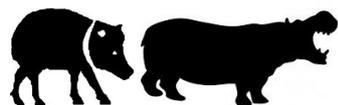
Brucellosis due to *Brucella suis* biovar 2 is one of the most important endemic diseases in wild boar (*Sus scrofa*) populations in Europe. The aim of the present study was to determine the seroprevalence of brucellosis in wild boars in the eastern part of Latvia. Wild boars killed by hunters in the period from January to April 2015 (n = 877) and from March to April in 2016 (n = 167) were examined for antibodies against *B. suis* by the Rose Bengal test (RBT), a complement fixation test (CFT), and by enzyme-linked immunosorbent assays. In 2015, 199 samples (22.7%) were positive by RBT and/or CFT while 36 samples (21.6%) were seropositive in 2016. Of the *Brucella* seropositive samples from 2015 and 2016 (n = 235), 162 (68.9%) were also seropositive to *Yersinia enterocolitica*. Considering cross-reactivity of serological tests, the seroprevalence of *B. suis* biovar 2 exposure in wild boars in the eastern part of Latvia was calculated to 14.0% in 2015 and 9.6% in 2016. From selected seropositive samples (42 in 2015 and 36 in 2016) total DNA was extracted and analyzed with an IS711-based nested polymerase chain reaction (PCR) assay. Species and biovar identification was conducted for bacteria isolated in monoculture from PCR positive samples by species specific primers and Bruce-ladder multiplex PCR. *Brucella suis* biovar 2 was isolated from 12/20 samples in 2015 and 9/9 samples in 2016. The average seroprevalence was relatively low compared to that found in certain other European countries. Males and females had an equal level of seropositivity, but a positive age-trend was observed for both males and females.

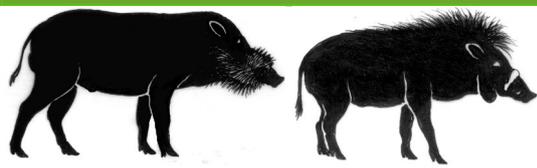
Serological survey in wild boar (*Sus scrofa*) in Switzerland and other European countries: *Sarcoptes scabiei* may be more widely distributed than previously thought.

Haas, C., Origgi, F.C., Rossi, S., Lopez-Olvera, J.R., Rossi, L., Castillo-Contreras, R., . . . Ryser-Degiorgis, M.P.

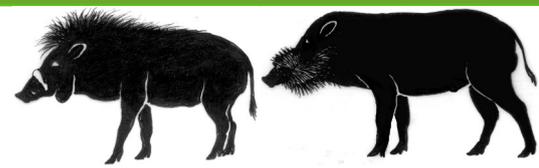
Bmc Veterinary Research, 14. doi:10.1186/s12917-018-1430-3

Sarcoptic mange has recently emerged in wild boar in Switzerland, raising the question of the origin of the infection. The main aim of this study was to assess the extent of exposure of the wild boar populations to *Sarcoptes scabiei* in Switzerland, prior to and after the detection of mange cases, to determine whether the mite has been recently introduced into the populations concerned. We performed a serological survey using a commercially available ELISA and 1056 archived blood samples of free-ranging wild boar from Switzerland. To facilitate the interpretation of the obtained data, we additionally estimated seroprevalence in wild boar populations of four other European countries (1060 samples), both from areas with confirmed clinical cases of mange and from areas without reported cases in wild boar. Lastly, we revised the evaluation of the commercial ELISA when used with wild boar sera. Results: Seropositive reactions were observed for samples from all five countries and from 15 of the 16 study areas. The obtained apparent seroprevalences ranged from 0.0% (0/82; 95% confidence interval [CI]: 0.0-4.4) to 17.4% (8/46; 95% CI: 7.8-31.4). Wild boar from study areas with known clinical cases and those <= 60 kg were four times more likely to be seropositive than wild boar from areas without reported cases and > 60 kg, respectively. Optical density values did not differ between the two types of study areas among seropositive samples but were significantly lower among seronegative





New literature on Suiformes



samples from areas without than from areas with clinical cases. No difference was observed between the two sampling periods in Switzerland. The revised ELISA specificity was 96.8% (984/1017; 95% CI: 95.5-97.7) when wild boar from areas without history of mange were considered truly negative. Conclusions: Seropositivity to *S. scabiei* is more frequent and occurs over a larger geographic range than expected. Data suggest that the parasite is endemic within the wild boar populations of Switzerland and other European countries but that its presence is not necessarily associated with disease occurrence. Extrinsic factors which trigger disease emergence in infected populations remain to be investigated. The applied ELISA represents a promising tool for future studies.

Evidence of pseudorabies virus shedding in feral swine (*Sus scrofa*) populations in Florida, USA.

Hernandez, F.A., Saylor, K.A., Bounds, C., Milleson, M.P., Carr, A.N., Wisely, S.M.

Journal of Wildlife Diseases, 54(1): 45-53. doi:10.7589/2017-04-071

Feral swine (*Sus scrofa*) are a pathogen reservoir for pseudorabies virus (PrV). The virus can be fatal to wildlife and contributes to economic losses in the swine industry worldwide. National surveillance efforts in the US use serology to detect PrV-specific antibodies in feral swine populations, but PrV exposure is not a direct indicator of pathogen transmission among conspecifics or to non-suid wildlife species. We measured antibody production and the presence of PrV DNA in four tissue types from feral swine populations of Florida, US. We sampled blood, nasal, oral, and genital swabs from 551 individuals at 39 sites during 2014-16. Of the animals tested for antibody production, 224 of 436 (51%) feral swine were antibody positive while 38 of 549 feral swine (7%) tested for viral shedding were quantitative polymerase chain reaction (qPCR)-positive for PrV. The detection of PrV DNA across all the collected sample types (blood, nasal, oral, and genital [vaginal] swabs) suggested viral shedding via direct (oronasal or venereal), and potentially indirect (through carcass consumption), routes of transmission among infected and susceptible animals. Fourteen of 212 seronegative feral swine were qPCR-positive, indicating 7% false negatives in the serologic assay. Our findings suggest that serology may underestimate the actual infection risk posed by feral swine to other species and that feral swine populations in Florida are capable of shedding the virus through multiple routes.

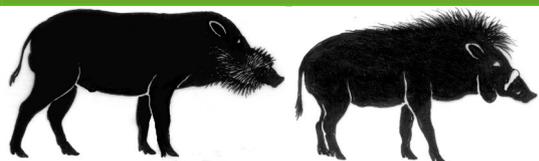
An unexpected case of a Japanese wild boar (*Sus scrofa leucomystax*) infected with the giant thorny-headed worm (*Macracanthorhynchus hirudinaceus*) on the mainland of Japan (Honshu).

Kamimura, K., Yonemitsu, K., Maeda, K., Sakaguchi, S., Setsuda, A., Varcasia, A., Sato, H.

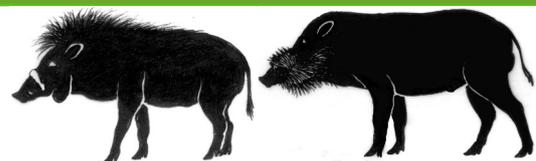
Parasitology Research, 117(7): 2315-2322. doi:10.1007/s00436-018-5922-7

The giant thorny-headed worm *Macracanthorhynchus hirudinaceus* is a zoonotic acanthocephalan species with a worldwide distribution. Its natural definitive hosts are primarily pigs and wild boars (*Sus scrofa*), and scarabaeid beetles serve as the intermediate host. To date, there has only been one record of this acanthocephalan in Japan: a Ryukyu wild boar (*Sus scrofa riukiuanus*) hunted in 1973 on Amami Island, faraway from the Japanese mainland. The present study reports the second case of this acanthocephalan in Japan: a Japanese wild boar (*Sus scrofa leucomystax*) hunted in May 2017 in Yamaguchi Prefecture, the westernmost part of the Japanese mainland (Honshu). More than a dozen acanthocephalans (123 to 233 mm in length and 5 to 6 mm in width) were found with their proboscides inserted deeply into the intestinal wall,





New literature on Suiformes



forming grossly visible nodules on the external surface. Isolated worms underwent a molecular genetic characterization of the ribosomal RNA gene (rDNA) and mitochondrial cytochrome c oxidase subunit 1 gene (cox-1). Long rDNA nucleotide sequences (5870 to 5890 bp) spanning the beginning of the 18S rDNA through to the 28S rDNA, including the internal transcribed spacer regions, and 1384-bp cox-1 nucleotide sequences were obtained. In the future, in conjunction with the accumulation of molecular genetic data of multiple *M. hirudinaceus* isolates from different endemic localities abroad, our data may help to postulate the origin or present transmission status of this extremely rarely encountered acanthocephalan in Japan.

Detection of *Brucella suis*, *Campylobacter jejuni*, and *Escherichia coli* Strains in Feral Pig (*Sus scrofa*) Communities of Georgia.

Lama, J. K., Bachoon, D. S.

Vector-Borne and Zoonotic Diseases, 18(7): 350-355. doi:10.1089/vbz.2017.2187

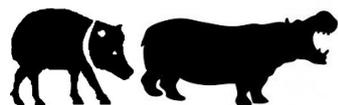
Feral pigs (*Sus scrofa*) are an environmentally destructive invasive species that act as a reservoir for zoonotic pathogens. The aim of this study was to determine the presence of *Brucella suis*, *Campylobacter jejuni*, and of *Escherichia coli* in feces of feral pigs from Georgia. Fecal samples were collected from 87 feral pigs from forested and agricultural regions of Georgia. DNA was extracted from the fecal samples and quantitative PCR (qPCR) was used to screen for each of the four pathogens. The qPCR assays indicated that *B. suis* and eaeA-containing strains of *E. coli* was present in about 22% and 28% of the samples, respectively. *C. jejuni* was undetected in any of the feral pig fecal samples. The incidence of *B. suis* was higher in the pigs from forested region, whereas *E. coli* strains possessing eaeA gene incidence was higher in the pigs from agricultural regions. In Georgia, feral pigs harbor infectious agents and are a growing threat to the transmission of pathogens to native wildlife, humans, and food crops.

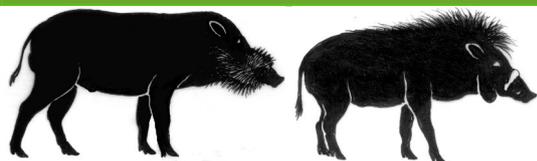
Inferring the evolution of the major histocompatibility complex of wild pigs and peccaries using hybridisation DNA capture-based sequencing.

Lee, C., Moroldo, M., Perdomo-Sabogal, A., Mach, N., Marthey, S., Lecardonnel, J., . . . Gongora, J.

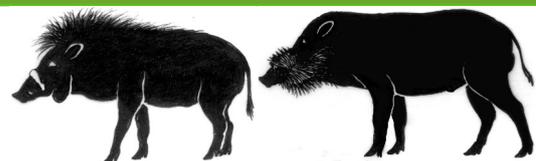
Immunogenetics, 70(6): 401-417. doi:10.1007/s00251-017-1048-9

The major histocompatibility complex (MHC) is a key genomic model region for understanding the evolution of gene families and the co-evolution between host and pathogen. To date, MHC studies have mostly focused on species from major vertebrate lineages. The evolution of MHC classical (Ia) and non-classical (Ib) genes in pigs has attracted interest because of their antigen presentation roles as part of the adaptive immune system. The pig family Suidae comprises over 18 extant species (mostly wild), but only the domestic pig has been extensively sequenced and annotated. To address this, we used a DNA-capture approach, with probes designed from the domestic pig genome, to generate MHC data for 11 wild species of pigs and their closest living family, Tayassuidae. The approach showed good efficiency for wild pigs (similar to 80% reads mapped, similar to 87x coverage), compared to tayassuids (similar to 12% reads mapped, similar to 4x coverage). We retrieved 145 MHC loci across both families. Phylogenetic analyses show that the class Ia and Ib genes underwent multiple duplications and diversifications before suids and tayassuids diverged from their common ancestor. The histocompatibility genes mostly form orthologous groups and there is genetic differentiation for most of these genes between Eurasian and sub-Saharan African wild pigs. Tests of selection showed that the peptide-binding region of





New literature on Suiformes



class Ib genes was under positive selection. These findings contribute to better understanding of the evolutionary history of the MHC, specifically, the class I genes, and provide useful data for investigating the immune response of wild populations against pathogens.

Prevalence of antibodies to Aujeszky's disease virus in wild boar in Poland, between 2011 and 2014: a retrospective study.

Lipowski, A., Szczotka-Bochniarz, A., Pejsak, Z.

Journal of Veterinary Research, 61(4), 397-404. doi:10.1515/jvetres-2017-0052

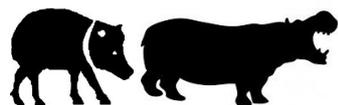
Introduction: Aujeszky's disease virus (ADV) infects a wide range of animals, including members of the Suidae family, i.e. domestic and wild pigs, as well as wild boar. Since wild boar are a potential ADV reservoir and a source of infection for domestic pigs, the aim of the study was to evaluate ADV antibody prevalence in the Polish wild boar population, during the years 2011 to 2014. Material and Methods: Wild boar blood samples were collected during three consecutive hunting seasons; i.e. 2011/2012, 2012/2013, and 2013/2014, and tested for ADV antibodies by ELISA. Results: ADV antibodies were detected in samples from all tested voivodships. The average seroprevalence reached 32.2%. Seroprevalence, over the examined hunting seasons, was 27.4% in 2011/2012, 32.4% in 2012/2013, and 35.5% in 2013/2014. The highest percentage of seroreagents was detected in four voivodships, situated along the western border of Poland, i.e. Zachodnio-Pomorskie (ZP), Lubuskie (LB), Dolnoslaskie (DS), and Opolskie (OP). This area is positively correlated with the highest density of the wild boar population and the highest wild boar hunting bag. Conclusion: The results of this study confirm that the wild boar population may still pose a threat to domestic pigs, which is of special importance at the final stage of Aujeszky's disease eradication programme in Poland.

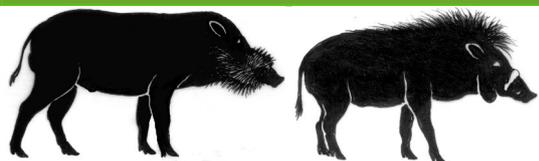
Determination of ochratoxin A in tissues of wild boar (*Sus scrofa* L.) by enzymatic digestion (ED) coupled to high-performance liquid chromatography with a fluorescence detector (HPLC-FLD).

Luci, G., Intorre, L., Ferruzzi, G., Mani, D., Giuliotti, L., Pretti, C., . . . Meucci, V.

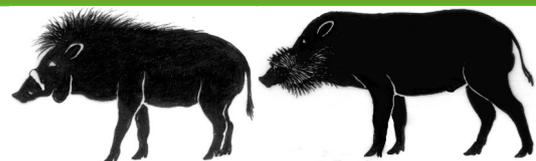
Mycotoxin Research, 34(1): 1-8. doi:10.1007/s12550-017-0292-z

Ochratoxin A (OTA) is a secondary toxic metabolite synthesized by *Aspergillus* or *Penicillium* species, which can contaminate various crops. The International Agency for Research on Cancer (IARC) classified OTA as a group 2B possible human carcinogen. The aim of the present study was to assess OTA concentrations in tissues of wild boar (*Sus scrofa* L.) from Tuscany (Italy). Over a period of 2 years, samples of muscle, liver, and kidney from 48 wild boars were collected and concentrations of OTA were determined by enzymatic digestion (ED) coupled to high-performance liquid chromatography with a fluorescence detector (HPLC-FLD). The highest concentrations of OTA were found in the kidneys of the 48 wild boars analyzed. No difference in concentrations was found based on years of collection and sex while a significantly higher OTA concentration was found in the kidney of the young wild boars with respect to the adult one. Monitoring the quality of meat destined for transformation is a priority in order to decrease the possibility of toxin carry-over to humans. The present study showed that contamination of wild boar meat products by OTA represents a potential emerging source of OTA.





New literature on Suiformes



Variability of anserine and carnosine concentration in the wild boar (*Sus scrofa scrofa*) meat.

Lukasiewicz, M., Puppel, K., Balcerak, M., Slosarz, J., Golebiewski, M., Kuczynska, B., . . . Popczyk, B.

Animal Science Papers and Reports, 36(2): 185-192.

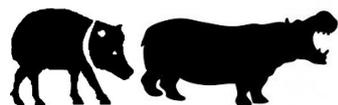
Wild game meat becomes an important part of the diet, and its participation in consumption in recent years has increased. Several studies have confirmed that European wild boar meat has some favorable characteristics that distinguish it from other red meats. Notwithstanding, the information regarding the antioxidant capacity of wild boar meat, particularly of the protein fraction - concentration of anserine and carnosine, is scarce. Carnosine and anserine have been shown to prevent lipid peroxidation and to act as neurotransmitters, modulators of enzymatic activities and chelates of heavy metals. The aim of the study was to evaluate the antioxidant capacity of the wild boar meat, through determining the anserine and carnosine content in relation to age, sex, and type of muscle. The samples of wild boar meat used in this study were sampled from 58 wild boars (14 males, 16 females and 28 shoats) shot during 4 battues in December 2015 and January 2016. The data were analyzed statistically by three-way ANOVA, and Tukey's post-hoc test. The study revealed that, sex, age, and muscle type played a significant role in shaping the concentration of both bioactive compounds. The concentrations of carnosine and anserine in mg g⁻¹ of meat ranged between 2.13-3.47 and 1.38-3.82, respectively. In females, the concentrations of the dipeptides increased visibly with age, reaching about 41% (8% higher than in the early postnatal period) in longissimus dorsi (MLD), and about 50% (11% higher) in Semimembranosus (MS). In males, no significant age caused changes in carnosine concentration have been observed, while anserine concentration decreased by about 11% in MLD, and increased some 14 % in MS. Based on the present results, it can be assumed that the synthesis of carnosine and anserine were dependent on animal age and sex - concentrations of both dipeptides were higher in females than in males and increased with age. Therefore, from the concentration of carnosine and anserine point of view, culling of sows should take place later in their lives while culling of the boars can take place earlier, to control the wild boar population.

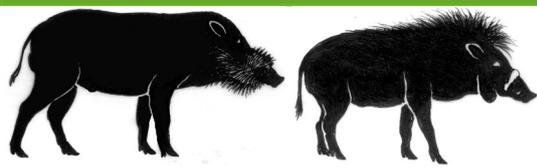
Tuberculosis in Southern Brazilian wild boars (*Sus scrofa*): First epidemiological findings.

Maciel, A.L.G., Loiko, M.R., Bueno, T.S., Moreira, J.G., Coppola, M., Dalla Costa, E.R., . . . Mayer, F.Q.

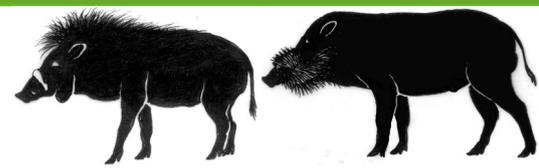
Transboundary and Emerging Diseases, 65(2): 518-526. doi:10.1111/tbed.12734

Bovine tuberculosis (bTB) is a zoonosis caused mainly by *Mycobacterium bovis* that affects domestic and wild animals. In Brazil, there are no epidemiological studies on tuberculosis in wild animal populations and their possible role in the disease maintenance in cattle herds; thus, the aim of this study was to evaluate the occurrence of tuberculosis in wild boars in Rio Grande do Sul, southern Brazil. Tissue samples of animals hunted under government consent were submitted to histopathology and *M.bovis* polymerase chain reaction (PCR) as screening tests; the positive samples were subsequently submitted to bacterial isolation, the gold standard diagnosis. Eighty animals were evaluated, of which 27.9% and 31.3% showed histopathological changes and *M.bovis* genome presence, respectively. Moreover, 23.8% of the animals had at least one organ with isolates classified as *Mycobacterium tuberculosis* complex (MTC). Three hunting points were risk factors for positive results on screening tests. This study shows the occurrence of tuberculosis in a wild boars' population, and raise the possibility of these animals to play a role as





New literature on Suiformes



disease reservoirs in southern Brazil. These results may help to improve the Brazilian tuberculosis control programme, as well as elucidate the circulation of mycobacteria in this country.

A serological survey of pathogens in wild boar (*Sus scrofa*) in Sweden.

Malmsten, A., Magnusson, U., Ruiz-Fons, F., Gonzalez-Barrio, D., Dalin, A.M.

Journal of Wildlife Diseases, 54(2): 229-237. doi:10.7589/2017-05-120

The wild boar (*Sus scrofa*) population has increased markedly during the last three decades in Sweden and in other parts of Europe. This population growth may lead to increased contact between the wild boar and the domestic pig (*Sus scrofa scrofa*), increasing the risk of transmission of pathogens. The objective of our study was to estimate the seroprevalence of selective pathogens, known to be shared between wild boars and domestic pigs in Europe, in three wild boar populations in Sweden. In total, 286 hunter-harvested female wild boars were included in this study. The sera were analyzed for antibodies against nine pathogens using different commercial or in-house enzyme-linked immunosorbent assays. Antibodies were detected against porcine parvovirus (78.0%), porcine circovirus type 2 (99.0%), swine influenza virus (3.8%), *Erysipelothrix rhusiopathiae* (17.5%), *Mycoplasma hyopneumoniae* (24.8%), and *Toxoplasma gondii* (28.6%). No antibodies were detected against porcine respiratory and reproductive syndrome virus, *Brucella suis*, or *Mycobacterium bovis*. Our results highlight the potential importance of the wild boar as a reservoir for pathogens potentially transmissible to domestic pigs and which also may affect human health.

Molecular Population Structure for Feral Swine in the United States.

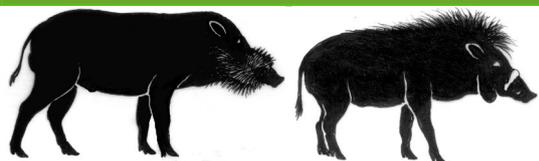
McCann, B.E., Smyser, T.J., Schmit, B.S., Newman, R.A., Piaggio, A.J., Malek, M.J., . . .

Simmons, R.B.

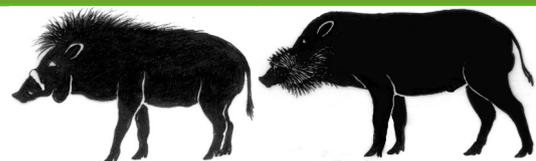
Journal of Wildlife Management, 82(4): 821-832. doi:10.1002/jwmg.21452

Feral swine (*Sus scrofa*) have invaded most of the United States and continue to expand throughout North America. Given the ecological and economic threats posed by increasing feral swine abundance, it is imperative to develop an understanding of their patterns of natural range expansion and human-mediated introductions. Towards this goal, we used molecular markers to elucidate the genetic structure of feral swine populations throughout the United States and evaluated the association between historical introductions and contemporary patterns of genetic organization. We used STRUCTURE and discriminant analysis of principal components (DAPC) to delineate genetic clusters for 959 individuals genotyped at 88 single nucleotide polymorphism loci. We identified 10 and 12 genetic clusters for the 2 clustering approaches, respectively. We observed strong agreement in clusters across approaches, with both describing clusters having strong geographic association at regional levels reflecting past introduction and range expansion patterns. In addition, we evaluated patterns of isolation by distance to test for and estimate spatial scaling of population structure within western, central, and eastern regions of North America. We found contrasting spatial patterns of genetic relatedness among regions, suggesting differences in the invasion process, likely as a result of regional variation in landscape heterogeneity and the influence of human-mediated introductions. Our results indicate that molecular analyses of population genetic structure can provide reliable insights into the invasion processes of feral swine, thus providing a useful basis for management focused on minimizing continued range expansion by this problematic species.





New literature on Suiformes



De novo assembly of mitochondrial genomes provides insights into genetic diversity and molecular evolution in wild boars and domestic pigs.

Ni, P., Bhuiyan, A.A., Chen, J.H., Li, J.J., Zhang, C., Zhao, S.H., . . . Li, K.

Genetica, 146(3): 277-285. doi:10.1007/s10709-018-0018-y

Up to date, the scarcity of publicly available complete mitochondrial sequences for European wild pigs hampers deeper understanding about the genetic changes following domestication. Here, we have assembled 26 de novo mtDNA sequences of European wild boars from next generation sequencing (NGS) data and downloaded 174 complete mtDNA sequences to assess the genetic relationship, nucleotide diversity, and selection. The Bayesian consensus tree reveals the clear divergence between the European and Asian clade and a very small portion (10 out of 200 samples) of maternal introgression. The overall nucleotide diversities of the mtDNA sequences have been reduced following domestication. Interestingly, the selection efficiencies in both European and Asian domestic pigs are reduced, probably caused by changes in both selection constraints and maternal population size following domestication. This study suggests that de novo assembled mitogenomes can be a great boon to uncover the genetic turnover following domestication. Further investigation is warranted to include more samples from the ever-increasing amounts of NGS data to help us to better understand the process of domestication.

A comparison of selenium concentrations in selected organs of wild boar (*Sus scrofa*) from industrialized and non-industrialized regions of Poland.

Nowakowska, E., Pilarczyk, B., Pilarczyk, R., Tomza-Marciniak, A., Bakowska, M.

Environmental Science and Pollution Research, 25(6), 6079-6084. doi:10.1007/s11356-018-1263-4

The aim of this study was to compare selenium concentration in the liver and kidneys of wild boar inhabiting industrialized and non-industrialized regions of Poland. Selenium concentrations in organs were determined using spectrofluorometric method. In all the animals studied, Se concentrations were a few times lower than in kidneys which may indicate too low content of this element either in the boar's diet or the presence of a poorly absorbable form of Se. No statistically significant differences were noted in the mean Se concentrations in the liver and kidney of wild boar from industrialized and non-industrialized areas. In the case of wild boar, it seems that the level of selenium in their organs is more dependent on geochemical conditions in the specific feeding ground than on the scale of regional industrialization, and that this situation is most likely related to the specificity of wild boar feeding.

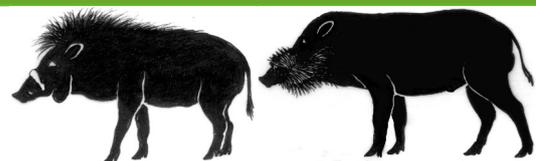
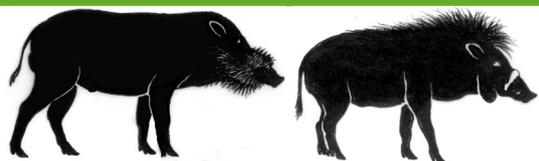
Antibody evidence of porcine reproductive and respiratory syndrome virus detected in sera collected from feral swine (*Sus scrofa*) across the United States.

Pedersen, K., Miller, R.S., Musante, A.R., White, T.S., Freye, J.D., Gidlewski, T.

Journal of Swine Health and Production, 26(1): 41-44.

Feral swine sera from across the United States were tested for antibodies to porcine reproductive and respiratory syndrome virus. Antibodies to the virus were detected in 1.2% (68 of 5506) of the samples tested, suggesting that feral swine are unlikely to be an important source of spillback into domestic swine.





Genome-wide associations identify novel candidate loci associated with genetic susceptibility to tuberculosis in wild boar.

Queiros, J., Alves, P.C., Vicente, J., Gortazar, C., de la Fuente, J.

Scientific Reports, 8. doi:10.1038/s41598-018-20158-x

Tuberculosis (TB) affects a wide range of host species worldwide. Understanding host-pathogen co-evolution remains a global challenge owing to complex interactions among host genetic factors, pathogen traits and environmental conditions. We used an endemic wild boar population that had undergone a huge increase in *Mycobacterium bovis* infection prevalence, from 45% in 2002/06 to 83% in 2009/12, to understand the effects of host genetics on host TB outcomes and disease dynamics. Host genomic variation was characterized using a high-density single nucleotide polymorphism (SNP) array, while host TB phenotype was assessed using both gross pathology and mycobacterial culture. Two complementary genome-wide association (GWAS) analyses were conducted: (i) infected-uninfected; and (ii) 2002/06-2009/12. The SNPs with the highest allelic frequency differences between time-periods and TB outcomes were identified and validated in a large dataset. In addition, we quantified the expression levels of some of their closest genes. These analyses highlighted various SNPs (i.e. rs81465339, rs81394585, rs81423166) and some of the closest genes (i.e. LOC102164072, BDNF/NT-3, NTRK2, CDH8, IGSF21) as candidates for host genetic susceptibility. In addition to TB-driven selection, our findings outline the putative role of demographic events in shaping genomic variation in natural populations and how population crashes and drift may impact host genetic susceptibility to TB over time.

***Alaria* spp. *mesocercariae* in Eurasian badger (*Meles meles*) and wild boar (*Sus scrofa*) from the Bialowieza Forest, north-eastern Poland.**

Renteria-Solis, Z., Kolodziej-Sobocinska, M., Riehn, K.

Parasitology Research, 117(4): 1297-1299. doi:10.1007/s00436-018-5819-5

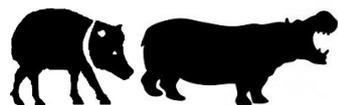
Alaria spp. *mesocercariae* are commonly found in wild boar and other omnivorous mammals. In Europe, the number of cases presenting *Alaria mesocercariae* infections has been on the rise in the last years. From October to December 2016, samples of muscle from tongue, neck, and mandibular regions were collected from 1 Eurasian badger (*Meles meles*) and 14 wild boars (*Sus scrofa*) hunted in the Bialowieza Forest, north-eastern Poland. Using the *Alaria* migration technique (AMT), *Alaria mesocercariae* were isolated and morphologically identified in one badger and one wild boar. To the authors' knowledge, this is the first report of *Alaria mesocercariae* in paratenic hosts from the Bialowieza Forest.

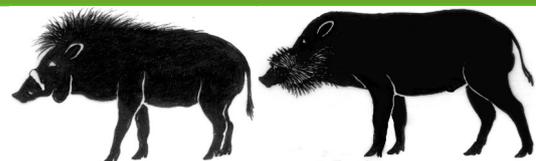
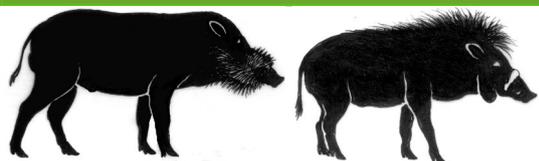
Prevalence of hepatitis E virus infection in wild boars from Spain: a possible seasonal pattern?

Rivero-Juarez, A., Risalde, M.A., Frias, M., Garcia-Bocanegra, I., Lopez-Lopez, P., Cano-Terriza, D., . . . Rivero, A.

Bmc Veterinary Research, 14. doi:10.1186/s12917-018-1377-4

Background: It has been shown that wildlife can serve as natural reservoirs of hepatitis E virus (HEV). The wild boar (*Sus scrofa*) is probably the main natural reservoir of HEV and could therefore represent an important route of transmission in Europe, especially in regions where game meat is widely consumed. We evaluated the prevalence of HEV infection in wild boar in the south of Spain, with the aim of identifying associated risk factors. A cross-sectional study that





included hunted wild boar was carried out during the 2015/2016 hunting season (October 15 to February 15) in Andalusia (southern Spain). The outcome variable was HEV infection, defined as amplification of HEV RNA in serum by RT-PCR. Results: A total of 142 animals, selected from 12 hunting areas, were included and formed the study population. Thirty-three wild boars (23.2%; 95% CI: 16.8%-30.7%) were positive for HEV infection. Prevalence peaked in October and November, then gradually declined until the end of December. After multivariate analysis, only hunting date was independently associated with HEV infection across sex and age. Conclusions: Our study found a relatively high prevalence of HEV infection in wild boar in the south of Spain, suggesting that prevalence may depend on the season when the animal is hunted. In consequence, the potential risk of zoonotic transmission could fluctuate.

Molecular identification of *Trichinella* spp. in wild boar, and serological survey of high-risk populations in Iran.

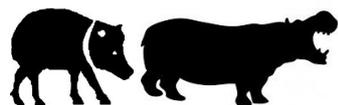
Rostami, A., Khazan, H., Kia, E.B., Bandehpour, M., Mowlavi, G., Kazemi, B., Taghipour, N. Food Control, 90: 40-47. doi:10.1016/j.foodcont.2018.02.016

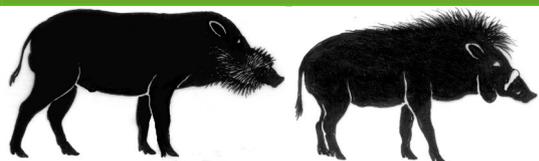
After half a century, *Trichinella* infection has been reported in humans following ingestion of wild boar meat hunted in Northern Iran. We have performed a cross-sectional study to evaluate the prevalence of *Trichinella* spp. infections in wild boar and prevalence of anti-*Trichinella* antibodies among at-risk individuals for the first time in Iran. Muscle and sera samples were collected from 79 wild boars and 364 at-risk individuals. *Trichinella* infection has been investigated by artificial digestion and molecular identification (in wild boar muscles) and by serology (in humans). *Trichinella* larvae were isolated from three wild boars (3,7%; 95% CI, 2.9-4.3). The isolated larvae were identified as *T. britovi* using CO1 and 5S rRNA gene primers amplification. The percent identity regarding to 5S rRNA gene (98.7-100%) and divergence (0-1.9%) further confirmed the isolates as *T. britovi*. Of the 364 participants, anti-*Trichinella* IgG were detected in 8 (2.2%; CI 95%, 1,9-2.4). Risk factors associated with *Trichinella* infection seropositivity in humans, were hunter being (OR, 13.5; 95% CI, 3.1-59.4; P = 0.003) and high consumption (more than 7 time in a year) of wild boar meat (OR, 17.5; 95% CI, 3.2-93.6; P < 0.001). In conclusion, results of this study emphasized that consumption of wild boar meat could be important source of human trichinellosis as a completely neglected infection disease in Iran. We suggest that the additional studies should be performed in different parts of Iran to further clarify the prevalence of trichinellosis in wild animals to guide the development of appropriate public health interventions.

A systematic review and meta-analysis on the global seroprevalence of *Trichinella* infection among wild boars.

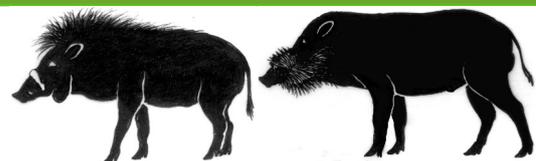
Rostami, A., Riahi, S.M., Ghadimi, R., Hanifehpour, H., Hamidi, F., Khazan, H., Gamble, H.R. Food Control, 91, 404-411. doi:10.1016/j.foodcont.2018.04.028

Trichinellosis, caused by the parasitic nematode *Trichinella* spp. is a widespread foodborne zoonotic disease and is a public health concern in many countries. Wild boar is the second most important source of trichinellosis for humans. We conducted a systematic review and meta-analysis to evaluate the global seroprevalence of *Trichinella* infection among wild boar. We searched five major databases for studies reporting *Trichinella* spp. seroprevalence in wild boar between January 1995 and January 2018. Inclusion and exclusion criteria were applied. A random-effects model was used to estimate the pooled seroprevalence of *Trichinella* in wild boar. A total of 21 studies involving 16,327 wild boar from 15 countries were included in this meta-





New literature on Suiformes



analysis. The pooled seroprevalence for *Trichinella* infection in wild boar was 6% (95% CI: 3-10%; 1084/16327). The estimated seroprevalence in North America was 9% (95% CI, 1-25%), in Europe 7% (95% CI, 3-13%), in Asia 3% (95% CI, 0.0-11%) and in Oceania 3% (95% CI, 2-4%). Geographical location, gender and age were not significantly associated with seropositivity. In sub-group analysis, the pooled seroprevalence of *Trichinella* infection in wild boar when ELISA was used as the diagnostic test (16%; 95% CI, 4-34%) was significantly higher when compared to western blot (4%; 95% CI, 0-12%). These results emphasize that wild boars are a potential source for acquisition of *Trichinella* infection in humans, and surveillance programs should be implemented in high-risk countries.

The development of a screening protocol for *Salmonella* spp. and enteropathogenic *Yersinia* spp. in samples from wild boar (*Sus scrofa*) also generating MLVA-data for *Y. enterocolitica* and *Y. pseudotuberculosis*.

Sanno, A., Jacobson, M., Sterner, S., Thisted-Lambertz, S., & Aspan, A.

Journal of Microbiological Methods, 150: 32-38. doi:10.1016/j.mimet.2018.05.014

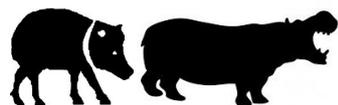
Salmonellosis and yersiniosis are notifiable human diseases that are commonly associated with contaminated food. Domestic pigs as well as wild boars and other wild-life have been identified as reservoirs of these bacteria. Methods for cultivation and molecular epidemiological investigations of *Salmonella* spp. are well established, however, cultivation of enteropathogenic *Yersinia* spp. is time-consuming and the commonly used method for molecular epidemiological investigations, pulsed-field gel electrophoresis, lack in discriminatory power. The aim of this study was to develop and evaluate a screening protocol well suited for wildlife samples and other highly contaminated samples. The method is based on PCR-screening followed by Multiple Loci Variant number tandem repeat Analysis (MLVA) on enrichment broth to obtain molecular epidemiological data for enteropathogenic *Yersinia* spp. without the need for pure isolates. The performance of the protocol was evaluated using wild boar samples (n = 354) including tonsils, faeces and lymph nodes from 90 Swedish wild boars. The new protocol performed as well as or better than the established ISO-standards for detection and cultivation of *Y. enterocolitica* and *Salmonella* spp., however for cultivation of *Y. pseudotuberculosis*, further development is needed. The selection for motility seems beneficial for the enrichment of *Salmonella* spp. and *Y. enterocolitica*. Further, the selective enrichment prior to PCR-analysis eliminates inhibitory factors present in the original sample. In total, ten isolates of *Y. enterocolitica* of various bio-serotypes were obtained, and the MLVA-profile of these isolates were consistent with the profiles from the corresponding enrichment broth. Further, 22 isolates of *Salmonella* spp. comprising six different serovars were obtained with *S. Fulica*, *S. Hadar* and a monophasic *S. Typhimurium* being the most common. In conclusion, the presented screening protocol offers a rapid and efficient way to obtain prevalence data from a large sample set as well as MLVA-data within a short time frame. These results can hence improve the knowledge on the epidemiology and distribution of these pathogens and their importance to public health.

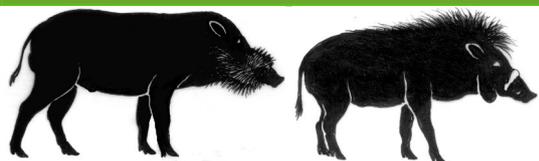
Distribution of enteropathogenic *Yersinia* spp. and *Salmonella* spp. in the Swedish wild boar population, and assessment of risk factors that may affect their prevalence.

Sanno, A., Rosendal, H., Aspan, A., Backhans, A., Jacobson, M.

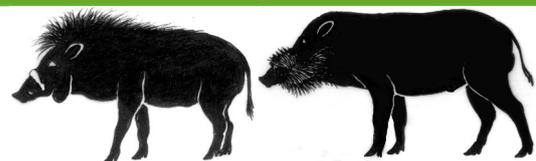
Acta Veterinaria Scandinavica, 60. doi:10.1186/s13028-018-0395-3

Background: Pure Eurasian wild boars and/or hybrids with domestic pigs are present in the wild





New literature on Suiformes



on most continents. These wild pigs have been demonstrated to carry a large number of zoonotic and epizootic pathogens such as *Salmonella* spp., *Yersinia enterocolitica* and *Y. pseudotuberculosis*. Wild boar populations throughout Europe are growing and more and more wild boar meat is being consumed, the majority within the homes of hunters without having passed a veterinary inspection. The aim of this study was to investigate if factors such as population density, level of artificial feeding, time since establishment of a given population, and the handling of animal by-products from slaughtered animals could influence the presence of these pathogens in the wild boar. Results: In total, 90 wild boars from 30 different populations in Sweden were sampled and analysed using a protocol combining pre-cultivation and PCR-detection. The results showed that 27% of the sampled wild boars were positive for *Salmonella* spp., 31% were positive for *Y. enterocolitica* and 22% were positive for *Y. pseudotuberculosis*. In 80% of the sampled populations, at least one wild boar was positive for one of these enteropathogens and in total, 60% of the animals carried at least one of the investigated enteropathogens. The presumptive risk factors were analysed using a case-control approach, however, no significant associations were found. Conclusion: Human enteropathogens are commonly carried by wild boars, mainly in the tonsils, and can thus constitute a risk for contamination of the carcass and meat during slaughter. Based on the present results, the effect of reducing population densities and number of artificial feeding places might be limited.

Molecular Evaluation of a Case of *Fasciola hepatica* in Wild Boar in Southwestern Iran: A Case Report.

Sarkari, B., Mansouri, M., Noorpisheh Ghadimi, S., Abdolahi Khabisi, S., Doshmanziari, A. Iranian Journal of Parasitology, 13(1): 149-155.

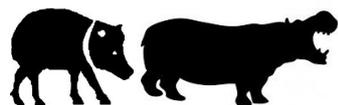
Wild boars may be infected with several zoonotic parasitic infections including *Fasciola* spp. We reported a case of *Fasciola* infection in a wild boar in Bushehr Province in southwestern Iran. The sample was isolated from the liver of a hunted wild boar. A few of adult worms were fixed and stained. DNA was extracted from apical and lateral parts of the worms and PCR amplified, targeting NADH dehydrogenase subunit 1 (*nad1*) and cytochrome C oxidase subunit 1 (*cox1*) mitochondrion genes. Although the worm was quite long and looked much similar to *F. gigantica*, sequencing and analysis of PCR products of *nad1* and *cox1* genes revealed that the isolate has the most similarity with *F. hepatica*. This is the first report of molecular evaluation of *Fasciola* spp. from wild boar in Iran.

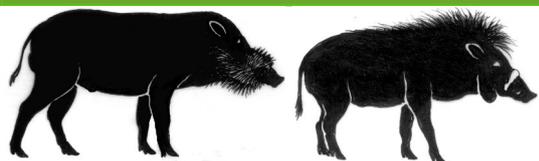
Prevalence and phylogenetic analysis of hepatitis E virus in pigs, wild boars, roe deer, red deer and moose in Lithuania.

Spancerniene, U., Grigas, J., Buitkuvieni, J., Zymantiene, J., Juozaitiene, V., Stankeviciute, M., . . . Stankevicius, A.

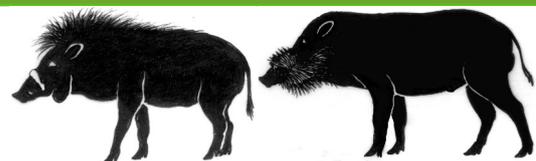
Acta Veterinaria Scandinavica, 60. doi:10.1186/s13028-018-0367-7

Background: Hepatitis E virus (HEV) is one of the major causes of acute viral hepatitis worldwide. In Europe, food-borne zoonotic transmission of HEV genotype 3 has been associated with domestic pigs and wild boar. Controversial data are available on the circulation of the virus in animals that are used for human consumption, and to date, no gold standard has yet been defined for the diagnosis of HEV-associated hepatitis. To investigate the current HEV infection status in Lithuanian pigs and wild ungulates, the presence of viral RNA was analyzed by nested reverse transcription polymerase chain reaction (RT-nPCR) in randomly selected samples, and





New literature on Suiformes



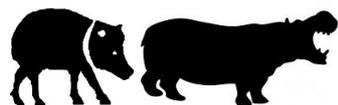
the viral RNA was subsequently genotyped. Results: In total, 32.98 and 22.55% of the domestic pig samples were HEV-positive using RT-nPCR targeting the ORF1 and ORF2 fragments, respectively. Among ungulates, 25.94% of the wild boar samples, 22.58% of the roe deer samples, 6.67% of the red deer samples and 7.69% of the moose samples were positive for HEV RNA using primers targeting the ORF1 fragment. Using primers targeting the ORF2 fragment of the HEV genome, viral RNA was only detected in 17.03% of the wild boar samples and 12.90% of the roe deer samples. Phylogenetic analysis based on a 348-nucleotide-long region of the HEV ORF2 showed that all obtained sequences detected in Lithuanian domestic pigs and wildlife belonged to genotype 3. In this study, the sequences identified from pigs, wild boars and roe deer clustered within the 3i subtype reference sequences from the GenBank database. The sequences obtained from pig farms located in two different counties of Lithuania were of the HEV 3f subtype. The wild boar sequences clustered within subtypes 3i and 3h, clearly indicating that wild boars can harbor additional subtypes of HEV. For the first time, the ORF2 nucleotide sequences obtained from roe deer proved that HEV subtype 3i can be found in a novel host. Conclusion: The results of the viral prevalence and phylogenetic analyses clearly demonstrated viral infection in Lithuanian pigs and wild ungulates, thus highlighting a significant concern for zoonotic virus transmission through both the food chain and direct contact with animals. Unexpected HEV genotype 3 subtype diversity in Lithuania and neighboring countries revealed that further studies are necessary to understand the mode of HEV transmission between animals and humans in the Baltic States region.

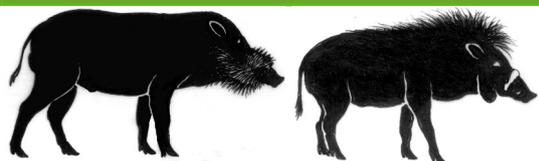
Population Genetic Structure of Wild Boars in Poland.

Tajchman, K., Drozd, L., Karpinski, M., Czyzowski, P., Goleman, M.

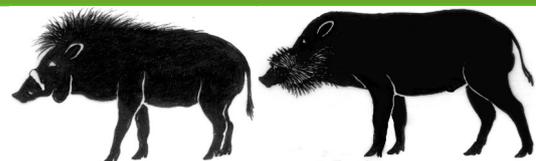
Russian Journal of Genetics, 54(5). 548-553. doi:10.1134/s1022795418050101

The analysis involved wild boars from the Lublin region, Warmia and Mazury, and Wielkopolska. The study material comprised muscle tissue samples collected from 100 wild boars. We analysed loci S0008, SW1129, SW986, SW1465, SW1492, SW1514, SW2532, SW461, SW841, SW2021, and SW2496 [1, 2]. The largest number of specific alleles, i.e. in six loci, was observed in wild boars from Warmia and Mazury; in turn, there were only two alleles in the group of wild boars from Lublin, and no alleles in individuals from Wielkopolska. The average value of the observed heterozygosity was $H(o) = 0.51$, and the average value of expected heterozygosity was $H(e) = 0.63$. PIC was another analysed indicator, with its lowest value determined for wild boars from the Wielkopolska region (0.53), and the highest value (0.62) was found for the animals from Warmia and Mazury. In the study population of wild boars, we also determined the $F(ST)$ index, which was 0.073, and $N(m)$ had a value greater than 3 (3.15); therefore, it can be concluded that the number of migrants per generation was 3. Both coefficients confirm the possibility of gene transfer and reproduction within and between the analysed populations of the wild boars. In our study, we observed a greater genetic distance between the wild boar populations from Wielkopolska and the Lublin and Warmia and Mazury regions in spite of the smaller geographical distance of these lands. This may be caused the less extensive network of ecological corridors as well as the occurrence of anthropogenic barriers e.g. large urban centres, an extensive network of roads, and the high volume of traffic in the direction of the capital.





New literature on Suiformes



The complete mitochondrial genome sequence of Changbai Mountains wild boar (Cetartiodactyla: Suidae).

Tan, Z. D., Shen, L. Y., Cheng, X., Gan, M. L., Zhang, S. H., & Zhu, L.

Conservation Genetics Resources, 10(1): 99-102. doi:10.1007/s12686-017-0773-6

The Changbai Mountains wild boar (Cetartiodactyla: Suidae) is an omnivorous, gregarious and non-hibernating animal that inhabits in Jilin province of China and is threatened by poaching and deforestation. In this study, we provide the first report of the complete mitogenome of Changbai Mountains wild boar. The total length of mitochondrial genome is 16,720 bp and consists of 22 transfer RNA genes, 13 protein-coding genes, two ribosomal RNA genes, and a major non-coding control region (D-loop region). The D-loop region contains one repeat motif. The full complement of genes in the Changbai Mountains wild boar are located on the H-strand, except for the ND6 gene and eight tRNA genes that are encoded on the L-strand. Phylogenetic analysis based on combining 13 protein-coding gene sequences of several species showed that it is closely related to genus *Sus scrofa* in north China. The mitochondrial genome of Changbai Mountains wild boar is useful for population genetics and phylogenetic analysis.

Evidence of antimicrobial and disinfectant resistance in a remote, isolated wild pig population.

Van Breda, L.K., Ward, M.P.

Preventive Veterinary Medicine, 147: 209-212. doi:10.1016/j.prevetmed.2017.09.014

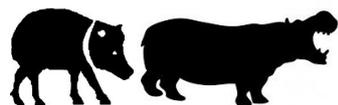
The spread of antimicrobial resistant *E. coli* within the environment is a global concern. Wildlife such as feral pigs have been identified as a possible reservoir of antimicrobial resistant bacteria. A cross-sectional survey of free-ranging, feral pigs within the Kimberley region of northwestern Australia was conducted to estimate the prevalence of antimicrobial and disinfectant resistant *E. coli* in this population. Of the 493 faecal samples collected, 115 *E. coli* isolates were randomly selected and their identity confirmed by matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF MS). Isolates were screened for susceptibility to 14 veterinary antimicrobials (including antimicrobials not permitted for use in Australia) using MIC broth microdilution using Sensititre (TM) (BOPO6F) and breakpoints according to CLSI and EUCAST guidelines. Isolates also underwent disinfectant susceptibility testing to six disinfectants at their recommended concentration for use as well as at a twofold dilution, based on methods adapted from the CLSI agar plate dilution method. A moderate prevalence of resistance was observed to sulfadimethoxine (50.4%; 58/115) and florfenicol (27.0%; 31/115). A low prevalence of resistance was estimated to chlortetracycline (5.2%; 6/115) and multi-drug resistance was only identified in 1.7% (2/115) of *E. coli* isolates tested. Isolates were susceptible to five of the six disinfectants screened. Feral pigs could potentially act as a reservoir of antimicrobial resistance in the environment with possible implications for domestic livestock. The role that feral pigs might play in transmission of antimicrobial resistance requires further investigation, and the occurrence of resistance in such isolated populations needs to be considered when attempting to infer source attribution of antimicrobial resistance in livestock and human populations.

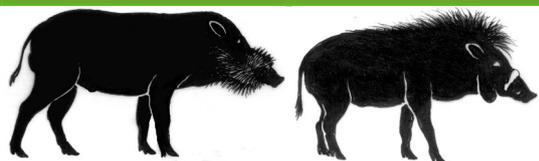
Effective Dose and Persistence of Rhodamine-B in Wild Pig Vibrissae.

Webster, S.C., Cunningham, F.L., Kilgo, J.C., Vukovich, M., Rhodes, O.E., Beasley, J.C.

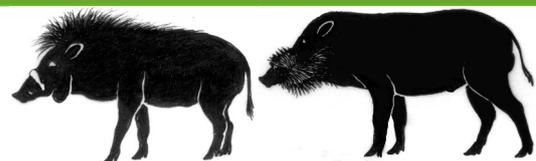
Wildlife Society Bulletin, 41(4): 764-769. doi:10.1002/wsb.834

As a result of substantial ecological and economic damage attributed to wild pigs (*Sus scrofa*),





New literature on Suiformes



there is international interest in using pharmaceutical baits to control populations. To assess the efficacy and specificity of baiting programs, chemical biomarkers can be used to evaluate uptake of pharmaceutical baits. Rhodamine B (RB) is known to be an effective biomarker in wild pigs. However, significant data gaps exist regarding the minimum effective dosage and persistence of RB in wild pigs. We used a controlled double-blind study experiment conducted in spring of 2014 on the Savannah River Site, Aiken, South Carolina, USA, wherein we administered a one-time dose of RB at 3 treatment levels (5mg/kg, 15mg/kg, or 30mg/kg) to 15 captive pigs, with 5 pigs/treatment group to investigate persistence of RB. Facial vibrissae were collected pre-RB ingestion as a control and every 2 weeks post-RB ingestion for 12 weeks. We examined samples for RB presence and used a generalized linear mixed model (GLMM) to determine the influence of treatment dose on persistence of RB. Additionally, we measured distance moved by the RB mark away from the vibrissae root and used a GLMM to assess movement rates of RB bands along growing vibrissae. We found consistently greater persistence of RB in the 15- and 30-mg/kg treatments across the sampling period. A significant, positive movement trend in RB bands was observed within the 15 mg/kg and 30 mg/kg groups. Based on our results, a 15mg/kg dosage can be considered a minimum effective dose for wild pigs and will reliably produce a detectable RB mark up to and likely beyond 12 weeks after ingestion.

Tooth outline shape analysis of the Ryukyu wild boar (*Sus scrofa riukivanus*) and the Japanese wild boar (*S. s. leucomystax*) by geometric morphometrics.

Yamada, E., Anezaki, T., Hongo, H.

Mammal Study, 43(2): 99-107. doi:10.3106/ms2017-0080

We examined whether the shapes of the teeth could be used to distinguish morphological differences of modern *Sus scrofa* between subspecies, and between regions. The occlusal outlines of the lower teeth of five populations of the Ryukyu wild boar (*S. s. riukivanus*) and two populations of the Japanese wild boar (*S. s. leucomystax*) were photographed and digitized into landmarks. The landmark coordinates were statistically compared among the populations. As a result, correct assignment rates of the populations based on their tooth shape was the highest for the fourth deciduous premolar. Pairwise test detected significant differences in tooth outline shape between the two subspecies. In addition, the tooth outline shapes of geographically adjacent populations tended to be similar. The results in this study indicated that the evaluation of tooth outline shapes, especially that of the fourth deciduous premolar, is a powerful approach for distinguishing subspecies of *S. scrofa* as well as for evaluating geographic variation among them. This method is useful in archaeological and paleontological studies because of its applicability for isolated teeth, and has potential to increase our understanding about the history of macroevolution, migration, and introduction of *S. scrofa* in the Japanese archipelago.

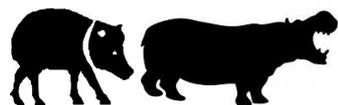
***Hepatozoon apri* n. sp (Adeleorina: Hepatozoidae) from the Japanese wild boar *Sus scrofa leucomystax* (Mammalia: Cetartiodactyla).**

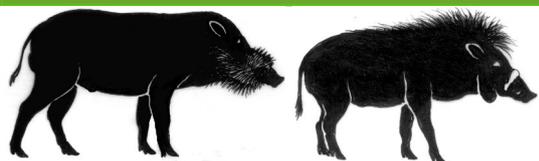
Yamamoto, M., Tokiwa, T., Tobiume, M., Akamatsu, S., Matsuo, K., Moribe, J., Ike, K.

International Journal for Parasitology-Parasites and Wildlife, 6(3): 354-360.

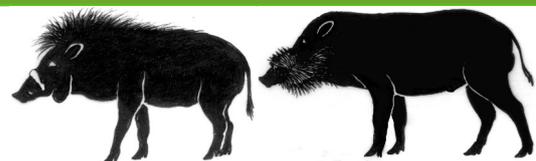
doi:10.1016/j.ijppaw.2017.11.001

Hepatozoon apri n. sp. is described from Japanese wild boars *Sus scrofa leucomystax* in Japan. The gamonts in the peripheral blood leukocytes were 11.6 +/- 1.4 x 6.7 +/- 1.3 μ m in size. The meronts in the muscle tissues were 35.0-47.5 μ m in length and 26.5-30 μ m in width. A high





New literature on Suiformes



rate (53.0%) of infection was found by nested PCR using muscle specimens from 181 wild boars captured in Tokushima, Japan. A phylogenetic analysis based on 18S rRNA gene sequences revealed that *H. apri n. sp.* detected in wild boars is closely related to *Hepatozoon* spp. isolated from carnivores. This is the first description of a species belonging to the genus *Hepatozoon* detected in ungulates.

Aberrant growth of maxillary canine teeth in male babirusa (genus *Babyrousa*).

Macdonald A.A.

Comptes Rendues Biologies 341: 245-255

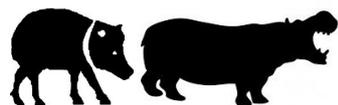
A worldwide survey of babirusa skulls curated in museum and private collections located 431 that were from adult males and had retained at least one maxillary canine tooth. Eighty-three of these skulls were identified as exhibiting aberrant maxillary canine tooth growth. Twenty-four of the skulls represented babirusa from Buru and the Sula Islands, and forty-five skulls represented babirusa from Sulawesi and the Togian Islands. The remaining series of fourteen babirusa skulls originally came from zoo animals. Fifteen skulls showed anomalous alveolar and tooth rotation in a median plane. Twenty-nine skulls had maxillary canine teeth that did not grow symmetrically towards the median plane of the cranium. Fourteen skulls showed evidence that the tips of one or both maxillary canine teeth had eroded the nasal bones. Twenty-one skulls had maxillary canine teeth that had eroded the frontal bones. The teeth of two skulls had eroded a parietal bone. One skull had two maxillary canines arising from an adjacent pair of alveoli on the left side of the cranium. Three skulls exhibited alveoli with no formed maxillary canine teeth in them. Analysis suggested that approximately 12% of the adult male babirusa in the wild experience erosion of the cranial bony tissues as a result of maxillary canine tooth growth. There was no skeletal evidence that maxillary canine teeth penetrate the eye.

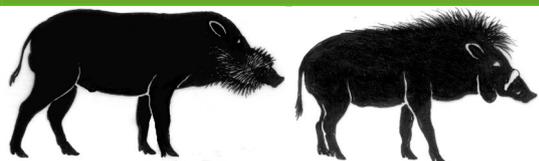
Maxillary tooth growth in the adult male babirusa (genus *Babyrousa*).

Macdonald, A.A., Shaw, D.J.

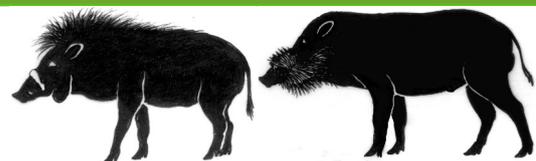
Comptes Rendues Biologies 341: 235-244

The growth of the maxillary canine teeth of the babirusa (genus *Babyrousa*) was studied on a sample of 149 adult male babirusa skulls from twenty-two international museum and private collections. Skulls from Buru, Sulawesi and the Togian Islands were represented. The continuous growth process was summarised into five stages ('A'-'E') according to the position of the tip of the tooth over the bones of the skull. The supracutaneous portion of the tooth grew in a curve-linear fashion dorso-caudally, and was orientated such that the tips grew towards the midline of the cranium. The teeth of Sulawesi and Togian babirusa grew more dorsally over the nasal and frontal bones. Measurements were made on a subset of 45 teeth from Sulawesi babirusa skulls. The subcutaneous portion of the maxillary canine tooth ($n = 22$) increased in size from 37.3 mm (95% CI: 29.9-44.4 mm) in growth stage 'B' to 54.3 mm (49.4-59.2 mm) in growth stage 'E' as the erupted portion of the tooth ($n = 19$) lengthened from 81.3 mm (43.8-118.9 mm) in growth stage 'A' to 215.3 mm (177.8-252.9 mm) in growth stage 'E'. The apical end of the tooth was open and thin-walled. The lumen of the tooth was filled with a cone of well vascularised dental pulp that extended almost to the tip of the tooth. The angle of curvature of the tooth within the alveolus ($n = 22$) decreased from 19.8 (17.3-22.3) degrees in growth stage 'B' to 7.4 (5.7-9.0) degrees in growth stage 'E'. The corresponding supracutaneous angle of curvature ($n = 25$) reduced from 36.8 (33.6-40.1) degrees in growth stage 'A' to 10.7 (8.6-12.8) degrees in growth stage 'E'.





New literature on Suiformes



Seroprevalence of *Mycobacterium bovis* infection in warthogs (*Phacochoerus africanus*) in bovine tuberculosis endemic regions of South Africa.

Roos, E.O., Olea Popelka, F., Buss, P., de Klerk Lorist, L.M., Cooper, D., van Helden, P.D., ... & Miller, M.A.

Transbound Emerg Dis., 00:1–8.

Bovine tuberculosis (bTB), caused by *Mycobacterium bovis* (*M. bovis*), has been reported in many species including suids. Wild boar are important maintenance hosts of the infection with other suids, that is domestic and feral pigs, being important spillover hosts in the Eurasian ecosystem and in South Africa, warthogs (*Phacochoerus africanus*) may play a similar role in *M. bovis* endemic areas. However, novel diagnostic tests for warthogs are required to investigate the epidemiology of bTB in this species. Recent studies have demonstrated that serological assays are capable of discriminating between *M. bovis* infected and uninfected warthogs (Roos et al., 2016). In this study, an indirect ELISA utilizing *M. bovis* purified protein derivative (PPD) as a test antigen was used to measure the prevalence and investigate risk factors associated with infection in warthogs.

IP-10: A potential biomarker for detection of *Mycobacterium bovis* infection in warthogs (*Phacochoerus africanus*).

Roos, E.O., Olea-Popelka, F., Buss, P., de Klerk-Lorist, L.-M., Cooper, D., Warren, R.M., van Helden, P.D., Parsons, S.D.C., Miller, M.A.

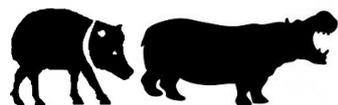
Bovine tuberculosis (bTB) is endemic in several areas of South Africa and has been reported in multiple species, including common warthogs (*Phacochoerus africanus*). Limited diagnostic tests and disease control programs exist for African wildlife. Thus, there is a need to develop techniques for bTB detection in species such as warthogs to assess their role in disease maintenance and spread in multi-host ecosystems. In this study, we obtained blood samples from warthogs in bTB endemic areas to investigate biomarkers for detection of *Mycobacterium bovis* infection. Warthog whole blood was incubated in QuantiFERON® TB Gold In-Tube tubes and pathogen specific release of interferon gamma (IFN- γ) and interferon gamma induced protein 10 (IP-10) was measured by a sandwich enzyme-linked immunosorbent assay. Although we were unable to measure IFN- γ , we could successfully measure IP-10. The IP-10 assay was able to distinguish between *M. bovis*-infected and *M. bovis*-culture negative warthogs, within bTB endemic areas, with an assay specific sensitivity of 68% and specificity of 84%. Of the 88 *M. bovis*-exposed warthogs screened, 42% were IP-10 test positive. These results indicate warthogs develop a measurable cell-mediated immune response after antigen stimulation of whole blood, which can distinguish between *M. bovis*-infected and *M. bovis*-culture negative animals. Thus, the IP-10 assay shows promise as an ante-mortem test to diagnose bTB in warthogs.

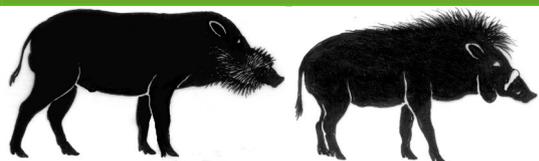
Embryonic and fetal development of the white-lipped peccary (*Tayassu pecari*).

dos Santos de Andrade, R., Barros Monteiro, F.O., El Bizri, H.R., Pantoja, L., Bodmer, R., Valsecchi, J., Mayor, P.

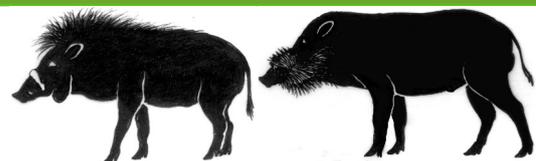
Theriogenology, 119: 163-174

The white-lipped peccary (*Tayassu pecari*) is an endangered large-sized Neotropical ungulate that is one of the most hunted mammals in the Amazon. Here, we used two embryos and 102 white-lipped peccary fetuses originated from animals hunted for subsistence in the Peruvian and





New literature on Suiformes



Brazilian Amazon to describe the intrauterine development of external and internal morphology of this Neotropical ungulate. Logistic regressions were used to estimate the probability of occurrence of main external characteristics in relation to the total dorsal length (TDL), while multiple linear and non-linear regressions were conducted to assess the relationship between external and visceral biometry with TDL. External characteristics appeared in the following chronological order: limbs, differentiated genitalia and opened eyelids (≥ 5.1 cm TDL), fused eyelids (≥ 6.2 cm TDL), hooves and outer ear (≥ 7.9 cm TDL), dorsal gland (≥ 9.4 cm TDL), skin (≥ 11.5 cm TDL); tactile pelage (≥ 13.8 cm TDL), covering pelage (≥ 20.9 cm TDL), tooth eruption (≥ 26.4 cm TDL) and opened eyelids (≥ 27.8 cm TDL). The formula of fetal age was $W = 0.084 (t - 31.80)$, with a high linear relationship between TDL and gestational age. All external biometric parameters and absolute volume of visceral organs showed strong positive relationship with TDL. Except for the liver, we found differences in the relative volume of most visceral organs between advanced fetuses (≥ 34.2 cm TDL) and adults. The most important events during the intrauterine development in the white-lipped peccary show that, in contrast with the domestic pig, it is a highly precocial species producing newborns with a high fetal growth velocity which allows newborns to achieve an early autonomous functionality. Our results are relevant to improve imaging techniques and assist the reproductive and clinical management for the white-lipped peccary both in captivity and in the wild.

Collared peccary (*Pecari tajacu*) are susceptible to porcine reproductive and respiratory syndrome virus (PRRSV).

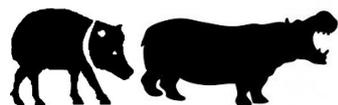
Molina Barrios, R., Luevano Adame, J., Henao Díaz, Y.A., Giménez Lirola, L., Piñeyro, P., Magtoto R., Cedillo Cobián, J., Díaz Rayo, C., Hernández, J., Zimmerman, J.
Transbound Emerg Dis., 00:1–8

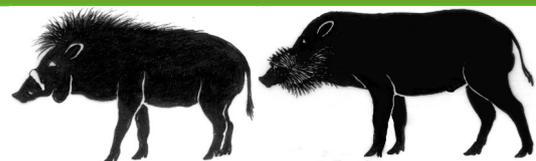
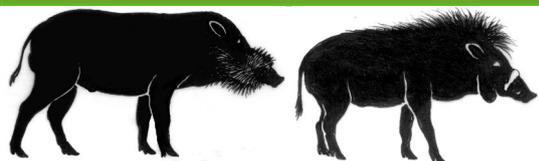
Collared peccary (*Pecari tajacu*) and pigs (*Sus scrofa*) are two members of superfamily Suoidea that coexist in the Americas and share some of the same viral infections. Although porcine reproductive and respiratory syndrome virus (PRRSV) is among the most impactful pathogens of swine on a worldwide basis, the susceptibility of peccaries to PRRSV has not been investigated. In this study, three peccaries were intramuscularly inoculated with a PRRSV 2 field virus. One PRRSV inoculated pig served as a positive control and two pigs and one peccary as negative controls. Serum samples were collected at regular intervals over a 23 day observation period and tested by PRRSV rtRT-PCR and isotype specific (IgM, IgA, IgG) PRRSV ELISAs. The detection of viremia (DPI 3–23) and a PRRSV specific humoral immune response (\geq DPI 10) supported the conclusion that collared peccary are susceptible to PRRSV. The results raise questions regarding the natural history of PRRSV in non *Sus* members of superfamily Suoidea and, more broadly, their role in the evolution and ecology of PRRSV.

Superoxide dismutase and catalase activity in collared peccary (*Pecari tajacu*) seminal plasma and their relation to sperm quality.

Araújo dos Santos, E.A., Cunha Sousa, P., da Silva, A.M., Correia Paiva, A.L., de Araújo Lago, A.E., de Paula, V.V., Pereira, A.F., Araripe Moura, A.A., Silva, A.R.
Ciências Agrárias, 39(2): 787-796

The study of the seminal plasma help us to understand the mechanisms by which reactive oxygen species (ROS) affect the sperm. The antioxidant enzymes, as the superoxide dismutase - SOD and catalase - CAT, are capable of removing the oxidative agents before they produce





injuries. The aim of the current study was to investigate the activity of antioxidant enzymes SOD and CAT in seminal plasma, and their association with sperm quality in collared peccaries. Study was conducted during the dry period (August and September) on a region characterized by a semiarid climate, with an average annual temperature of 27°C and irregular rainfall (Mossoro, RN, Brazil; 5°10'S and 37°10'W). Nine ejaculates were obtained from sexually mature males (1 sample per animal) by electroejaculation. Semen was evaluated for microscopic parameters and the activity of SOD and CAT was measured by spectrophotometry. All ejaculates were white in color. Mean values for concentration were of $207 \pm 160 \times 10^6$ sperm/mL, motility of $83.0 \pm 20.9\%$ and viability of $72.5 \pm 10.4\%$. In regards to the enzymatic activity, none was observed for the CAT enzyme. Trace levels of SOD (0.034 ± 0.049 AU/mgP) were detected in the ejaculates of all individuals; however, no correlation was observed between SOD levels and the sperm motility ($R = 0.35$; $P = 0.931$), vigor ($R = 0.29$; $P = 0.133$), viability ($R = 0.16$; $P = 0.29$), functional membrane ($R = 0.04$; $P = 0.617$) or morphology ($R = 0.03$; $P = 0.637$). In conclusion, we demonstrated the first description of antioxidant enzyme activity in seminal plasma of fresh ejaculates obtained from collared peccaries. SOD antioxidant activity was evident during the dry period of a semi-arid region, but no relationship between SOD and semen parameters was observed.

Genetic diversity of *Hepatozoon* spp. in *Hydrochoerus hydrochaeris* and *Pecari tajacu* from eastern Amazon.

de Azevedo Gomes, L., Moraes, L.A., Figueira Aguiar, D.C., Tavares Dias, H.L., Sardinha Ribeiro, A.S., do Couto Rocha, H.P., Teixeira Nunes, M.R., Gonçalves, E.C.

Ticks and Tick-borne Diseases, 9(2): 314-318

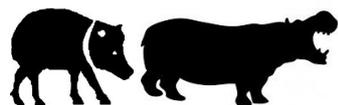
This study aimed to identify and characterize genetically species of the genus *Hepatozoon* detected in *Hydrochoerus hydrochaeris* (capybaras) and *Pecari tajacu* (collared peccaries) from two localities from the Eastern Amazon. Blood samples from 196 free-living *H. hydrochaeris* from Marajó Island and 109 *P. tajacu* kept in captivity in Belém, Pará, were collected and analyzed for the presence of *Hepatozoon* spp. Partial sequences of the 18S rRNA gene were obtained and analyzed in comparison to others available in the NCBI database. Our results demonstrated a high prevalence of *Hepatozoon canis* in both mammals and the existence of four haplotypes of *Hepatozoon* spp., three of *Hepatozoon canis* and one of *Hepatozoon cuestasensis*, found only in *H. hydrochaeris*. In addition, these data increase the genetic diversity of *H. canis* from the Eastern Amazon, as well as reporting, for the first time, the infection of mammals by *H. cuestasensis* and *P. tajacu* by *H. canis*.

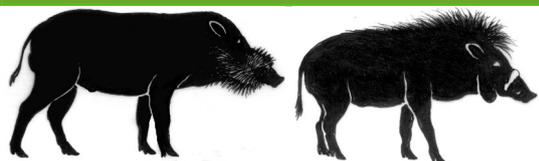
Environmental Factors Related to a Semiarid Climate Influence the Freezability of Sperm from Collared Peccaries (*Pecari tajacu* Linnaeus, 1758).

Maia, K.M., Souza, A.L.P., Praxedes, E.C.G., Bezerra, L.G.P., Silva, A.M., Campos, L.B., Moreira, S.S.J., Apolinário, C.A.C., Souza Jr, J.B.F, Silva, A.R.

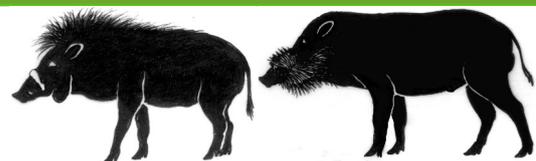
Biopreservation and Biobanking 16(3)

The influence of environmental factors in a semiarid climate on characteristics of fresh and frozen/thawed sperm collected from collared peccaries (*Pecari tajacu*) was assessed. Semen from 11 male collared peccaries was collected by electroejaculation during the peaks of the dry and rainy periods while rainfall indices, air temperatures, relative humidity levels, and wind speeds were measured. The number, motility, morphology, osmotic response, and membrane integrity of sperm in the collected ejaculates were assessed. Samples were then frozen in liquid





New literature on Suiformes



nitrogen, thawed, and reassessed. The rainfall index of the rainy period (73.2 mm) was significantly higher than that of the dry period (13.6 mm) and the relative humidity was significantly higher during the rainy period (74.6%) than it was during the dry period (66.8%). Air temperature and wind speed did not differ between the two periods. Characteristics of sperm in the fresh samples were not affected by environmental parameters. In contrast, computerized analysis revealed that sperm in samples frozen during the rainy period exhibited better post-thaw membrane integrity ($28.6 \pm 6\%$), motility ($29.5 \pm 7.7\%$), and rapid sperm population ($13.7 \pm 6.2\%$) than did sperm in samples frozen during the dry period ($23.4 \pm 3\%$ membrane integrity, $14.6 \pm 4.1\%$ motility, and $4.1 \pm 1.2\%$ rapid sperm; $p < 0.05$). Other characteristics of the frozen/thawed sperm did not differ depending on the period in which they were collected. We demonstrated that environmental parameters did not affect the quality of fresh sperm, but could influence the freezability of sperm collected from collared peccaries raised under a semiarid climate.

Combination of ethylene glycol with sucrose increases survival rate after vitrification of somatic tissue of collared peccaries (*Pecari tajacu* Linnaeus, 1758).

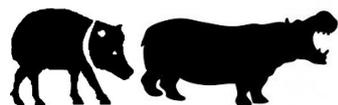
Borges, A.A., Neta, L.B.Q., Santos, M.V., Oliveira, M.F., Silva, A.R., Pereira, A.F.
Pesquisa Veterinária Brasileira, 38(2), 350-356

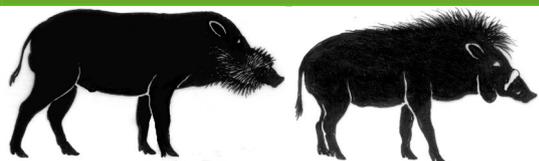
The cryopreservation of somatic tissue in collared peccaries promotes an alternative source of genetic material of this specie. The solid-surface vitrification (SSV) is a great option for tissue conservation; nevertheless, the optimization of SSV requirements is necessary, especially when referred to cryoprotectants that will compose the vitrification solution. Therefore, the aim was to evaluate the effect of the presence of 0.25 M sucrose in addition to different combinations (only or association) and concentrations (1.5 M or 3.0 M) of ethylene glycol (EG) and/or dimethyl sulfoxide (DMSO) in the somatic tissue vitrification of collared peccaries. Subsequently, we tested six combinations of cryoprotectants with or without sucrose in Dulbecco modified Eagle medium (DMEM) plus 10% fetal bovine serum (FBS). Thus, 3.0 M EG with sucrose was able to maintain normal tissue characteristics compared with non-vitrified (control), especially for the volumetric ratio of epidermis (61.2 vs. 58.7%) and dermis (34.5 vs. 36.6%), number of fibroblast (90.3 vs. 127.0), argyrophilic nucleolar organizer region (AgNOR) ratio (0.09 vs. 0.17%) and nucleus area (15.4 vs. $14.5 \mu\text{m}^2$) respectively. In conclusion, 3.0 M EG with 0.25 M sucrose and 10% FBS resulted in a better cryoprotectant composition in the SSV for somatic tissue of collared peccaries.

Serologic Survey for Selected Viral and Bacterial Swine Pathogens in Colombian Collared Peccaries (*Pecari tajacu*) and Feral Pigs (*Sus scrofa*).

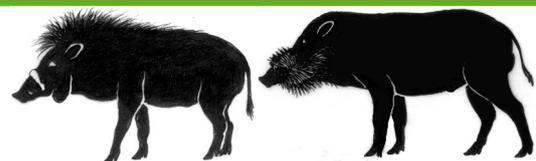
Montenegro, O.L., Roncancio, N., Soler-Tovar, D., Cortés-Duque, J., Contreras-Herrera, J., Sabogal, S., Navas-Suárez, P.E.
Journal of Wildlife Diseases

In South America, wild populations of peccaries coexist with domestic and feral pigs, with poorly understood consequences. We captured 58 collared peccaries (*Pecari tajacu*) and 15 feral pigs (*Sus scrofa*) in locations of Colombia where coexistence of these species is known. Blood samples were tested for antibodies against four viral agents, classical swine fever virus (CSFV), Aujeszky's disease virus (ADV), porcine circovirus (PCV-2), and vesicular stomatitis virus (New Jersey and Indiana subtypes) and two bacterial agents, *Brucella* spp. and six serovars of





New literature on Suiformes



Leptospira interrogans. The prevalence of CSFV was 5% (3/58) in collared peccaries and 7% (1/15) in feral pigs. The prevalence of PCV-2 was 7% (1/15) in collared peccaries and 67% (2/3) in feral pigs. Vesicular stomatitis prevalence was 33% (8/24) in collared peccaries and 67% (4/6) in feral pigs. *Leptospira* prevalence was 78% (39/50) in collared peccary and 100% (8/8) in feral pigs; bratislava, grippotyphosa, icterohaemorrhagiae, and pomona were the most frequent serovars. Also, the only white-lipped peccary (*Tayassu pecari*) sampled was positive for *L. interrogans* serovar bratislava and for vesicular stomatitis virus, New Jersey strain. No samples were positive for ADV or *Brucella*. The seroprevalence of antibodies against *L. interrogans* was similar to that observed in other studies. Icterohaemorrhagiae appears to be a common serovar among in situ and ex situ peccary populations. Positive antibodies against PVC-2 represent a novel report of exposure to this pathogen in Colombian peccaries. Our results indicate the possible transmission of various pathogens, important for pig farms, in the studied pig and peccaries.

Taxonomic, Biogeographic and Evolutionary Studies

Synchronous diversification of Sulawesi's iconic artiodactyls driven by recent geological events

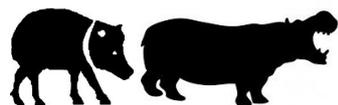
Frantz, L.A.F., Rudzinski, A., Nugraha, A.M.S., Evin, A., Burton, J., Hulme-Beaman, A., Linderholm, A., Barnett, R., Vega, R., Irving-Pease, E.K., Haile, J., Allen, R., Leus, K., Shephard, J., Hillyer, M., Gillemot, S., van den Hurk, J., Ogle, S., Atofanei, C., Thomas, M.G., Johansson, F., Mustari, A.H., Williams, J., Mohamad, K., Damayanti, C.S., Wiryadi, I.D., Obbles, D., Mona, S., Day, H., Yasin, M., Meker, S., McGuire, J.A., Evans, B.J., von Rintelen, T., Ho, S.Y.W., Searle, J.B., Kitchener, A.C., Macdonald, A.A., Shaw, D.J., Hall, R., Galbusera, P., Larson, G. Proceedings of the Royal Society B-Biological Sciences, 285 (1876):10.

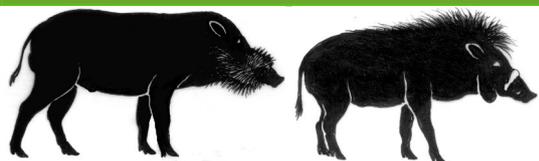
The high degree of endemism on Sulawesi has previously been suggested to have vicariant origins, dating back to 40 Ma. Recent studies, however, suggest that much of Sulawesi's fauna assembled over the last 15 Myr. Here, we test the hypothesis that more recent uplift of previously submerged portions of land on Sulawesi promoted diversification and that much of its faunal assemblage is much younger than the island itself. To do so, we combined palaeogeographical reconstructions with genetic and morphometric datasets derived from Sulawesi's three largest mammals: the babirusa, anoa and Sulawesi warty pig. Our results indicate that although these species most likely colonized the area that is now Sulawesi at different times (14 Ma to 2-3 Ma), they experienced an almost synchronous expansion from the central part of the island. Geological reconstructions indicate that this area was above sea level for most of the last 4 Myr, unlike most parts of the island. We conclude that emergence of land on Sulawesi (approx. 1-2 Myr) may have allowed species to expand synchronously. Altogether, our results indicate that the establishment of the highly endemic faunal assemblage on Sulawesi was driven by geological events over the last few million years.

Ancient DNA analysis of the extinct North American flat-headed peccary (*Platygonus compressus*).

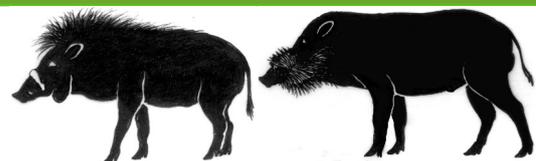
Perry T., van Loenen A.L., Heiniger H., Lee C., Gongora J., Cooper A., Mitchell K.J. Mol Phylogenet Evol., 112:258-267. doi:10.1016/j.ympev.2017.03.024.

The geographical range of extant peccaries extends from the southwestern United States through





New literature on Suiformes



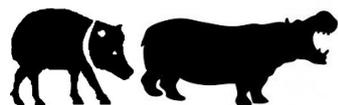
Central America and into northern Argentina. However, from the Miocene until the Pleistocene now-extinct peccary species inhabited the entirety of North America. Relationships among the living and extinct species have long been contentious. Similarly, how and when peccaries moved from North to South America is unclear. The North American flat-headed peccary (*Platygonus compressus*) became extinct at the end of the Pleistocene and is one of the most abundant subfossil taxa found in North America, yet despite this extensive fossil record its phylogenetic position has not been resolved. This study is the first to present DNA data from the flat-headed peccary and full mitochondrial genome sequences of all the extant peccary species. We performed a molecular phylogenetic analysis to determine the relationships among ancient and extant peccary species. Our results suggested that the flat-headed peccary is sister-taxon to a clade comprising the extant peccary species. Divergence date estimates from our molecular dating analyses suggest that if extant peccary diversification occurred in South America then their common ancestor must have dispersed from North America to South America well before the establishment of the Isthmus of Panama. We also investigated the genetic diversity of the flat-headed peccary by performing a preliminary population study on specimens from Sheriden Cave, Ohio. Flat-headed peccaries from Sheriden Cave appear to be genetically diverse and show no signature of population decline prior to extinction. Including additional extinct Pleistocene peccary species in future phylogenetic analyses will further clarify peccary evolution.

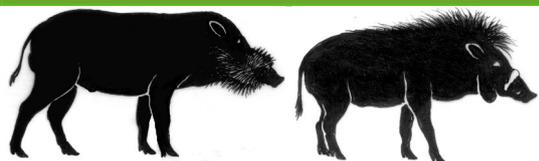
Dietary variability of extinct tayassuids and modern white-lipped peccaries (*Tayassu pecari*) as inferred from dental microwear and stable isotope analysis.

Bradham, J.L., De Santis, L.R.G., Jorge, M.L.S.P., Keuroghlian, A.

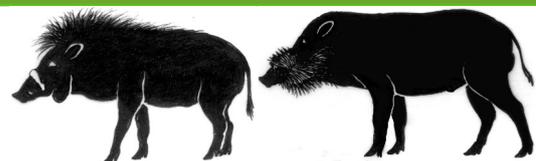
Palaeogeography, Palaeoclimatology, Palaeoecology, 499: 93-101

Prior geochemical work documents dietary shifts coincident with climate change in extinct peccaries, with taxa typically shifting between browsing and mixed-feeding. This study employs dental microwear texture analysis (DMTA) and stable carbon isotopes to interpret the diet of extinct peccaries in Florida, specifically *Platygonus*, *Mylohyus*, and *Protherohyus* from the late Miocene throughout the Pleistocene, to evaluate how dietary behavior has fluctuated over time. When *Mylohyus* and *Protherohyus* coexisted in the Hemphillian, *Mylohyus* consumed C3 food sources with harder textures, consistent with the consumption of woody browse, while *Protherohyus* consumed a greater proportion of C4 vegetation (likely grass). During the Blancan, both *Platygonus* and *Mylohyus* can be considered primarily C3 browsers, based on both DMTA and stable isotope data. However, during the Irvingtonian, both *Mylohyus* and *Platygonus* consumed a larger proportion of C4 vegetation than during previous North American Land Mammal Ages (NALMAs). *Platygonus* consumed predominantly C3 vegetation during the Rancholabrean, while *Mylohyus* consumed a mixture of C3 and C4 vegetation in more open environments. Independent of NALMA, *Platygonus* consumed predominantly tough vegetation, (e.g., tough leaves and/or grass) while *Mylohyus* consumed harder food items, consistent with morphological differences in their teeth. In contrast, extant *Tayassu* peccaries are obligate C3 feeders and show no evidence of C4 consumption. Further, *Tayassu* are indistinguishable in all dental microwear textural properties from both of their extinct relatives, suggesting that while extant peccaries eat primarily foods from forested environments, those foods are highly variable in textural properties. Collectively, these data suggest that extinct peccaries, *Mylohyus* and *Platygonus*, altered their diet over time and possibly in response to changing climates.





New literature on Suiformes



Ecological, Behavioural and Conservation Studies

Research Priorities for Managing Invasive Wild Pigs in North America.

Beasley, J.C., Ditchkoff, S.S., Mayer, J.J., Smith, M.D., Vercauteren, K.C.

Journal of Wildlife Management, 82(4): 674-681. doi:10.1002/jwmg.21436

With recent increases in distribution and numbers of feral pigs (*Sus scrofa*; invasive wild pigs) in North America, there has been a concurrent increase in the ecological and economic effects they have had on native and anthropogenic ecosystems. Despite the amplified interest in invasive wild pig research, there remains a significant knowledge gap regarding their basic biology and ecology, the scope of the damage they cause, and the efficacy of many control strategies. Such information is important to support the successful management of invasive wild pigs throughout North America and other areas. In 2016, members of the National Wild Pig Task Force met and developed a set of research priorities to aid in effective management of invasive wild pigs. These research priorities identify 4 topical areas where increased effort and science is most needed to manage invasive wild pigs: biology and ecology, economic and ecological damages, control strategies, and education and human dimensions, with particular emphasis on areas where specific data gaps remain within each topical area. Resolution of such knowledge deficits would advance the understanding of invasive wild pig ecology, enabling more efficient and effective management of this species.

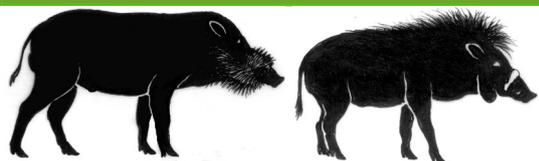
Climate, tree masting and spatial behaviour in wild boar (*Sus scrofa* L.): insight from a long-term study.

Bisi, F., Chirichella, R., Chianucci, F., Von Hardenberg, J., Cutini, A., Martinoli, A., Apollonio, M.

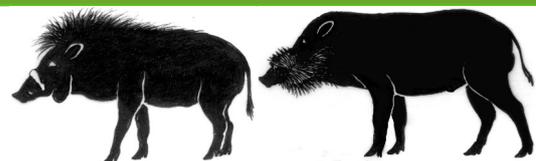
Annals of Forest Science, 75(2). doi:10.1007/s13595-018-0726-6

Key message Climate factors affect seed biomass production which in turn influences autumn wild boar spatial behaviour. Adaptive management strategies require an understanding of both masting and its influence on the behaviour of pulsed resource consumers like wild boar. Context Pulsed resources ecosystem could be strongly affected by climate. Disentangling the role of climate on mast seeding allow to understand a seed consumer spatial behaviour to design proper wildlife and forest management strategies. **Aims** We investigated the relationship between mast seeding and climatic variables and we evaluated the influence of mast seeding on wild boar home range dynamics. **Methods** We analysed mast seeding as seed biomass production of three broadleaf tree species (*Fagus sylvatica* L., *Quercus cerris* L., *Castanea sativa* Mill.) in the northern Apennines. Next, we explored which climatic variables affected tree masting patterns and finally we tested the effect of both climate and seed biomass production on wild boar home range size. **Results** Seed biomass production is partially regulated by climate; high precipitation in spring of the current year positively affects seed biomass production while summer precipitation of previous year has an opposite effect. Wild boar home range size is negatively correlated to seed biomass production, and the climate only partially contributes to determine wild boar spatial behaviour. **Conclusion** Climate factors influence mast seeding, and the negative correlation between wild boar home range and mast seeding should be taken into account for designing integrated, proactive hunting management.





New literature on Suiformes



Achilles heel of a powerful invader: restrictions on distribution and disappearance of feral pigs from a protected area in Northern Pantanal, Western Brazil.

Cordeiro, J.L.P., Hofmann, G.S., Fonseca, C. Oliveira, L.F.B.

Peerj, 6. doi:10.7717/peerj.4200

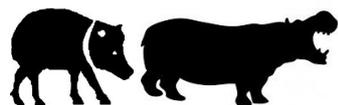
This paper focuses on a rare case of natural disappearance of feral pigs (*Sus scrofa*) in an extensive area without using traditional methods of eradication programs. The study was conducted both in the Private Reserve of Natural Heritage (PRNH) Sesc Pantanal and in an adjacent traditional private cattle ranch. In 1998, feral pigs were abundant and widely distributed in the PRNH. However, the feral pigs gradually disappeared from the area and currently, the absence of pigs in the PRNH contrasts with the adjacent cattle ranch where the species is abundant. To understand the current distribution of the species in the region we partitioned the effects of variation of feral pigs' presence considering the habitat structure (local), landscape composition and the occurrence of potential predators. Additionally, we modeled the distributions of the species in Northern Pantanal, projecting into the past using the classes of vegetation cover before the PRNH implementation (year 1988). Our results show areas with more suitability for feral pigs in regions where the landscape is dominated by pastures and permeated by patches of Seasonal Dry Forest. The species tends to avoid predominantly forested areas. Additionally, we recorded that the environmental suitability decreases exponentially as the distance from water bodies increases. The disappearance of feral pigs in the PRNH area seems to be associated with changes in the landscape and vegetation structure after the removal of the cattle. In the Brazilian Pantanal, the feral pigs' occurrence seems strongly conditioned to environmental changes associated to livestock activity.

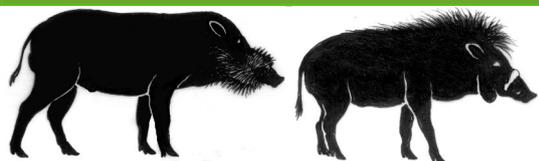
Hunting as the Main Technique Used to Control Wild Pigs in Brazil.

Da Rosa, C.A., Wallau, M.O., Pedrosa, F.

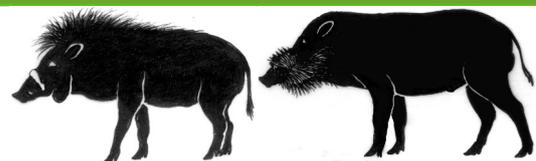
Wildlife Society Bulletin, 42(1): 111-118. doi:10.1002/wsb.851

Wild pigs (*Sus scrofa*) have expanded their range in Brazil since late 1980s, with reports of damage becoming more frequent in recent years. In 2013, use of lethal methods for wild pig control was legalized by the federal environmental agency. However, several restrictions related to the purchase and transportation of guns and ammunition hamper the ability to evaluate the effectiveness of control measures. Nevertheless, many citizens engaged in wild pig control in Brazil do not officially report their control activities as required by the legislation. Our goal was to characterize the profile of wild pig controllers in Brazil to understand their methods and motivations, estimate the number of wild pigs killed per person per year, and evaluate current regulations regarding their applicability to the situations observed in the field. We formulated and distributed a structured questionnaire distributed in 2014 and 2015 to pig controllers (n = 172), including both hunters and nonhunters. Respondents reported killing 2,389 wild pigs, and killing an average of 17.2 (SE = 24.8) pigs/respondent/year, with male and female pigs killed in the same proportion. Forty percent of respondents were acting illegally. Hunters primarily controlled wild pigs to defend third-party properties. Volunteers provided most of the effort toward controlling wild pigs in Brazil and farmers suffered most of the impacts. Therefore, we believe that adjusting the approach to use of hunting after crop harvest, or implementing an integrated program of hunting and traps placed around crops, could be an important new management tool for reducing wild pig population and crop damage. Further, to enhance wild pig control in Brazil, we recommend incentivizing use of corral traps and cages because such techniques have the greatest effect on reducing wild pig population.





New literature on Suiformes



The influence of wild boar (*Sus scrofa*) on microhabitat quality for the endangered butterfly *Pyrgus malvae* in the Netherlands.

de Schaetzen, F., van Langevelde, F., WallisDeVries, M.F.

Journal of Insect Conservation, 22(1): 51-59. doi:10.1007/s10841-017-0037-5

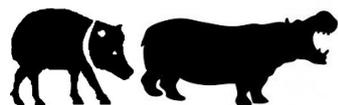
The decline of open habitats in Europe, such as semi-natural grasslands and heathlands, has caused a general decline in biodiversity, which has been well documented for butterflies. Current conservation practices often involve grazing by domestic livestock to maintain suitable butterfly habitats. The extent to which wild ungulates may play a similar role remains largely unknown. Through their rooting activity, wild boar could be effective to reduce grass encroachment and restore pioneer microhabitats that are vital to many grassland insects in temperate climates. Here, we assessed the microhabitat requirements of *Pyrgus malvae*, an endangered butterfly of heathland and grassland habitats in the Netherlands, with special attention for the influence of wild boar rooting. To date, oviposition site selection of this species has concentrated on calcareous grasslands, whereas we also include heathlands. Overall, larval occupancy was higher in warm, open and sparsely vegetated microhabitats, which supports earlier findings. In heathland, microhabitat occupancy was positively affected by bryophyte and litter cover. In heath-grassland mosaic, microhabitat occupancy was also influenced by bryophyte and litter cover, but in addition low grass cover increased occupancy by favouring host plants. In grassland, only low grass cover and host plant cover determined microhabitat quality. Across all habitats, occupied microhabitats were characterized by lower vegetation as well as higher average daytime temperatures than unoccupied microhabitats. We discovered that wild boar play an important role in reducing grass cover by shallow rooting in grass patches, thereby increasing host plant availability. Hence, wild boar may have an added value in maintaining and restoring *P. malvae* microhabitats in grassland habitats in addition to grazing by domestic livestock.

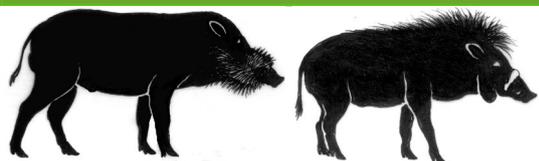
Seasonal variation in effectiveness of the boar-operated system to deliver baits to wild boar.

Ferretti, F., Coats, J., Cowan, D. P., Pietravalle, S., Massei, G.

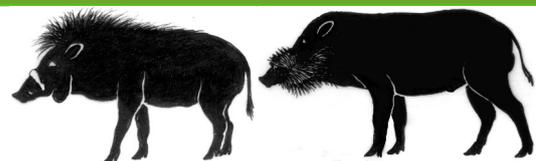
Pest Management Science, 74(2): 422-429. doi:10.1002/ps.4723

BACKGROUND Wild boar and feral pig numbers are growing worldwide and have substantial economic and environmental impacts. Bait-delivered pharmaceuticals such as disease vaccines, toxicants and contraceptives are advocated to mitigate these impacts. Effective campaigns based on these pharmaceuticals rely on optimising the target species' bait uptake, which may differ between seasons. We investigated seasonal differences in the use of Boar-Operated Systems (BOSs) by wild boar and non-target species in an English woodland. **RESULTS** In a pre-trial phase (BOS left open), wild boar, wild mammals, birds, livestock and companion animals fed on the peanuts and maize used as bait in the BOS. During the trial (BOS closed), only wild boar consumed the baits. Wild boar visited and fed from a larger number of BOSs in spring than in summer or winter. No aggressive intra-group interactions were recorded when wild boar fed from the BOSs but adult males were observed to monopolise two BOSs. Group size was highest in spring and bait uptake was lowest in winter. **CONCLUSION** The study confirmed the species-specificity of the BOS throughout the year and highlighted that, at least in this area, bait uptake by wild boar for baits delivered through the BOS would be maximised in spring.





New literature on Suiformes



Abiotic and biotic influences on home-range size of wild pigs (*Sus scrofa*).

Garza, S.J., Tabak, M.A., Miller, R.S., Farnsworth, M.L., Burdett, C.L.

Journal of Mammalogy, 99(1): 97-107. doi:10.1093/jmammal/gyx154

Wild pigs (*Sus scrofa*) are among the most widespread and destructive invasive mammals in the world. Understanding the spatial ecology of this species is foundational to effectively mitigating further range expansion. We compiled size estimates of home ranges of wild pigs from 30 locations worldwide and modeled the relationship between home-range size and both abiotic (evapotranspiration, latitude, precipitation, and temperature) and biotic (vegetation productivity and mammal species richness) environmental factors. Size of home ranges varied markedly, ranging from 0.62 to 48.3 km². Mammal species richness was positively correlated with home-range size and was the only predictor in the best model; other abiotic factors typically correlated with richness, i.e., latitude and evapotranspiration, were not significant predictors of wild pig home-range size. Despite indicating correlation rather than cause, our analyses were conducted at the scale of the home range and therefore may support the invasion paradox hypothesis for mammals, which states that biotic interactions have a greater influence on invasive species at finer spatial scales. While we do not suggest that mammal species richness can preclude populations of wild pigs from continuing to spread in their native or non-native ranges, our correlative results suggest that areas with a diverse mammal community may be more resistant to invasion. This finding supports the intrinsic value of conserving native species and highlights the need for future work exploring the specific mechanisms by which species richness and biodiversity can influence the ecology of invasive species.

Contrasting ecological roles of non-native ungulates in a novel ecosystem.

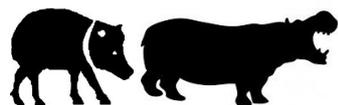
Gawel, A.M., Rogers, H.S., Miller, R.H., Kerr, A.M.

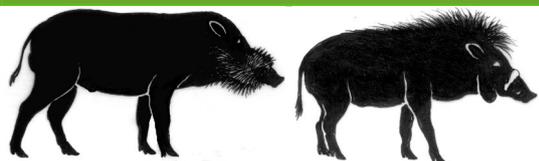
Royal Society Open Science, 5(4). doi:10.1098/rsos.170151

Conservation has long focused on preserving or restoring pristine ecosystems. However, understanding and managing novel ecosystems has grown in importance as they outnumber pristine ecosystems worldwide. While non-native species may be neutral or detrimental in pristine ecosystems, it is possible that even notorious invaders could play beneficial or mixed roles in novel ecosystems. We examined the effects of two long-established non-native species-Philippine deer (*Rusa marianna*) and feral pigs (*Sus scrofa*)-in Guam, Micronesia, where native vertebrate frugivores are functionally absent leaving forests devoid of seed dispersers. We compared the roles of deer and pigs on seedling survival, seed dispersal and plant community structure in limestone karst forests. Deer, even at low abundances, had pronounced negative impacts on forest communities by decreasing seedling and vine abundance. By contrast, pigs showed no such relationship. Also, many viable seeds were found in pig scats, whereas few were found in deer scats, suggesting that pigs, but not deer, provide an ecosystem function-seed dispersal-that has been lost from Guam. Our study presents a discrepancy between the roles of two non-native species that are traditionally managed as a single entity, suggesting that ecological function, rather than identity as a non-native, may be more important to consider in managing novel systems.

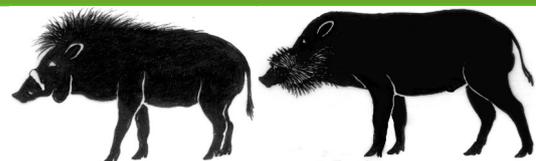
Differential long-term impacts of a management control program of axis deer and wild boar in a protected area of north-eastern Argentina.

Gurtler, R.E., Rodriguez-Planes, L.I., Gil, G., Izquierdo, V.M., Cavicchia, M., Maranta, A.





New literature on Suiformes



Biological Invasions, 20(6): 1431-1447. doi:10.1007/s10530-017-1635-6

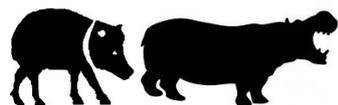
Exotic ungulates are among the top global invasive mammals and a threat to biodiversity. Axis deer (*Axis axis*) and wild boar (*Sus scrofa*) are of increasing concern in multiple regions. A management program reduced wild boar abundance and soil damage below target levels through controlled still shooting from watchtowers and dog-hunting performed by recreational hunters at El Palmar National Park, Argentina. Here we assess program impacts on axis deer over a 10-year period in which 2380 deer were dispatched, and document two largely unexpected outcomes: increasing axis deer abundance toward a plateau, and a strong inverse correlation between deer and wild boar numbers. Unlike the initial steep decline and subsequent stabilization of wild boar, deer abundance indexed by standardized catchper-unit-effort increased at 37.6% per year over 0-5 years post-intervention (YPI) and stabilized from 7 YPI on when still-shooting effort averaged 948 hunting party-hours per quarter. Deer catch was non-linearly related to still-shooting effort. Timing of deer and boar catches did not differ significantly regardless of sex, season and YPI. Catch-per-unit-effort indices and nightly spotlight deer counts showed similarly increasing trends. The fraction of older adult deer declined over 0-4 YPI and remained stable thereafter. Sex ratios were consistently skewed toward males only among older adults. Failure to reduce deer abundance may be explained by several major processes: protracted exponential growth of the deer population after park invasion; deer regional expansion with increasing immigration; insufficient sex- and stage-biased hunting mortality, and competitor (and perhaps predator) release from wild boar.

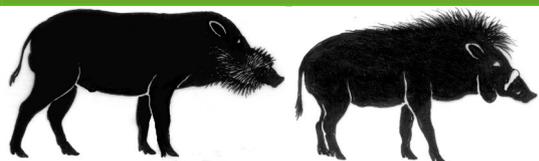
Invasion ecology of wild pigs (*Sus scrofa*) in Florida, USA: the role of humans in the expansion and colonization of an invasive wild ungulate.

Hernandez, F.A., Parker, B.M., Pylant, C.L., Smyser, T.J., Piaggio, A.J., Lance, S.L., . . . Wisely, S.M.

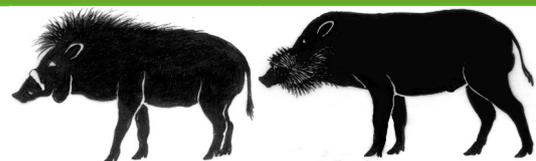
Biological Invasions, 20(7): 1865-1880. doi:10.1007/s10530-018-1667-6

Wild pigs (*Sus scrofa*) are the most widely distributed invasive wild ungulate in the United States, yet the factors that influence wild pig dispersal and colonization at the regional level are poorly understood. Our objective was to use a population genetic approach to describe patterns of dispersal and colonization among populations to gain a greater understanding of the invasion process contributing to the expansion of this species. We used 52 microsatellite loci to produce individual genotypes for 482 swine sampled at 39 locations between 2014 and 2016. Our data revealed the existence of genetically distinct subpopulations ($F_{ST} = 0.1170$, $p < 0.05$). We found evidence of both fine-scale subdivision among the sampling locations, as well as evidence of long term genetic isolation. Several locations exhibited significant admixture (interbreeding) suggesting frequent mixing of individuals among locations; up to 14% of animals were immigrants from other populations. This pattern of admixture suggested successive rounds of human-assisted translocation and subsequent expansion across Florida. We also found evidence of genetically distinct populations that were isolated from nearby populations, suggesting recent introduction by humans. In addition, proximity to wild pig holding facilities was associated with higher migration rates and admixture, likely due to the escape or release of animals. Taken together, these results suggest that human-assisted movement plays a major role in the ecology and rapid population growth of wild pigs in Florida.





New literature on Suiformes



Pasture intake and grazing behaviour of growing European wild boar (*Sus scrofa* L.) and domestic pigs (*Sus scrofa domesticus*, Landrace x Large White) in a semi-extensive production system.

Hodgkinson, S.M., Polanco, C., Aceiton, L., Lopez, I.F.

Journal of Agricultural Science, 155(10): 1659-1668. doi:10.1017/s002185961700065x

The objective of the present study was to determine the pasture intake of European wild boar and domestic pigs throughout their growth period (from 60 to 207 days of age). The proportion of time that each animal type spent grazing was also determined. Twelve 60-day-old pure-bred European wild boar (six castrated males and six females, average live-weight (+/- s.e.m.) 6.8 +/- 0.37 kg) and 12 70-day-old domestic pigs (Large White x Landrace, six castrated males and six females, average live-weight [+/- s.e.m.] 24.1 +/- 0.66 kg) were used in the study. Each day during the study, the animals grazed from 08.00 until 16.00 h, after which they had ad-libitum access to a supplemental diet for 1 h. Every 14 days throughout the study (a total of ten determinations), the pasture consumption was determined as the difference between the pasture dry matter (DM) availability pre- and post-grazing. The supplemental diet consumption was also determined. Three times during the study (age of animals 85, 140 and 198 days), the behaviour of each animal was observed over four consecutive days while grazing. When considered on a metabolic bodyweight basis, the pasture consumption of the European wild boar was greater than that in the domestic pigs. Approximately 0.20 of the total DM intake by the wild boar was pasture, whereas only 0.10 of the total DM intake by the domestic pigs was pasture. However, domestic pigs consumed a greater quantity of supplemental diet than the wild boar. The wild boar obtained 0.20 of their total daily dietary apparent energy intake from pasture, compared with 0.07 in the domestic pigs. Wild boar were more active during 8-h grazing periods spending 0.54 of their time grazing or moving around, compared with 0.32 of the time in domestic pigs.

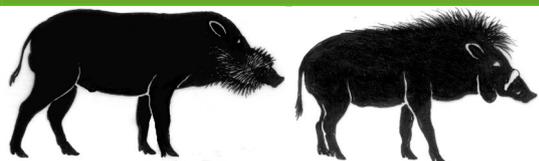
Reproductive Ecology of Recently Established Wild Pigs in Canada.

Koen, E.L., Vander Wal, E., Kost, R., Brook, R.K.

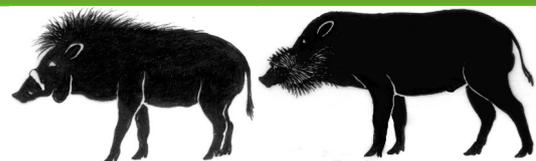
American Midland Naturalist, 179(2): 275-286.

An essential component of management efforts to control invasive species is the estimate of life history parameters, such as reproductive rate and litter size. Wild pigs (*Sus scrofa*), one of the most invasive terrestrial mammals worldwide, have recently become established on the Canadian prairies. We estimated life history traits in a population of wild pigs in Saskatchewan, Canada, at the current northern limit of their North American distribution. The average pregnant wild pig weighed 73.8 kg (46 - 130 kg; n = 7). Fifty-four percent of females \geq 46 kg were pregnant in Feb., with an average of 5.6 fetuses per pregnant female (range 4 - 7; n = 7). Although small sample sizes precluded statistical significance, we found that larger females in better body condition tended to have more fetuses and that the sex ratio of fetuses tended to be female-biased. Based on the cohort that we sampled in Feb., we predicted parturition would occur between Feb. and May; this range of parturition dates may have been wider had we sampled wild pigs at other times of the year. We show that the number of fetuses of wild pigs in Saskatchewan is similar to other areas, suggesting that population growth and spread could be just as rapid. Our estimates represent the first empirical life history measures of wild pigs in Canada and are an essential step in developing science-based eradication plans for this highly invasive species.





New literature on Suiformes



Development and Evaluation of a Bait Station for Selectively Dispensing Bait to Invasive Wild Pigs.

Lavelle, M.J., Snow, N.P., Halseth, J.M., Kinsey, J.C., Foster, J.A., VerCauteren, K.C.

Wildlife Society Bulletin, 42(1): 102-110. doi:10.1002/wsb.856

Populations of invasive wild pigs (*Sus scrofa*; hereafter, wild pigs) are expanding, requiring cost-effective tools for control, and disease prevention, such as toxic or vaccine baits. Specifically, development of a novel and humane toxicant is underway for control of wild pigs in the United States and Australia. A species-specific bait station for delivering the toxic bait must be used to protect nontarget animals. Further, a bait station must be designed to maximize feeding by wild pigs by accommodating their group-feeding behaviors. We sought to develop a bait station that delivered bait to the maximum proportion of wild pigs and excluded the most ubiquitous nontarget species, specifically white-tailed deer (*Odocoileus virginianus*) and raccoons (*Procyon lotor*). We used direct observations and cameras during 2015 to evaluate wild pig feeding behavior and nontarget access for various sizes, arrangements, and construction materials of prototype bait stations in pen and field settings in Texas, USA. We found that a bait station constructed of 2 back-to-back troughs, 1.1 m in length, without a divider was sufficient for feeding the largest proportion of wild pigs in pens. Using this design of bait station at 30 field sites, we found that wild pigs fed more frequently from plastic than metal bait stations, although both bait stations reduced feeding by wild pigs compared with control sites. From near-video imagery at 3 field sites, we identified that 80% of wild pigs (33 of 41), 0% of white-tailed deer (0 of 7), and 17% of raccoons (1 of 6) accessed the bait stations on the final night of testing following a 2-week acclimation and training period. Future steps toward development of a wild pig-specific bait station include adding resistance to the lids of bait stations to completely exclude raccoons and identify baiting strategies that most efficiently acclimate wild pigs to using bait stations. Published 2018. This article is a U.S. Government work and is in the public domain in the USA.

Maximum entropy modelling of farmland damage caused by the wild boars (*Sus scrofa*).

Lee, W.S., Kim, S.O., Kim, Y., Kim, J.H., Jang, G.S.

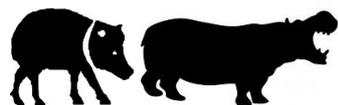
Applied Ecology and Environmental Research, 16(2): 1101-1117.

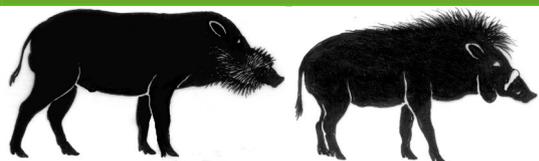
doi:10.15666/aeer/1602_11011117

Farmland damage caused by wild boars was modeled by the Maxent model using the field-inspecting data surveyed in Gyeongnam Province of South Korea during 2012 and 2013. A total of 3,854 cases (2,286 in 2012 and 1,568 in 2013) were chosen for the model after the field inspection. The Maxent model obtained quite high AUCs exceeding 0.8, indicating that the probability derived from the model had high accuracy. The variable 'distance from forest boundary (d_forest)' revealed a higher probability for damaged areas located closer to forest boundaries. The areas damaged by wild boars were also located much closer to agricultural areas, including paddies and fields. Overall, areas located within 500 m of other agricultural areas showed a higher likelihood of damage by wild boars. Based on the predictions in Maxent, damage to farmland caused by wild boars was more closely related to distance from its habitat (i.e., forest) and use of land as food resources (i.e., rice paddies and fields) than topographical factors such as elevation and slope.

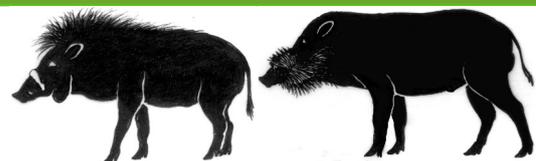
Encoding of Emotional Valence in Wild Boar (*Sus scrofa*) Calls.

Maigrot, A.L., Hillmann, E., Briefer, E.F.





New literature on Suiformes



Animals, 8(6). doi:10.3390/ani8060085

Measuring emotions in nonhuman mammals is challenging. As animals are not able to verbally report how they feel, we need to find reliable indicators to assess their emotional state. Emotions can be described using two key dimensions: valence (negative or positive) and arousal (bodily activation or excitation). In this study, we investigated vocal expression of emotional valence in wild boars (*Sus scrofa*). The animals were observed in three naturally occurring situations: anticipation of a food reward (positive), affiliative interactions (positive), and agonistic interactions (negative). Body movement was used as an indicator of emotional arousal to control for the effect of this dimension. We found that screams and squeals were mostly produced during negative situations, and grunts during positive situations. Additionally, the energy quartiles, duration, formants, and harmonicity indicated valence across call types and situations. The mean of the first and second formants also indicated valence, but varied according to the call type. Our results suggest that wild boars can vocally express their emotional states. Some of these indicators could allow us to identify the emotional valence that wild boars are experiencing during vocal production and thus inform us about their welfare.

Camera traps and activity signs to estimate wild boar density and derive abundance indices.

Massei, G., Coats, J., Lambert, M.S., Pietravalle, S., Gill, R., Cowan, D.

Pest Management Science, 74(4): 853-860. doi:10.1002/ps.4763

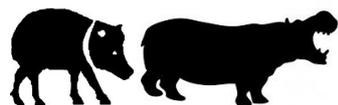
BACKGROUND Populations of wild boar and feral pigs are increasing worldwide, in parallel with their significant environmental and economic impact. Reliable methods of monitoring trends and estimating abundance are needed to measure the effects of interventions on population size. The main aims of this study, carried out in five English woodlands were: (i) to compare wild boar abundance indices obtained from camera trap surveys and from activity signs; and (ii) to assess the precision of density estimates in relation to different densities of camera traps. For each woodland, we calculated a passive activity index (PAI) based on camera trap surveys, rooting activity and wild boar trails on transects, and estimated absolute densities based on camera trap surveys. **RESULTS** PAIs obtained using different methods showed similar patterns. We found significant between-year differences in abundance of wild boar using PAIs based on camera trap surveys and on trails on transects, but not on signs of rooting on transects. The density of wild boar from camera trap surveys varied between 0.7 and 7 animals/km². Increasing the density of camera traps above nine per km² did not increase the precision of the estimate of wild boar density. **CONCLUSION** PAIs based on number of wild boar trails and on camera trap data appear to be more sensitive to changes in population size than PAIs based on signs of rooting. For wild boar densities similar to those recorded in this study, nine camera traps per km² are sufficient to estimate the mean density of wild boar.

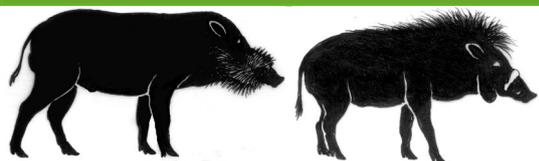
A globally-distributed alien invasive species poses risks to United States imperiled species.

McClure, M.L., Burdett, C.L., Farnsworth, M.L., Sweeney, S.J., & Miller, R.S.

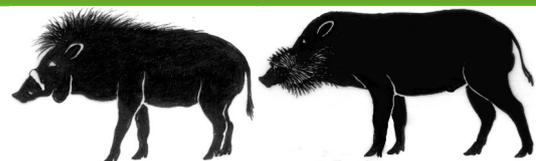
Scientific Reports, 8. doi:10.1038/s41598-018-23657-z

In the midst of Earth's sixth mass extinction event, non-native species are a driving factor in many imperiled species' declines. One of the most widespread and destructive alien invasive species in the world, wild pigs (*Sus scrofa*) threaten native species through predation, habitat destruction,





New literature on Suiformes



competition, and disease transmission. We show that wild pigs co-occur with up to 87.2% of imperiled species in the contiguous U.S. identified as susceptible to their direct impacts, and we project increases in both the number of species at risk and the geographic extent of risks by 2025. Wild pigs may therefore present a severe threat to U.S. imperiled species, with serious implications for management of at-risk species throughout wild pigs' global distribution. We offer guidance for efficient allocation of research effort and conservation resources across species and regions using a simple approach that can be applied to wild pigs and other alien invasive species globally.

Biometrical measurements as efficient indicators to assess wild boar body condition.

Risco, D., Goncalves, P., Mentaberre, G., Navarro-Gonzalez, N., Casas-Diaz, E., Gasso, D., . . . Serrano, E.

Ecological Indicators, 88: 43-50. doi:10.1016/j.ecolind.2017.12.048

Body condition (i.e., the amount of the energy stored in organs and tissues) is a key parameter that has been related with health, reproductive performance and density of wild ungulates including the wild boar (*Sus scrofa*). In this wild pig, a reference method to assess body condition has not yet been agreed and different procedures have been used in recent literature. The aim of this work was to generate an easy and reliable method based on biometrical measurements and with the ability to predict body fat in live or die boars. For this, a total of 207 hunted wild boar from three Spanish populations with contrasting food availability were included in this study. Sex, age, biometrical parameters (body weight, total length and chest girth) and body condition indicators (brisket and rump fat thickness, kidney fat index (KFI), ratio between chest girth-total length and scaled mass index) were assessed for each animal. A boosted regression trees (BRT) approach was carried out to find models based on age, sex and biometrical features that predicted brisket fat thickness in the studied animals. BRT models including sex, body weight, total length and chest girth as explanatory variables were able to predict brisket fat thickness in wild boar (68-73% of deviance explained). These models were not influenced by the location of sampling and their predictive values showed a good agreement with real brisket fat thickness (94.1-95.6). Predictive values obtained in BRT models from each area also agreed with food availability suggesting this is a valid indicator of body condition of wild boar in a broad range of environmental conditions.

Assessing the utility of metabarcoding for diet analyses of the omnivorous wild pig (*Sus scrofa*).

Robeson, M.S., Khanipov, K., Golovko, G., Wisely, S.M., White, M.D., Bodenchuck, M., . . . Piaggio, A.J.

Ecology and Evolution, 8(1): 185-196. doi:10.1002/ece3.3638

Wild pigs (*Sus scrofa*) are an invasive species descended from both domestic swine and Eurasian wild boar that was introduced to North America during the early 1500s. Wild pigs have since become the most abundant free-ranging exotic ungulate in the United States. Large and ever-increasing populations of wild pigs negatively impact agriculture, sport hunting, and native ecosystems with costs estimated to exceed \$1.5billion/year within the United States. Wild pigs are recognized as generalist feeders, able to exploit a broad array of locally available food resources, yet their feeding behaviors remain poorly understood as partially digested material is often unidentifiable through traditional stomach content analyses. To overcome the limitation of stomach content analyses, we developed a DNA sequencing-based protocol to describe the plant





New literature on Suiformes



and animal diet composition of wild pigs. Additionally, we developed and evaluated blocking primers to reduce the amplification and sequencing of host DNA, thus providing greater returns of sequences from diet items. We demonstrate that the use of blocking primers produces significantly more sequencing reads per sample from diet items, which increases the robustness of ascertaining animal diet composition with molecular tools. Further, we show that the overall plant and animal diet composition is significantly different between the three areas sampled, demonstrating this approach is suitable for describing differences in diet composition among the locations.

Quantifying Damage From Wild Pigs With Small Unmanned Aerial Systems.

Samiappan, S., Czarnecki, J.M.P., Foster, H., Strickland, B.K., Tegt, J.L., Moorhead, R.J.
Wildlife Society Bulletin, 42(2): 304-309. doi:10.1002/wsb.868

Wild pig (*Sus scrofa*) population expansion and associated damage to crops, wildlife, and the environment is a growing concern in the United States. The destructive rooting behavior of wild pigs indicates where they have foraged and their general presence on the landscape. We used aerial imagery with a small unmanned aerial system to assess damage of corn (*Zea mays*) fields by wild pigs in the Mississippi Alluvial Valley of Mississippi, USA, during the 2016 growing season. Images were automatically classified using segmentation-based fractal texture analysis and support vector machines. We assessed the accuracy of automated classification with 5,400 Global Positioning System ground reference points collected in the fields. Classification accuracies for identification of damaged and nondamaged areas were between 65% and 78%. In general, automated classification underestimated the area of damage present within fields. Kappa values ranged from 0.26 to 0.51, on a scale of 0.0-1.0. Small unmanned aerial systems overcome limitations of existing methods because they can survey an entire field rapidly and without significant field labor.

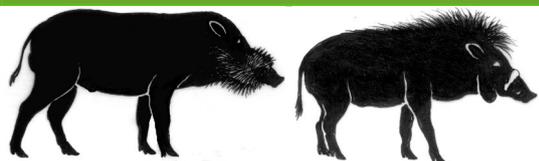
Potential secondary poisoning risks to non-targets from a sodium nitrite toxic bait for invasive wild pigs.

Snow, N.P., Foster, J.A., VanNatta, E.H., Horak, K.E., Humphrys, S.T., Staples, L.D., . . .
VerCauteren, K.C.

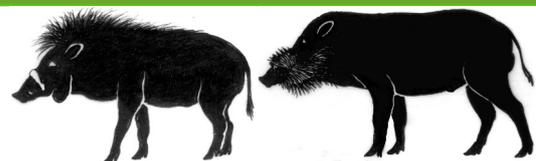
Pest Management Science, 74(1): 181-188. doi:10.1002/ps.4692

BACKGROUND An acute and orally delivered toxic bait containing micro-encapsulated sodium nitrite (MESN), is under development to provide a novel and humane technology to help curtail damage caused by invasive wild pigs (*Sus scrofa*). We evaluated potential secondary risks for non-target species by: testing whether four different types of micro-encapsulation coatings could reduce vomiting by invasive wild pigs, testing the levels of residual sodium nitrite (SN) in tissues of invasive wild pigs, testing the environmental persistence of SN in vomitus, and conducting a risk assessment for scavengers. **RESULTS** Micro-encapsulation coatings did not affect the frequency of vomiting. We identified no risk of secondary poisoning for non-target scavengers that consume muscle, eyes, and livers of invasive wild pig carcasses because residual SN from the toxic bait was not detected in those tissues. The risk of secondary poisoning from consuming vomitus appeared low because approximate to 90% of the SN was metabolized or broken down prior to vomiting, and continued to degrade after being exposed to the environment. Secondary poisoning could occur for common scavengers that consume approximately 15% of their daily dietary requirements of digestive tract tissues or undigested bait from carcasses of invasive wild





New literature on Suiformes



pigs in a rapid, single-feeding event. The likelihood of this occurring in a natural setting is unknown. The digestive tracts of poisoned invasive wild pigs contained an average of approximate to 4.35mg/g of residual SN. CONCLUSION Data from this study suggest no risks of secondary poisoning for non-target species (including humans) that consume muscle, liver, or eyes of invasive wild pigs poisoned with a MESN toxic bait. More species-specific testing for scavengers that consume digestive tract tissues and undigested bait is needed to reduce uncertainty about these potential risks.

Effects of wild boar (*Sus scrofa* L.) rooting on seedling emergence in Bialowieza Forest.

Sondej, I., Kwiatkowska-Falinska, A.J.

Polish Journal of Ecology, 65(4): 380-389. doi:10.3161/15052249pje2017.65.4.007

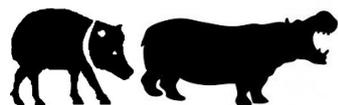
The wild boar is an omnivorous animal, and by foraging (rooting) disturbs the top soil layer. In some regions of Poland and Europe seasonal fluctuations in rooting have been observed. Wild boars not only eat plants, but also strongly modify their habitat. In Bialowieza National Park wild boar most frequently visit oak-hornbeam forests on fertile soil. On sites where the forest floor is covered with dense vegetation the germination of seeds is difficult, and wild boar rooting can promote the removal of diaspores from deeper layers of the soil seed bank. Within a 3-year observation on 30 subplots about 10,000 seedlings emerged representing 38 species. Our study revealed that rooted patches are characterised by a very rich and diverse flora of seedlings representing mostly forest species, but their density is low. The dominant species germinating in the disturbed ground vegetation is *Urtica dioica*, a species forming the persistent soil seed bank. There is a possibility that seedlings of herbaceous plants emerging on permanently rooted patches are of exogenous origin, since the seeds germinating there were in many cases damaged by repeatedly rooting animals and had no chance for further growth and reaching the generative phase. However, the soil seed bank in the rooted area has to be analysed to confirm this theory, that they have exogenous or endogenous origin. Seedling density in a repeatedly rooted oak-hornbeam forest is determined by factors other than those related to rooting. In this context the present study did not demonstrate a negative impact of rooting intensity on seedling emergence.

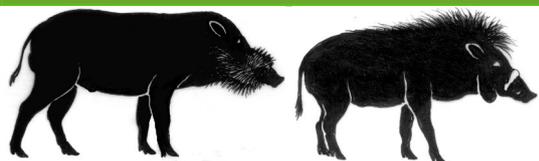
Pigs in space: An agent-based model of wild boar (*Sus scrofa*) movement into cities.

Toger, M., Benenson, I., Wang, Y.Q., Czamanski, D., Malkinson, D.

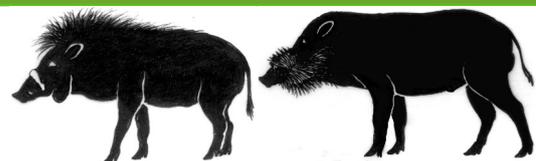
Landscape and Urban Planning, 173: 70-80. doi:10.1016/j.landurbplan.2018.01.006

Last decades saw a dramatic increase in wildlife populations within urban areas. Policymakers seek to minimize human-wildlife conflicts resulting from overabundance of species, such as wild boars (*Sus scrofa*). To this end, there is a need to understand the drivers governing infiltration of wildlife into cities. In this paper we study the availability and distribution of food resources in urban areas as driver of wild boar movement patterns. Based on the optimal foraging theory, we utilize an agent-based simulation model to investigate the ever-growing infiltration of wild boars into some cities. We apply the model to an artificial city that mimics the landscape of the city of Haifa. Manipulating food availability and relative resistance costs of different land-covers we demonstrate that infiltration of boars depends on population size of wild boars and on the amount and spatial distribution of attractors (e.g., food). Model outputs for likely sets of parameters demonstrate good correspondence to the reports of boar observations within the city of Haifa, Israel, where the porosity of the urban fabric and the connectivity of open space patches provide





New literature on Suiformes



a trail network that makes food throughout the city accessible at a relatively low search-cost. Our results indicate that land cover and food patterns determine critically boars' foraging movement and infiltration into the city. The proposed modeling framework provides a tool to investigate wildlife management policies that aim at reducing people-wildlife conflicts in cities.

Biology and Impacts of Pacific Islands Invasive Species. 14. *Sus scrofa*, the Feral Pig (Artiodactyla: Suidae).

Wehr, N.H., Hess, S.C., Litton, C.M.

Pacific Science, 72(2): 177-198. doi:10.2984/72.2.1

Feral pigs (*Sus scrofa* L.) are perhaps the most abundant, widespread, and economically significant large introduced vertebrate across the Pacific island region. Unlike many other nonnative invasive species, feral pigs have both cultural and recreational importance in the region, complicating their management. Today, Pacific island feral pigs are a mixture of several strains of domestic swine, Asiatic wild boar, and European wild boar. Due to their generalist diet and rooting behavior, feral pigs alter soils and watersheds and negatively impact native and nonnative flora and fauna. As a result, feral pigs have played a role in the extinction of several species of plants and animals on Pacific islands and have negative effects on both ecotourism and agricultural industries in the region. Despite numerous published studies on feral pigs in the Pacific island region, of which the majority include systematic analyses of original empirical data, some fundamental aspects of feral pig ecology remain poorly characterized, at least partly due to the remote and inaccessible environments that they often inhabit. To address these knowledge gaps, effort should be made to integrate research conducted outside the Pacific island region into local management strategies. This review summarizes the origins, history, ecology, environmental effects, and current management of feral pigs in the Pacific island region; integrates regional scientific findings with those of other insular and continental systems; and identifies current knowledge gaps requiring further research to inform the ecology and management of this impactful invasive species.

Wild pigs breach farm fence through harvest time in southern San Joaquin Valley.

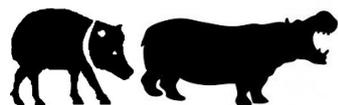
White, M.D., Kauffman, K.M., Lewis, J.S., Miller, R.S.

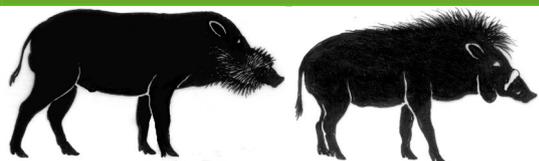
California Agriculture, 72(2): 120-126. doi:10.3733/ca.2018a0017

Wild pigs cause around \$1 billion of damage to agriculture in the United States each year; foraging on crops, breaking branches and vines, and damaging irrigation lines and fences - but little is known about how and when they access agricultural fields. We used wildlife camera traps to document and describe wild pig access to two fenced southern San Joaquin Valley farms. Pigs breached fences around agricultural fields, especially during the harvest period when crops were ripe, and almost exclusively at night, outside of the regulated, daytime recreational pig hunting period. GPS data from an adult boar revealed that pigs may travel long distances from wildlands to reach crops. The results of our case study suggest that increasing monitoring and maintenance of fences during the harvest season and removing pigs that have learned to access farms may help reduce pig damage to agricultural fields. The results also suggest a formal scientific investigation of risk factors and strategies to reduce wild pig damage is warranted.

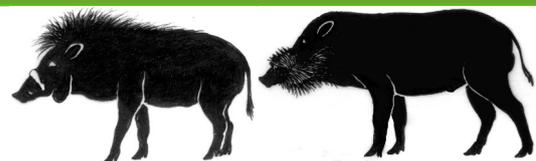
Habitat and management influence on a seasonal diet composition of wild boar.

Zeman, J., Hrbek, J., Drimaj, J., Kudlacek, T., Heroldova, M.





New literature on Suiformes



Biologia, 73(3): 259-265. doi:10.2478/s11756-018-0027-4

The purpose of this study was to compare the diet composition of two wild boar populations living in the Czech Republic, one living in a floodplain, broadleaved, forest (A) and the other in a highland mostly coniferous forest (B). Food consumed by A showed to be mostly of natural origin, while that of B was predominantly supplemented. The diet consisting of natural resources was significantly different than the diet including mainly supplemented food. All diversity indices of food volume were higher in lowland localities compared to highland in all season's cumulative sample. Similarity of the relative volume and relative frequency gradually decreased from spring to winter. Significant differences were found in wild boar consumption of roots (higher in A), grasses (higher in A), seeds and fruits (higher in B) and cereal husks (higher in B). Differences were also found in body mass of the piglets in A, as piglets were dominant group in both localities. Food supply of the localities and population management by the wildlife managers (supplemented food) were the main factors influencing the diet composition of the wild boar.

Population ecology of the giant forest hog, *Hylochoerus meinertzhageni* in Chebera Churchura National Park, Ethiopia.

Mekonnen, A., Bekele, A., Balakrishnan, M.

Afr. J. Ecol., 56:272–278

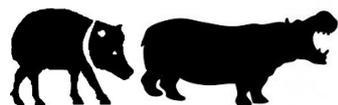
Population, feeding habit, distribution and activity patterns of the giant forest hog (*Hylochoerus meinertzhageni*) were studied in Chebera Churchura National Park (CCNP), Ethiopia, using line transect sample counts. Population estimate of the hogs was 845 individuals. Among the counted individuals, 42.4% were males and 57.6% were females. Among them, 32.8% were adults, 26.9% were subadults, and 40.3% were piglets. Large sounders of up to 20 individuals were seen during the wet season. They were seen in all habitat types in CCNP with higher abundance in the riverine vegetation. Availability of food, green vegetation cover and water were factors governing distribution of forest hogs in the study area. Grass was the major food item of the hogs (90%), mainly of *Panicum* sp., *Acalypha psilostachya*, *Cissapelos rigidifolia*, *Psilotrichum gnaphalobryum* and *Abutilon ceclii*. Feeding was the major activity for which 49.7% of the active daytime was used. Resting (lying down, standing and wallowing) was the next major activity, for which they spent 38.8% of the daytime, followed by other activities (11.5%). Morning and late afternoon activity peaks were more intensive during the dry season. This female biased giant forest hog population is expected to sustain in CCNP.

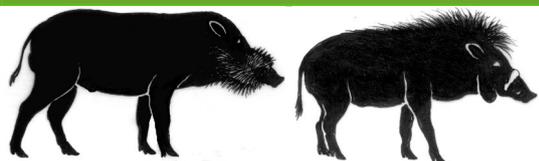
Habitat Preferences of the Bohor Reedbuck (*Redunca redunca*) and Common Warthog (*Phacochoerus africanus*) in Arsi Mountains National Park, South-eastern Ethiopia.

Girma, Z.

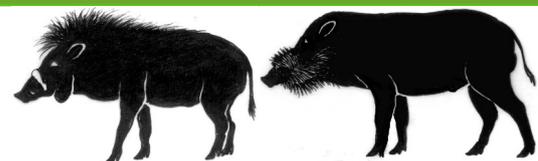
International Journal of Ecology and Environmental Sciences 44 (3): 227-237

The habitat preferences of two ungulates mammals were studied in Galama mountains of Arsi Mountains National Park. A stratified random sampling design established around four dominant habitat types (dry evergreen Afro-montane forests, mixed plantation forests, Erica shrub lands and the Afro-alpine) was used to study the habitat preferences of the Bohor reedbuck and common warthog. Intensive-Modified Whitaker (I-MW) nested plot design was used to sample vegetation ground percent cover and scat of the Bohor reedbuck, warthog and livestock across the study area. The highest habitat preference indices for Bohor reedbuck (0.28) and common warthog (0.55) were recorded in the Afro-alpine habitat and mixed plantation forest respectively





New literature on Suiformes



during dry season. There was significant difference in mean scat count of both Bohor reedbuck ($H = 9.27$, $df = 3$, $p = 0.026$) and warthog ($H = 11.32$, $df = 3$, $p = 0.010$) among habitat types. For warthog, livestock abundance was a good negative predictor of habitat use during the dry season, while both livestock abundance (negative predictor) and herb species percent cover (positive predictor) accounted for the wet season. Livestock abundance and slope were good negative predictors of Bohor reedbuck habitat use during the dry season, while livestock, slope average percent cover (positive predictor) accounted more in the wet season. Herb abundance used for forage and livestock encroachment determines the habitat preferences of the two mammals. Livestock encroachments abundance has been found to significantly limit the abundance of both warthog and Bohor reedbuck in Galama Mountains of Arsi Mountains National Park. As a result, to save the animals there is a need for urgent halting of livestock encroachments and other human disturbances.

Seasonality, crop type and crop phenology influence crop damage by wildlife herbivores in Africa and Asia.

Gross, E.M., Lahkar, B.P., Subedi, N., Nyirenda, V.R., Lichtenfeld, L.L., Jakoby, O. *Biodiversity and Conservation*, 27(8): 2029-2050. doi:10.1007/s10531-018-1523-0

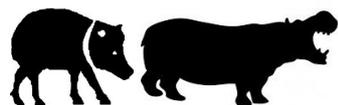
Wildlife species damaging crops can cause substantial losses to farmers and at the same time create negative attitudes against wildlife and conservation efforts that may result in negative interactions against wildlife and lead to human-wildlife conflicts (HWCs). For the analysis of negative interactions between humans and terrestrial wildlife species, a globally applicable scheme for monitoring was developed and applied over 6 years in study areas of two Asian (Nepal and India) and two African (Zambia and Tanzania) countries. Factors influencing crop consumption by eight different groups of herbivores were monitored and analyzed using generalized linear models. Seasonality, crop availability, type and the phenological stage of the crop seem to play an important role in the crop damaging behavior of herbivores. Crop consumers such as elephants (*Loxodonta africana* and *Elephas maximus*), zebra (*Equus quagga* spp.) and boars/hogs (*Sus scrofa*, *Potamochoerus larvatus* and *Phacochoerus africanus*) show preferences for harvested and/or maturing crops. Rhinos (*Rhinoceros unicornis*) and antelopes/deer (*Taurotragus oryx*, *Aepyceros melampus*, *Boselaphus tragocamelus* and *Axis axis*) damage the highest numbers of fields with crops at an intermediate growth stage. The findings of this study can inform management of HWCs in areas where people and wildlife coexist. Furthermore, this study demonstrates the benefits of standardized HWC assessments in order to compare data from different continents and between different species to be able to draw generalized conclusions for the management of HWC.

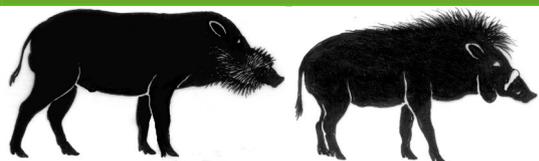
Evidence for Current Presence of a Collared Peccary (*Pecari tajacu*) Population in Guanajuato, Mexico.

Charre-Medellín, J. F., Rangel-Rojas, J. M., Magaña-Cota, G., Monterrubio-Rico, T. C., & Charre-Luna, J. L.

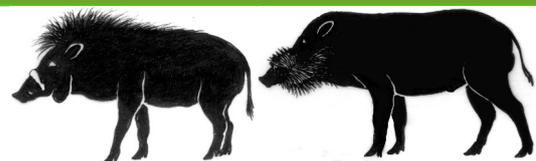
Western North American Naturalist, 78(1):106-111

On the basis of 86 photographic records, we report the presence of a relatively stable collared peccary (*Pecari tajacu*) population in the state of Guanajuato, Mexico. These records complement geographical and ecological information for the species along the Gulf of Mexico. The species' predominant habitat is submontane scrub, which corresponded to 54.6% of the records. Family





New literature on Suiformes



groups (herds) were observed with 3.9 ± 2.9 (mean \pm SD) individuals on average. The presence of young indicated 2 reproductive periods per year (March and August). The presence of collared peccaries in the region of greatest biological diversity in Guanajuato provides additional value to the protected areas of the state. This herbivorous species plays a fundamental ecological role as a preferred prey of this area's main predators, such as the jaguar (*Panthera onca*) and the cougar (*Puma concolor*). It is important to continue monitoring wild fauna with the purpose of delimiting distributions and estimating populations at the local level.

Genetic evidence of promiscuity in a mammal without apparent sexual dimorphism, the white-lipped peccary (*Tayassu pecari*).

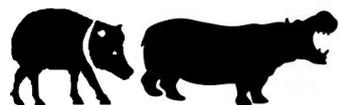
Leite, D.A., Keuroghlian, A., Rufo, D.A., Miyaki, C.Y., Biondo C.
Mammalian Biology, 92: 111-114

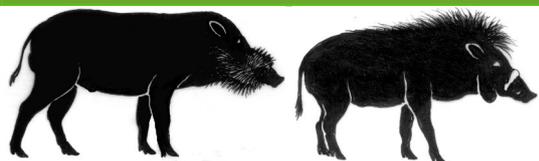
Polygyny in mammals, as in other groups, is related to sexual dimorphism, with males being larger than females or with elaborate weaponry as a response to sexual selection. However, sexual selection can also act on females, leading to cases where dimorphism is reversed or absent and females mate with several males, leading to a promiscuous mating system. In this study, we analyzed the mating system of a monomorphic mammalian species, the white-lipped peccary (*Tayassu pecari*), using microsatellite molecular markers and parentage tests. The white-lipped peccary mating system is predicted to be polygyny, but so far, no systematic study exists. To verify their mating behavior, 131 individuals of a herd from the Brazilian Pantanal were genotyped for 11 microsatellite loci and parentage tests were performed for all the sampled young. We determined that both males and females had offspring with more than one partner which is compatible with a promiscuous mating system. Promiscuity in this species could be related to competition among females as a result of the female-biased sex ratio leading to sexual and/or natural selection not only on males but also females.

Ethnozoological uses of common hippopotamus (*Hippopotamus amphibius*) in Benin Republic (Western Africa).

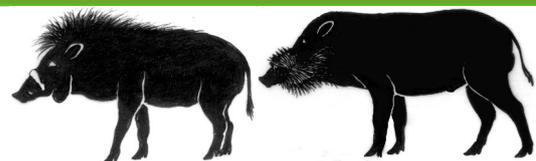
Dossou, E.M., Lougbegnon, T.O., Houessou, L.G., Codjia, J.T.C.
Indian Journal of Traditional Knowledge, 17(1), 85-90

Hippopotamus amphibius is the 3rd largest and heaviest terrestrial mammal after elephants (*Loxodonta africana*) and white rhinos (*Ceratotherium simum*) in Africa. This investigation conducted in the Benin Republic aims to assess the local inhabitants' traditional knowledge associated with hippo in different use categories (medicinal, cultural and spiritual). Data were gathered using ethnozoological questionnaires. One hundred and fifty informants from 13 ethnic groups in Benin were randomly selected and interviewed. Chi square test was used to analyze the answers given regarding the uses categories of hippo. Principal Correspondence Analysis was used to describe traditional beliefs associated with hippo according to the ethnic groups. Results revealed seven use categories for hippo. A significant difference was observed between age groups ($\chi^2(2) = 27.537$; $p = 0.027$; $dF = 2$) regarding use categories. But no significant differences were found between ethnic groups ($\chi^2(2) = 16.437$; $p = 0.057$; $dF = 12$) for the use categories. The Principal Component Analysis revealed differences in traditional beliefs associated with hippo. For example, the male adult Yoruba and Adja regard hippo as cruel and diabolic animal. The Fon and old men from Idatcha, Alzo, Mahi, Goun, Holly and Cotafon ethnic groups have considered hippo as saviour, protector and fetish.





New books about Suiformes

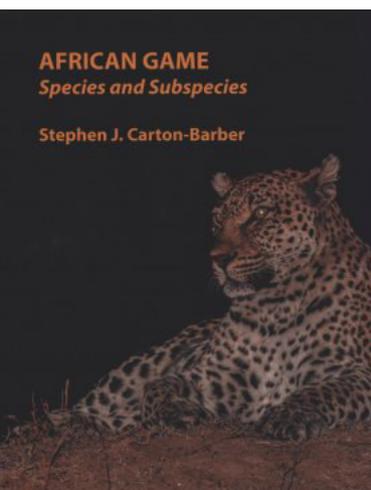


Effects of the hippopotamus on the chemistry and ecology of a changing watershed.

Stears, K., McCauley, D.J., Finlay, J.C., Mpemba, J., Warrington, I.T., Mutayoba, B.M., . . .
Brashares, J. S.

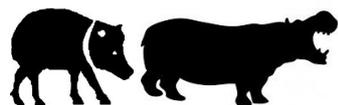
Proceedings of the National Academy of Sciences of the United States of America, 115(22):
E5028-E5037. doi:10.1073/pnas.1800407115

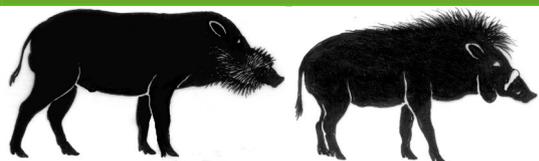
Cross-boundary transfers of nutrients can profoundly shape the ecology of recipient systems. The common hippopotamus, *Hippopotamus amphibius*, is a significant vector of such subsidies from terrestrial to river ecosystems. We compared river pools with high and low densities of *H. amphibius* to determine how *H. amphibius* subsidies shape the chemistry and ecology of aquatic communities. Our study watershed, like many in sub-Saharan Africa, has been severely impacted by anthropogenic water abstraction reducing dry-season flow to zero. We conducted observations for multiple years over wet and dry seasons to identify how hydrological variability influences the impacts of *H. amphibius*. During the wet season, when the river was flowing, we detected no differences in water chemistry and nutrient parameters between pools with high and low densities of *H. amphibius*. Likewise, the diversity and abundance of fish and aquatic insect communities were indistinguishable. During the dry season, however, high-density *H. amphibius* pools differed drastically in almost all measured attributes of water chemistry and exhibited depressed fish and insect diversity and fish abundance compared with low-density *H. amphibius* pools. Scaled up to the entire watershed, we estimate that *H. amphibius* in this hydrologically altered watershed reduces dry-season fish abundance and indices of gamma-level diversity by 41% and 16%, respectively, but appears to promote aquatic invertebrate diversity. Widespread human-driven shifts in hydrology appear to redefine the role of *H. amphibius*, altering their influence on ecosystem diversity and functioning in a fashion that may be more severe than presently appreciated.



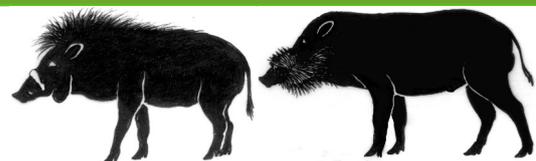
As already indicated by the title this book is about African game species – animals, that can easily be watched on safaries. The author Stephen Carton-Barber runs a safari business in his own game ranch in South Africa. In the introduction chapter Carton-Barber defines game species as „those animals, that are typically hunted, or eaten“. He also includes the ostrich and crocodiles, but excludes all primate species and many smaller mammals. Regarding the validity of subspecies, the author recognize a subspecies as valid, if a description of it has taken place, has a „observable and/or other differences“ and is geographically separate from other subspecies.

A brief introduction to taxonomy is presented in the second chapter; the third contains historical and present distribution of game species. As Carton-Barber points out there is a lack of proper distribution maps for subspecies either historical or present. The IUCN Red List of Threatened Species has only very few subspecies accounts. A further problem is that subspecies hybridize with other subspecies. After these three general chapters, the African game species are described, each chapter dealing with one genus starting with white rhinos. The genus name's origin is mentioned first, the history of the genus' taxonomy. Then the different species and their subspecies are listed and maps of





New books about Suiformes



the present distribution of the subspecies and for some (where knowledge is available) for their historical range are shown, followed by a description of their appearance in contrast to closely related species. Each chapter comprises many big photos of the species and when possible of the subspecies or at least some of them.

In the chapter about hippos, five subspecies of the Common hippo are listed. This is on contrast to Lewison (2011) where only three subspecies (*amphibius*, *capensis* and *kiboko*) are mentioned as valid subspecies. Similarly, the chapter about warthogs lists five subspecies for the Common warthog (*Phacochoerus africanus*), while Butynski and de Jong (2018) consider only four to be valid. Similarly, for bushpigs, Red river hogs and the Eurasian wild boar other authors recognize less subspecies than Carton-Barber (see species accounts for these species in Melletti and Meijaard 2018).

Unfortunately, the order in which the different genera of game species are presented in this book is not comprehensible. After chapters about odd-toed ungulates many chapters with artiodactyls follow but then are chapters about some carnivores, crocodiles, again some about artiodactyls, some about carnivores, one about ostriches and some again about carnivores.

The author has done a big effort to collect all the information about the different game species and their subspecies. As he writes in the first chapter of the book many people would disagree about his decision which subspecies are valid and which not. He looks „forward to dialogue in this regard.“ but the book does not contain a reference list or a description of the characteristics that differ between the mentioned subspecies. It would have been good to have both to compare the sources, from which this author draws his conclusions in comparison to the conclusion of other authors. Therefore, people who are interested in detailed taxonomic discussions should consult the sources mentioned above and furthermore Groves and Grubb (2011). Nevertheless, this book shows the biodiversity of African game species and presents many good photos. It could help to raise interest in African game species and their populations, whether they are considered valid subspecies or not.

African Game Species and Subspecies

by Stephen J. Carton-Barber

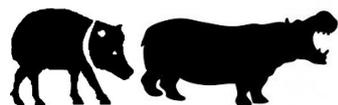
467 pages

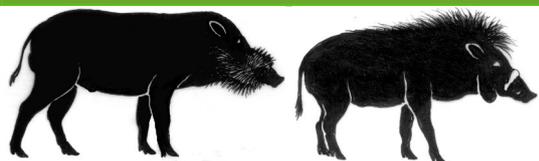
2017, African Wildlife Subspecies Foundation, Benoni, South Africa

References

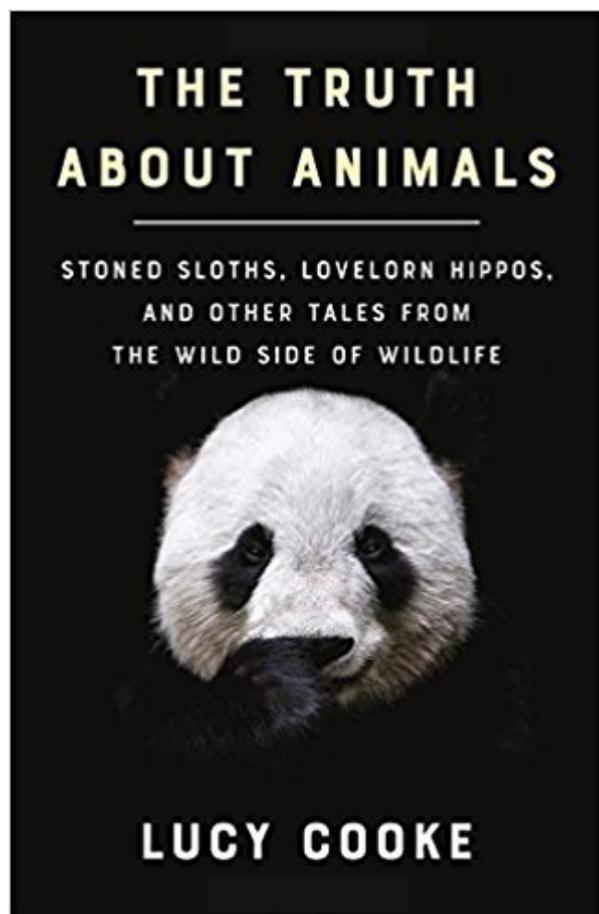
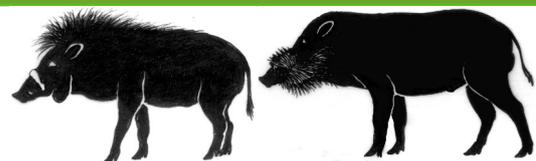
- Butynski, T. and Y. de Jong (2018). Common Warthog *Phacochoerus africanus* (Gmelin, 1788), p. 85-100 in Melletti, M. and E. Meijaard (eds.) (2018). Ecology, Conservation and Management of Wild Pigs and Peccaries. Cambridge University Press, Cambridge, UK.
- Groves, C. and P. Grubb (2011). Ungulate Taxonomy. The John Hopkins University Press. Baltimore, USA.
- Lewison, R.L. (2011). Family Hippopotamidae (Hippopotamuses), p. 308-319 in Wilson D.E. & R.A. Mittermeier (eds.). Handbook of the Mammals of the World Vol. 2. Hoofed Mammals. Lynx Edicions, Barelona, Spain.
- Melletti, M. and E. Meijaard (eds.) (2018). Ecology, Conservation and Management of Wild Pigs and Peccaries. Cambridge University Press, Cambridge, UK.

Reviewed by Thiemo Braasch





New books about Suiformes



Lucy Cooke has written a book about myths and legends of different animals. These animals range from eel, frogs and birds to mammals like bats, hyenas, chimpanzees or hippos. She tells e.g. about the search of the birthplace of European eels, the legend of beavers cutting off their testicles when threatened, sloths' lifestyle, the origin of vampirism, how storks helped to solve the mystery of bird migration, drunken moose, the pseudo-penis of female hyenas and the modern legend of giant pandas unwilling to mate. She also writes about ancient perceptions of animals, outlandish theories to explain them and bizarre experiments to solve the myths and misconceptions citing famous naturalists like George-Louis Leclerc de Buffon, John James Audubon or Pliny the Elder.

The chapter about hippos deals with the liquid excreted by hippos that was thought to be blood but in fact is a sunblock, bug repellent and antiseptic. Hippos were considered to be closely related to pigs for a long time. Due to this long-lasting consideration they are covered by Suiform Soundings. Cooke writes about Bill Barklow, his observations of hippo communication and the first

suggestions that whales are hippos' next relatives. Finally, the story of the hippos, that once lived in Pablo Escobar's private zoo in Colombia, later escaped and that now make an interesting ecological experiment of big mammals transferred by humans to a South America, complete this chapter (for Pablo Escobar's hippos see also Suiform Soundings 15(1): 151-152).

Historical descriptions of animals and their characteristics change with the author's personal experiences with the animals. Some ancient images or photos of the species are also presented in each chapter. To sum it up, the book is about anthropomorphism and human arrogance towards animals. The chapter 11 about pandas and the myth of their unwillingness to mate shows clearly that even the modern world is not immune against misconceptions and myths. Cooke's style of writing is often ironical or sarcastic but never boring. There are only few authors writing about natural history so entertainingly and Lucy Cooke is definitely one of them!

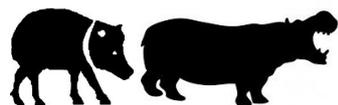
The Truth about Animals

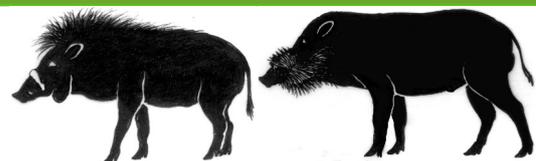
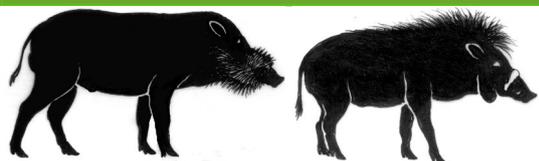
by Lucy Cooke

320 pages

2018, Basic Books, New York, USA

Reviewed by Thiemo Braasch





China's swine fever outbreak may spread in Asia: FAO

<http://www.dailymail.co.uk/wires/afp/article-6105045/Chinas-swine-fever-outbreak-spread-Asia-FAO.html>

By Afp

Published: 06:57 BST, 28 August 2018 | Updated: 06:57 BST, 28 August 2018

An outbreak of African swine fever in China may spread to other parts of Asia, the UN Food and Agriculture Organization warned Tuesday, as the world's largest pork producer scrambled to contain the disease. China has culled more than 24,000 pigs in four provinces to stop the disease from proliferating, the FAO said in a statement. The first outbreak was reported in early August. The FAO said the cases have been detected in areas more than 1,000 kilometres (600 miles) apart, meaning it could cross national borders.

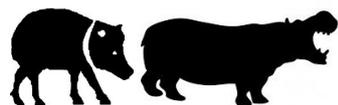
"The deadly pig virus may spread to other Asian countries anytime," the FAO said. The "diverse geographical spread of the outbreaks in China have raised fears that the disease will move across borders to neighbouring countries of Southeast Asia or the Korean Peninsula where trade and consumption of pork products is also high," it added. China reported its first case of the disease in northeast Liaoning province earlier this month. Last week, the eastern city of Lianyungang announced it had culled 14,500 pigs in an attempt to check the disease's spread. "The movement of pig products can spread diseases quickly and, as in this case of African swine fever, it's likely that the movement of such products, rather than live pigs, has caused the spread of the virus to other parts of China," explained Juan Lubroth, FAO's chief veterinarian. African swine fever is not harmful to humans but causes haemorrhagic fever in domesticated pigs and wild boar that almost always ends in death within a few days. There is no antidote or vaccine, and the only known method to prevent the disease from spreading is a mass cull of the infected livestock. In a report to the World Organisation for Animal Health, Beijing said an emergency plan had been launched and control measures taken to halt the spread of the disease. The FAO warned in May of the risk of the spread of African swine fever from Russia. Around half of the world's pigs are raised in China, and the Chinese are the biggest consumers of pork per capita, according to the FAO.

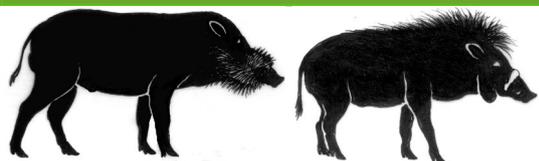
Bornean bearded pigs seen adapting to oil palm habitats, study finds

<https://news.mongabay.com/2018/03/bornean-bearded-pigs-seen-adapting-to-oil-palm-habitats-study-finds/>

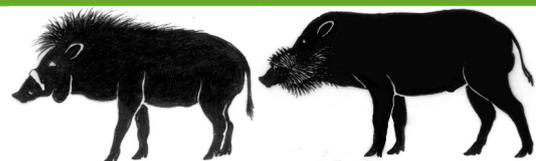
by Basten Gokkon on 6 March 2018

Bornean bearded pigs appear to thrive in oil palm plantations, but remain heavily dependent on nearby forests as their primary habitat, a recent study indicates. The findings are crucial because of the species' key role as an "ecosystem engineer," controlling the spread of tree species and turning over the soil with their rooting behavior. The researchers have called on the Malaysian government to better protect these forests in a bid to ensure a sustainable population of bearded pigs in mixed forest-oil palm areas. Bearded pigs in Malaysian Borneo appear to have adapted to oil palm plantations, a key driver of deforestation in the region, but still depend heavily on adjacent forests as their primary habitat, a recent study suggests.





Articles in the news

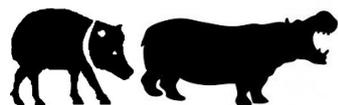


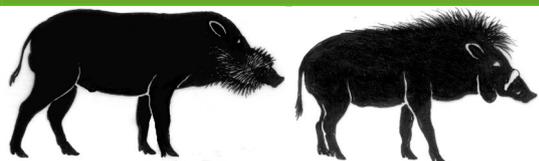
The paper, published Feb. 27 in the journal *Wildlife Research*, described the findings of surveys conducted between February and April 2014 in landscapes surrounding Danau Girang Field Centre in the Lower Kinabatangan area of eastern Sabah state. The site included 10 protected areas, ranging in size from 12 to 74 square kilometers (4.6 to 28.5 square miles), but 48 percent of the territory was occupied by oil palm plantations.

The study found that populations of the Bornean bearded pig (*Sus barbatus*) were present in all forested sites and 80 percent of the surveyed oil palm plantations, but that the animals were engaged in far more activities, such as wallowing and nesting, in the forests than the plantations. The researchers noted that 95 percent of the bearded pigs in the study were considered to be in “good” or “very good” physical condition. “Consistent bearded pig presence in oil palm is potentially an indication of successful adaptation to agricultural expansion in the study area,” said lead author Kieran Love from the Danau Girang Field Centre. “The apparently good body condition displayed by the vast majority of pigs in our study likely results from year-round cross-border fruit subsidies from surrounding oil palm plantations.”

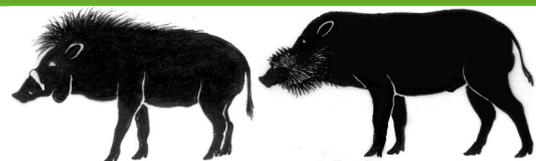
Oil palm plantations have become a dominant landscape in Southeast Asia, particularly in Malaysia and Indonesia, which share the island of Borneo and supply nearly 90 percent of the world’s palm oil. But the rapid growth of the industry has resulted in rampant deforestation across the region. Habitat destruction and fragmentation, as well as overhunting, have slashed the population of the bearded pig, a species of high ecological, social and conservation importance. The pigs serve as “ecosystem engineers” by removing saplings to build nests, turning over the soil through their rooting behavior, and acting as seed predators for many rainforest tree species. They are also an important prey for large predators, including the Sunda clouded leopard (*Neofelis diardi*). Bearded pigs feed largely on leaves, roots, fungi, invertebrates, small vertebrates and carrion, but their cycles of body condition, growth and breeding have been linked mainly to the availability of fruits, including oil palm fruit. “Our research aimed to understand how the bearded pig is adapting to increasingly common fragmented forests bordering oil palm, in an effort to establish foundational data for science and sustainable management of this popular game species in Sabah,” said Benoit Goossens, director of the Danau Girang Field Centre and scientific adviser to the Sabah Wildlife Department. The researchers said they had started a long-term study in which individual pigs would be fitted with GPS collars, in order to better understand the pigs’ movements within, and their use of, the oil-palm landscape. They also called on the Malaysian government to include protection of secondary forest fragments adjacent to oil palm plantations in their priorities for conservation, to ensure a sustainable population of bearded pigs in mixed forest-oil palm areas. “The fact that we have well-fed bearded pigs throughout a fragmented forest-oil palm landscape shows that there may be several options for long-term bearded pig management, which is good news for both hunters and conservationists,” said corresponding author David Kurz, a doctoral candidate at the University of California, Berkeley.

The bearded pig, notable for its facial hair and with a longer snout and legs than the Eurasian wild boar, is a protected species in Sabah, but can be hunted with a license. It is listed as vulnerable by the IUCN. A study published late last year found that wild boars that were drawn to oil palm plantations in peninsular Malaysia for the fruit were responsible for extensive damage to small trees and shrubs in adjacent tracts of forest. Periods when the oil palms were mature and therefore bearing fruit coincided with a “hyper-abundance” of boar nests, made using understory vegetation such as tree saplings. Nest density swelled a hundredfold in these instances, and dropped just as dramatically during periods of replanting, when no palm fruit was available.





Articles in the news



Mauled to pieces by a pack of dogs in gambling death pits: Animal rights groups condemn Indonesia's boar fighting tradition where owners' canines kill wild animals for prize money

<http://www.dailymail.co.uk/news/article-5421775/Activists-condemn-fights-boars-dogs.html>
By Khaleda Rahman For Mailonline
Published: 12:09 BST, 22 February 2018 | Updated: 13:33 BST, 22 February 2018

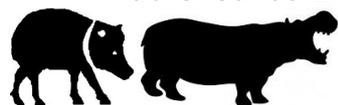


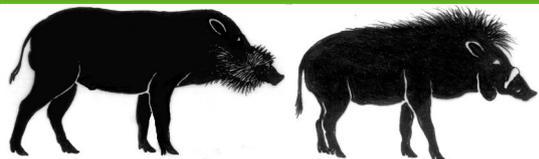
Pictures show pitbulls mauling wild boars during death matches in Indonesia. Known as 'adu bagong,' locals gamble on the fights held in remote villages. But animal rights activities condemned the brutal practice, which locals say keep the boar population in check.

Animal rights groups have condemned Indonesia's boar fighting tradition which sees the wild animals mauled by dogs belonging to locals who gamble on the matches for prize money. These gruesome pictures show blood-soaked dogs attacking boars in a muddy arena made of bamboo as a 400-strong crowd of people look on in Cibiru, West Java. Known locally as 'adu bagong,' locals gamble on the fights that take place in remote villages to keep the boar population in check. Dog owners pay 200,000 to two million Indonesian rupiah (£11 - £105) to enter - and winners can scoop up cash prizes of up to £1,500. 'Most of the pigs died,' photographer Jefri Tarigan, 32, said. 'They are bound to be severely injured by the dogs, and even if they survive one dog, they will be pitted against another one.' 'If a pig loses, his flesh will be sold. The main purpose has been to reduce the numbers of wild boars damaging farms in the area.' 'Wild boar populations are still very high, and they can be very aggressive to humans if they feel threatened.' Mr Tarigan said eight pigs were killed on the day he attended a fight and 20 dogs were injured, some of them severely. But despite strong support from locals, animal right activists have been mounting pressure on the government to crackdown on the games. Indonesia Animal Welfare Society spokesperson Marison Guciano, 35, said: 'This is animal torture. The bloody battle often either ends with the death of the dog or the wild boar,' 'Wild boars are pests, but torturing them in forcing them to fight dogs in this way is cruel. The people overseeing 'adu bagong' are criminals'. 'The West Java government has issued a ban on 'adu bagong'. In some places, the arenas have been shut down by police, but some contests continue in secret.' 'We will continue to monitor 'adu bagong'. If we see this vile 'sport' occurring again, we will report it to the police.'

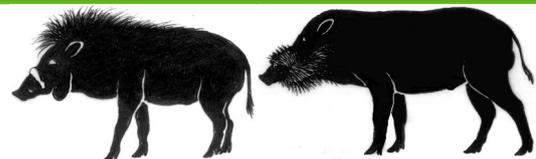
African warthog spotted marauding through streets of Florida is finally captured after eluding authorities for days and stealing food from traps laid down to snare it

<http://www.dailymail.co.uk/news/article-5624419/African-warthog-spotted-marauding-streets-Florida-finally-captured.html>
By Phoebe Southworth For Mailonline
Published: 09:21 BST, 17 April 2018 | Updated: 15:03 BST, 17 April 2018





Articles in the news



Warthogs are normally found in the Sub-Sahara roaming free in the wild.

But this greedy beast was spotted in Lakewood Park in St Lucie County.

Residents said the pig-like creature was friendly when they offered food. It led the authorities on a wild goose chase for several days last .

An African warthog has been captured after it was spotted marauding around the streets of Florida. The Sub-Sahara is where many of the tusky pigs roam free in the wild, but this one was seen trotting through woods and yards in Lakewood Park, St. Lucie County. And the greedy beast eluded the authorities for days, pinching food out of traps laid down to snare it and making the most of its excursions around the Treasure Coast. For several days last month it explored Belleair and Brookline Avenues, according to the Florida Fish and Wildlife Conservation Commission (FWC). Residents said it was friendly when offered food and didn't seem to be afraid of people. But it may have been carrying diseases which could affect other animals, said FWC spokeswoman Carol Lyn Parrish. A captive wildlife license approved by the state is required to own a warthog but no one in the area had one, she said.

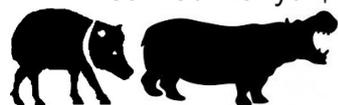
Wildlife officials were first notified about the creature March 4 and set up a trap to capture it. They found no sign of the creature when they searched the next day. They returned March 8 with a trap baited with food. Yet when they went to check it the following day, the food had been scooped and the warthog was nowhere to be seen. The beast was finally spotted that afternoon. FWC officials used a rope snare and more food to try to capture it - but with no success. It was left to FWC Officer Bradley Toby to tackle the warthog while a biologist brought over a trap to guide the creature in. Veterinarians euthanized the animal to examine its body for disease, said Ms Parrish. 'Because of its unknown source, staff were concerned about disease transmission,' she said.

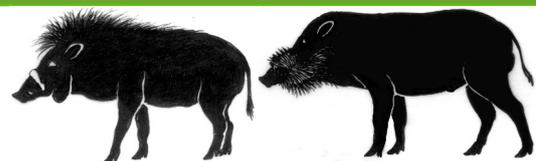
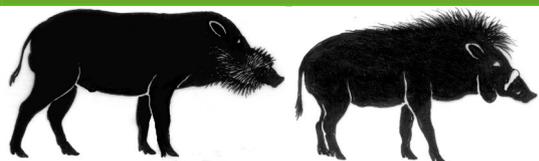
Hippo bite kills Taiwan tourist in Kenya

<https://www.bbc.co.uk/news/world-africa-45162747>

13 August 2018

A Taiwanese tourist has died after being bitten in the chest by a hippo he was trying to photograph in Kenya. Chang Ming Chuang, 66, was tracking the animal at a wildlife resort on Lake Naivasha, 90km (56 miles) north-west of the capital, Nairobi. A second tourist, also from Taiwan, was injured. Wildlife officials later shot dead the hippo. High water levels have seen hippos - the world's deadliest large land mammal - stray on to resorts for pasture. The Kenya Wildlife Service (KWS) initially identified the two tourists as Chinese but Taiwan's foreign ministry later confirmed they were Taiwanese nationals. Kenya has no formal ties with Taiwan and recognises China's claims over the island. Witnesses said the two had come too close to the animal near the Sopa hotel. The bitten man was rushed to hospital bleeding profusely but later died. The second tourist, named as Wu Peng Te, was treated for minor bruising at Naivasha District Hospital. "Our officers tracked and shot the animal after the incident," said KWS warden Nelson Cheruiyot. David Kilo, chairman of Lake Naivasha Boat Owners Association, told Kenya's Star newspaper that rising water levels had reduced pasture areas for hippos, forcing them on to farms and hotel grounds, and increasing contact between the mammals and humans. Six people have been killed by hippos in the area this year. Hippos, which are aggressive, have sharp teeth and weigh up to 2,750kg (three tons), kill an estimated 500 people every year in Africa. Tourism earned Kenya \$1.2bn (£950m) last year, with 1.4 million international arrivals.





Death by hippo poop: Scientists solve a fish massacre in the Mara River

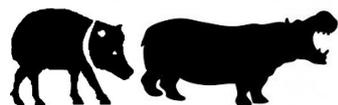
<https://news.mongabay.com/2018/05/death-by-hippo-poop-scientists-solve-a-fish-massacre-in-the-mara-river/>

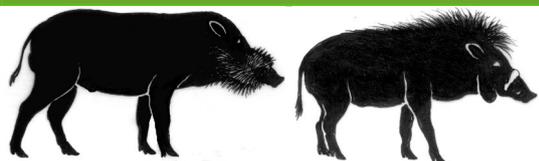
by Shreya Dasgupta on 30 May 2018

In the Mara River in Kenya, an overload of hippo feces can deplete the oxygen in the river water, resulting in mass fish die-offs downstream, a new study has found. Hippo pools are not just oxygen-poor, but also full of ammonium, hydrogen sulfide, methane and carbon dioxide — byproducts of microbial metabolism, some of which are potentially toxic to fish, the researchers say. When it rains heavily, the feces-laden, oxygen-poor water from the hippo pools gets flushed downstream, causing fish deaths. These frequent fish-kill events provide a great resource for the scavenger community in the Mara-Serengeti ecosystem, and have likely shaped The Mara River's ecosystem, scientists say.

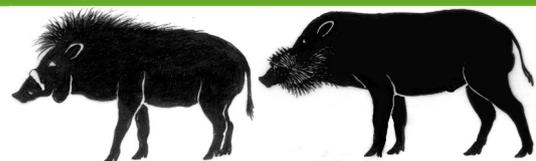
In the Mara River in Kenya, fish die in the thousands every now and then. And the hippopotamus is to blame, a new study has found. Hippos (*Hippopotamus amphibius*) spend a considerable amount of time in rivers to cool off their bodies. They also spend a lot of time defecating in the water, their tails swishing like propellers as they violently spray their dung around. In the Kenyan portion of the Mara that flows through the Maasai Mara National Reserve, there are more than 4,000 hippos. And they poop a lot, flushing about 8,500 kilograms (18,740 pounds) of feces into the river every single day. When it rains, this abundant excrement gets flushed downstream, sometimes causing low-oxygen conditions that end up killing large numbers of fish, researchers report in the study published in the journal *Nature Communications*. It was in 2010 that Christopher Dutton, an aquatic ecologist at Yale University, U.S., and his colleagues first realized that something strange was going on in the Mara River. They had installed a water-quality probe in the river, one that could measure dissolved oxygen, and what they saw surprised them. “We noticed that there were some extreme drops in dissolved oxygen during a few flood events and that sometimes, there would be a massive fish kill event,” Dutton told Mongabay. “We were very surprised at the frequency of the crashes in dissolved oxygen.” Dutton added that this phenomenon in the Mara had previously gone undocumented because “it is very hard to keep a dissolved oxygen sensor working in a river with Nile crocodiles, hippos and other large wildlife.”

“We’ve spent a great deal of time, money and resources just keeping that sensor operational,” Dutton said. The researchers thought of a few possible explanations, but soon began wondering if the Mara’s resident hippos had something to do with the fish deaths. A series of experiments later revealed that the hippos were indeed responsible. Overall, the researchers found that during the dry season, water flow in the Mara declines, and oxygen-poor water accumulates in hippo pools. Dutton’s team deployed a remote-controlled boat armed with a sensor to determine the water chemistry of hippo pools, the areas where hippos tend to congregate. They found that the pools were not just oxygen-depleted because microbes were using much of the dissolved oxygen to digest hippo feces. They were also full of ammonium, hydrogen sulfide, methane and carbon dioxide — by-products of microbial metabolism. Ammonium and sulfide are potentially toxic and could be contributing to the fish deaths, the researchers say. When it rains heavily, the feces-laden, oxygen-poor water gets flushed downstream, resulting in fish deaths, the team found. Over three years, the researchers recorded 55 flushing flows — instances when intense rain increases the river flow to twice its normal rate — and found that dissolved oxygen levels fell during 49 of





Articles in the news



those events. In 13 of these events, oxygen levels went extremely low and lasted for hours — a condition that’s stressful for fish, the researchers say. As for mass fish kills, the team recorded nine of those. The researchers confirmed through a number of experiments that the hippos were behind the low oxygen levels downstream. These involved adding hippo waste to bathtub-sized artificial streams, and using sandbags to create a temporary dam in a pool. When the researchers “breached the dam” to simulate the flow of hippo waste downstream, they found that oxygen levels downstream declined. “In the Mara River system, flushing flows are important for cleaning hippo waste out of pools, but the accumulated toxic chemicals and deoxygenated water have severe impacts on aquatic life downstream,” co-author David Post, an ecologist at Yale University, said in a statement. What this shows, Dutton said, is that “in a natural river with a large population of resident hippos, they can load enough organic matter to cause frequent crashes in dissolved oxygen during floods and that the aquatic species present have likely evolved in response to this frequent disturbance.”

These fish-kill events also become a great source of food for the scavenger community in the Mara-Serengeti ecosystem. “Once a fish kill happens, the fish are typically all consumed or washed downstream within a day or two. The scavengers are really able to capitalize very quickly on a fish kill event,” Dutton said. It’s not just the hippos that shape the Mara River’s ecosystem in surprising ways. Last year, Dutton and his Yale colleague Amanda Subalusky published a study showing that the drowning of thousands of wildebeest in the Mara during their annual mass migration provides a pulse of food and nutrients to the river ecosystem. “Our research shows that inputs from both hippos and wildebeest have large impacts on the river food web and ecosystem, and they interact in complex ways that we are still working on untangling,” Dutton said.

Surprise hippo invades bird walk in Burundi

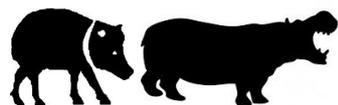
<https://www.birdlife.org/worldwide/news/surprise-hippo-invades-bird-walk-burundi>

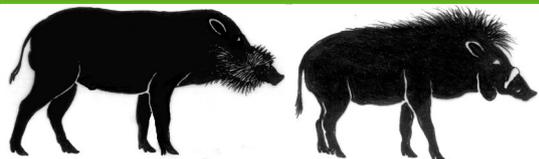
By Blandine Mélis, BirdLife Africa & Eric Niyongabo, ABN

30 Apr 2018

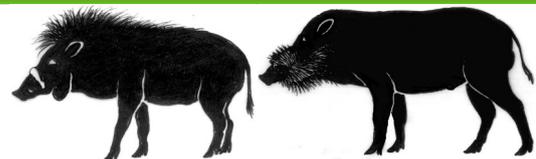
The appearance of a hippopotamus at an African bird hotspot was funny and perilous in equal measure – but highlights the underlying problem of human encroachment driving these massive mammals out of their usual home. On the first Saturday of every month, members of the Association Burundaise pour la protection de la Nature (ABN - Birdlife Partner) prepare for Naturewalk, their famous bird discovery trip. Participants set out in the hope of spotting a beautiful new bird species – but these shared moments in nature are also a valuable opportunity to observe and monitor the state of the environment. Members keep a weather eye out for signs of pollution, habitat degradation, landslides and poaching along their route.

On the morning of 3 March 2018, Naturewalk took its members to the suburbs of Bujumbura city to explore Buterere sewage lagoons. This might not sound like the most glamorous of excursions, but in fact, the waste water provides nutrients that support an abundant diversity of life, attracting large flocks of birds that congregate and feed there. However, on this particular day, the birdwatchers’ appreciation of the area’s special species (including the Jacobin Cuckoo *Clamator jacobinus*) was interrupted by panicked cries from local children shouting: “NO Imvubu irabarya!” – which in Kirundi means “Stop! You could be attacked by a hippo!” The surprise was universal and the bucolic stroll, carefully planned by ornithologist guide Eric Niyongabo, suddenly took on





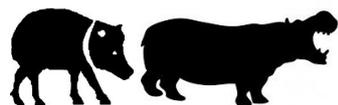
Articles in the news

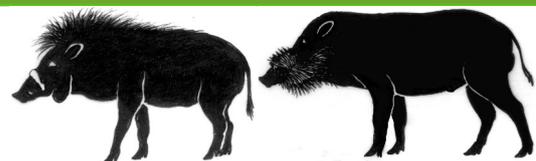
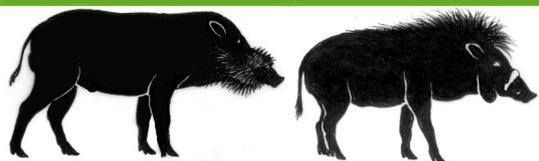


An idyllic birding stroll turned into a dangerous safari with the arrival of this pachyderm.

Photo: ABN

the dimensions of a dangerous safari. Only the inhabitants were not surprised. Lately, there have been several reports of hippos in the neighbourhood. But what was this hippo doing in the waters of Buterere, so close to residential areas? Only the inhabitants were not surprised. Lately, there have been several reports of solitary hippos wandering the neighbourhood. Some residents even claim to have seen this individual in particular: "It lets children approach and even touch it. Even local calves come closer, imagining it is their mother." And yet, with an animal of this size, all who come near risk being crushed or mauled. Normally, these animals wallow in the river Rusizi, which empties into Lake Tanganyika on the outskirts of the city. This landscape, once pristine, is today being gradually invaded by agriculture and development, driven by a growing population and the rapid expansion of the Burundian capital. Hippopotamuses generally live in large groups dominated by a polygamous and aggressive male, for whom the protection of females and territory are his primary concern. Males that are highly submissive or lacking in combat skills move away from the herd and thus find themselves alone, isolated from their fellow pachyderms. This, combined with the abundance of green space at Buterere and the destruction of their original territory, is what drives these colossal herbivores to seek refuge here. And, in doing so, disturb our naturalists' escapade. Although it is herbivorous, this animal is among the most dangerous species in Africa, responsible for 2,900 human deaths a year. However, humans pose an equal threat to the species, and are often forced to exterminate intruding hippopotami in defence of their community. It's safe to say that human-hippo overlap ends badly for both parties. To be on the safe side, the Naturewalk attendees turned back and retraced their steps, in equal parts impressed to encounter this majestic wild beast, and worried for the future of its kind. This unexpected encounter drives home a valuable lesson: that encroaching bit by bit upon our wild spaces is not without consequence. To avoid human-wildlife conflict, we need to respect the Environment Code in force in Burundi, which stipulates that nothing can be built within 150 meters of the banks of Lake Tanganyika, 50 meters for the other lakes and 25 meters for the rivers. These measures need to be enforced more strongly, including an appropriate and shared approach to land use. Otherwise, encounters such as these will inevitably increase.





DISCLAIMER

- with respect to content:

IUCN encourages meetings, workshops and other fora for the consideration and analysis of issues related to conservation, and believes that reports of these meetings are most useful when broadly disseminated. The opinions and views expressed by the authors may not necessarily reflect the formal policies of IUCN, its Commissions, its Secretariat or its members.

- with respect to geography:

The designation of geographical entities in this book, and the presentation of the material, do not imply the expression of any opinion whatsoever on the part of IUCN concerning the legal status of any country, territory, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

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

These groups consist of technical experts focusing on the 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.

