

Suiform Soundings

Newsletter of the WPSG, PSG and HSG

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Suiform Soundings

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Photo front page: Frederico Gemesio Lemos photographed this Collared peccary *Pecari tajacu* in July 2009 while conducting puma research. It was seen at a Cerrado fragment, in the municipality of Araguari, Minas Gerais State, Brazil.

At Araguari the peccaries are found in herds of up to 20 individuals and have to live on small patches of Cerrado isolated in a matrix of pasture and corn and soy bean cultivation. Due to their close proximity to these cultivated areas, they are often in conflict with farmers and are sometimes heavily hunted, as they feed on the corn and the soy bean.

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Editorial: Challenges and opportunities..

When I look back to the editorial I wrote in January 2009, we were all reeling from the recession that hit us in 2008, and were wondering how on earth to secure funding in a climate where everyone was tightening their belts - a lot! It certainly hasn't been an easy year from that point of view, but it hasn't stopped us from moving forward with our conservation and research work. The number of new papers included in our abstract section bears testament to this.

Unfortunately we were all a little disappointed with the results of the climate change discussions in Copenhagen, given the air of optimism and expectancy that preceded the talks. However, even there we can take something positive from the conference - it highlighted the importance of the developing world, and not just the western nations, as a force in addressing climate change, and some progress was made on actions for preventing the spread of deforestation. These are topics of huge relevance to the conservation of pigs, peccaries and hippos, and as we enter the International Year of Biodiversity we have to meet these challenges, and opportunities, head on.

As usual, our newsletter highlights the latest research and conservation news on peccaries, whilst also including an interesting article on bearded pigs predating on a python! This edition also contains a little more news on the African species, which is great to see. Butynski, de Jong and Cotterill discuss the different warthog species, while a new contributor, Aenne Post, highlights human-hippo conflict issues in Kenya.

Please continue to send through your articles, comments and letters. All contributions are very much appreciated.

I hope you enjoy this edition of our newsletter, and here's wishing you a happy and successful 2010!

Anne-Marie Stewart, Addis Ababa, Ethiopia.



This photo, published on the Wildlife Direct website, was taken by Andrea Turkalo (dzanga2000@yahoo.com) at the Dzanga Clearing in the Central African Republic. It shows giant forest hogs scavenging on an elephant carcass. The photographer has also observed red river hogs scavenging on carcasses. (A photo of a warthog scavenging on a donkey carcass was published in the January 2009 edition of *Suiform Soundings*).

The ‘Wild Pigs Specialist Group’: updates and announcements

William Oliver, Chair, WPSG

The recent separation of the former PPHSG into three separate Groups, namely the ‘Wild Pigs’, ‘Peccaries’ and ‘Hippos’ SGs, naturally also led to the necessary re-organisation and restructuring of each in order to better arrange and manage their particular mandates. However, as both the (former) Peccaries and Hippo ‘Sub-groups’ had anyway been operating largely independently of the PPHSG as a whole for a number of years, these requirements and this process was surely most acutely felt within the new WPSG, which thereby also found itself bereft of many of its formerly most active and influential members; a loss felt all the more acutely by the resignations of certain other long-standing suid specialists most active in the two key regions of sub-Saharan Africa and south/south-east Asia.

In addition the new WPSG also somehow seemed to inherit the primary responsibility for finding a new ‘PPHSG’ website manager (to hopefully continue to serve all three groups), following the similar resignation of Dr. Susanne Plesner Loweth, who had kindly and more-or-less singly handedly established and managed this site since its inception. I would therefore like to take this opportunity to not only reiterate our heartfelt gratitude to Susanne for her many years of unstinting effort, and to announce the appointment of Dr. Emilia Lastica (emlastica@gmail.com) as the new manager of the (former) IUCN/SSC PPHSG website. ‘Em’ is an experienced wildlife veterinarian and manager now based at the College of Veterinary Medicine, at the University of the Philippines in Los Banos (UPLB, Republic of the Philippines). As such, it is to be hoped that she may not only assume the primary responsibility of sustaining and developing the new ‘WPSG’ website, but also welcome and embrace the new PSG and HSG as co-equal partners, contributors and beneficiaries to this endeavour. To these ends, I would therefore also request Drs. Andrew Taber and Rebecca Lewison (as Chairs of the PSG and HSG, respectively) and any of their SG officers and members to liaise directly with her per any salient updates or other activities which might be usefully included in the (soon to be revamped) former PPHSG website, which is located at: data.iucn.org/themes/ssc/sgs/pphsg/home.htm.

We were happily saved from any similar concerns relating to this Newsletter, thanks to Anne-Marie Stewart’s willingness to continue as Editor in Chief (please also see her last editorial in *Suiform Soundings* 9(1), 2009), or having to identify and appoint a new Red List Authority (RLA), by Dr. Kristin Leus (kristin@cbsgeurope.eu) kindly agreeing to continue to serve as the WPSG RLA. We are therefore also inordinately grateful to Anne-Marie and Kristin in these regards.

On the other hand, the mounting work and other pressures prompting the resignations of Dr. Jean-Pierre d’Huart as the (former) PPHSG ‘Afrotropical Regional Coordinator’ and Dr. Erik Meijaard as the (former) PPHSG ‘Asia Regional Coordinator’ and ‘Newsletter Editor’ not only prompted searches for likely replacements, but also left serious hiatuses in the operational arrangements and programme activities in these two major areas. We were therefore most grateful to Chris Gordon for helping to sustain some key group interests as interim Afrotropical Regional Coordinator and to Dr. Tom Butynski (TButynski@aol.com) and Dr. Yvonne de Jonge (yvonne@wildsolutions.nl) for jointly agreeing to assume these responsibilities commencing late last year. However, in order to both better distinguish and enhance their respective roles within the Group, it was also agreed that Tom would assume the position of WPSG ‘Vice-Chair for Africa and the Middle East’, whilst Yvonne took on the role of WPSG ‘Afro-tropical Regional Coordinator’; albeit that the precise TORs for each of these positions have yet

to be finalised.

In much the same vein, we also very pleased to announce Dr. Erik Meijaard's (emeijaard@pnc-int.com) return to the centre of group affairs as the new 'WPSG Vice-Chair for Asia', commencing forthwith. However, we are still in the process of exploring options for the possible addition of one or more 'Regional Coordinator' to assist programme developments in particular parts of this vast region, and therefore also to hopefully assist Erik in identifying developing and implementing agreed priority research and conservation management interventions in different parts of this region.

The notion of subdividing the new WPSG into major regional compartments broadly follows organisational arrangements initiated under the auspices of the expanded PPHSG in the late 1990s. It is therefore also intended to better accommodate salient, regionally-based interests and expertise amongst the WPSG membership, whilst also hopefully enabling the more active involvements of many more key individuals in orchestrating WPSG activities in these regions during the current quadrennium. Any suggestions anyone may have in any of these regards would be warmly appreciated.

Old World Pigs And New World Peccaries - Conservation Status, Management And Health: A report on a symposium at the 10th International Mammalogical Congress in Mendoza, Argentina in August 2009.

Andrew Taber, Mariana Altrichter, Harald Beck, Alexine Keuroghlian, Goutam Narayan, and Alessandra Nava.

A symposium reviewing the state of the science and conservation priorities for the Tayassuidae and Suidae families was held at the 10th International Mammalogical Congress in Mendoza, Argentina in August 2009. The organizers of this symposium, Taber, Altrichter and Beck, with support from the other authors of this note, felt that the time was ripe to organize such an event, particularly in light of the recent establishment of the Peccary Specialist Group (PSG) of the IUCN/SSC. We report on salient findings from Mendoza on that symposium, as well as list various training events, talks and posters of relevance to peccaries and suids presented there (see Box 1).

Unfortunately, due in part to the global economic downturn, we were unable to raise funds, as originally hoped, to ensure a broad participation from across the field of pig and peccary research. Further, some institutions restricted travel for key scientists who had been planning to attend the meeting, and a number of participants cancelled due to concerns regarding the 2009 H1N1 Flu prevailing in Argentina at that time. Despite the relatively low turnout, we had a lively symposium with some 50 people in the audience. The six talks presented are listed in Box 1, along with email addresses of authors for readers who want additional information. The oral presentations were followed by a panel discussion and question and answer session.

Two of the talks focused on conservation status and priorities for individual species. The two taxa reviewed could not have been more different. White-lipped peccaries (*ca.* 35 – 40 kg), *Tayassu pecari*, whose status across the Neotropics has been reported elsewhere in Suiform Soundings (e.g., see Reyna-Hurtado, 2009), are one of the widest ranging species in these two families. They are categorized as Near Threatened on the IUCN Red List; but their long-term persistence is at risk in approximately half their historic range. In contrast, Pygmy hogs (*ca.* 10 kg), *Porcula salvania*, have a highly restricted distribution in the foothills of the Himalayas, and are categorized as Critically Endangered. For the first species, priorities include increasing the coverage and effectiveness of protected areas, control of hunting outside protected areas, and sustainable use under precautionary management principles where appropriate. A key challenge for this species' conservation is to insure that it is taken into account in national and local wildlife management priorities. In the second case, pygmy hogs require strict protection if this species is to persist in the wild. Their survival further depends on a combination of captive breeding, reintroduction to establish multiple independent wild populations, and rigorous protection and ecological restoration of key reserves.

Two other talks, presented respectively by Beck and Keuroghlian, provided a thorough overview of the ecological roles of Collared and White-lipped peccaries in structuring ecosystems through a range of processes including seed and mycorrhizae dispersal, seed predation, and fine scale engineering through creating and maintaining wallows. The latter can also affect anuran density and species richness at a landscape level. While further research is clearly needed, the science unequivocally documents the important ecological role these species play – and emphasizes the importance of protecting them for their

provision of ecosystem services, as well as a key resource for local people, across the Neotropics. Alexandra Nava presented a useful overview of the interplay of disease between domestic livestock and peccaries in a site in southern Brazil. There are a growing number of examples where disease has affected peccary populations; further, there is a risk of new or novel diseases moving into the Neotropics which could affect peccary health, including H1N1 Flu, Blue-Ear Disease, Post Weaning Mortality Syndrome and others. Dr. Nava's talk drew attention to health threats to wildlife, domestic livestock and people, and emphasizes the need for additional research and monitoring. Finally, a review on peccary genetics and systematics was provided, summarizing recent research, and major remaining taxonomic questions. This talk was lead authored by Jaime Gongora. He was not able to attend the meeting, so it was presented by co-author Alexine Keuroghlian.

The authors of this note also received additional training from the IUCN Species Program through workshops on (i) the use and application of IUCN Red List Categories and Criteria, and (ii) the use and updating of the IUCN Species Information Service. This training broadened available skills across both the pigs and peccaries specialist groups. At the first workshop, as a practical exercise, IUCN Red Listing Criteria for regional assessments were used to evaluate the status of White-lipped peccaries in Argentina. Our preliminary results suggested that this species should probably be listed as Critically Endangered in that country, in contrast to its overall assessment as Near Threatened. This exercise provided an excellent demonstration of the utility of applying these methods on a country-by-country, regional by regional, or other geographic basis.

Members of the Peccary Specialist Group of the IUCN/SSC present at the conference discussed responsibilities and roles of group members, the need to have a fuller meeting of the PSG during 2010, and preliminary plans to develop Species Conservation Strategies for all three peccary species – with priority being for the endangered Chacoan peccary. In addition, following the meeting a Facebook group page for the PSG was developed (please contact Alexine Keuroghlian for additional information).

We thank Caroline Pollock, Dena Cator, Jan Schipper and Arturo Mora of the IUCN for the two training opportunities they provided. Also, we are grateful to Simon Stuart, Chair of the Species Survival Commission, for the copious advice and time he gave group members in Mendoza. Financial support to attend the meeting was provided to Harald Beck and Mariana Altrichter from, respectively, Towson University and the University of Redlands.

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Box 1. – Oral presentations and posters of relevance to pig and peccary science and conservation presented at the 10th International Mammalogical Congress, Mendoza, Argentina, August 2009. Communicating author emails are also included.

Old World Pigs and New World Peccaries – Conservation Status, Management and Health Symposium Presentations:

- A range-wide conservation status assessment of the White-lipped peccary (*Tayassu pecari*). **Mariana Altrichter** (mariana_altrichter@redlands.edu), Andrew Taber, Silvia C. Chalukian, Karen Minkowski, Leonidas Lizárraga, Eric Sanderson, Damián Rumiz, Eduardo Ventincinque, Edsel Amorim Moraes, Jr, Carlos de Angelo, Miguel Antúnez, Guido Ayala, Harald Beck, Richard Bodmer, Salvador Boher B., José Luis Cartes, Soledad de Bustos, Don Eaton, Louise Emmons, Neyreda Estrada, Luiz Flamarion de Oliveira, José Fragoso, Rony Garcia, Claudia Gomez, Humberto Gómez, Alexine Keuroghlian, Karim Ledesma, Diego Lizcano, Carolina Lozano, Olga Montenegro, Nora Neris, Andrew Noss, Juan Alejandro Palacio Vieira, Agustin Paviolo, Pablo Perovic, Héctor Portillo, Jeremy Radachowsky, Rafael Reyna-Hurtado, Juliana Rodriguez Ortiz, Leo Salas, Adriana Sarmiento Duenas, Javier A Sarria Perea, Karina Schiaffino, Benoit de Thoisy, Mathias Tobler, Victor Utreras, Diego Varela, Robert B. Wallace, and Galo Zapata Ríos.
- Challenges for the recovery of the most endangered Suiform, the Pygmy hog (*Porcula salvania*). **Goutam Narayan** (goutam.narayan@gmail.com), Parag J. Deka and William L. R. Oliver.
- Peccary synecology: A holistic review of their interaction with Neotropical fauna and flora. **Harald Beck** (hbeck@towson.edu).
- Peccaries and ecological health in the Neotropics: an overview of past events and future threats. **Alessandra Nava** (alenava@stetnet.com.br).
- The impacts of trophic effects and ecological engineering by white-lipped peccaries in the Neotropics. **Alexine Keuroghlian** (alexinek@hotmail.com).
- An overview of peccary genetics and reassessment of the systematics of the family Tayassuidae: recent breakthroughs and remaining questions. Jaime Gongora (j.gongora@usyd.edu.au), Cibele Biondo, Jennifer D. Cooper, **Alexine Keuroghlian** (alexinek@hotmail.com), Pedro Mayor, Mariana Altrichter, Peter Waser, J. Andrew DeWoody, Filomena Adegá, Raquel Chaves, Henrique Guedes-Pinto and Amanda Yoon-Yee Chong. Panel Discussion. Andrew Taber, Harald Beck, Alessandra Nava, Alexine Keuroghlian, Mariana Altrichter, and Goutam Narayan.

Other relevant oral presentations or posters at the International Mammalogical Congress:

- Assessing the impact of roads on mammals: oil-roads in Yasuní Biosphere Reserve, Ecuadorian Amazon. Galo Zapata-Ríos (gzapata@wcs.org), Esteban Suárez, Victor Utreras Víctor, Samantha Strindberg, Eduardo Toral and Javier Torres.
- Density and site occupancy of Collared peccary (*Pecari tajacu*) at two protected areas of Colombia. Bibiana Gomez (bgomezv@gmail.com) and Olga Montenegro.

- Geographic size variation of peccaries (*Tayassu pecari* and *Pecari tajacu*) in Colombia. Pedro Sánchez (psanchezp@unal.edu.co), Olga Montenegro and Bibiana Gómez.
- Habitat use and activity of ungulates using camera traps in El Rey National Park, Argentina. Soledad de Bustos (soledaddebustos@yahoo.com.ar), S. Chalukian, M. Alveira, M. Saravia, M. Saravia and K. Rodriguez.
- Habitat use by rodents in intensive pig production farms. María Violeta Rimieri (violetarimieri@hotmail.com), María Soledad Fernández and Regino Cavia.
- Hunted mammals in two indigenous villages of Wayana and Aparai in the Brazilian Amazon. Iori Linke, Oliveira van Velthem and Ana Cristina Mendes (cris@ufpa.br).
- Invasive mammals vs. conservation in the Antilles Islands. Rafael Borroto-Páez (borroto@ecologia.cu).
- Jaguar (*Panthera onca*) feeding habits in Porto Jofre region, Pantanal, Brazil. Míriam Perilli (miriam_perilli@yahoo.com) and Sandra Cavalcanti.
- Modeling geographic distribution of peccaries (*Tayassu pecari* and *Pecari tajacu*) in Colombia. Olga Montenegro (olmontenegrod@unal.edu.co), Elizabeth Mesa, Bibiana Gómez, Pedro Sánchez and Carlos Sarmiento.
- Poaching promotes the ecological extinction of large felids and ungulates in the Atlantic Forest. Agustín Paviolo, Carlos De Angelo, Yamil Di Blanco, Ilaria Agostini, Esteban Pizzio, Ricardo Melzew, Carolina Ferrari, Lucía Palacio and Mario S. Di Bitetti.
- Trophic and non-trophic ecosystem engineering interactions of peccaries (Tayassuidae). Harald Beck (hbeck@towson.edu).
- Xenarthrans from the Quaternary of Serra da Bodoquena (Mato Grosso do Sul, Brazil). C.R. Moraes Neto, F.A. Perini (faperini@yahoo.com.br), P. G. Guedes, and L. O. Salles.

Warthogs: An Alert to Zoos, Museums, Trophy Hunters, and Conservationists

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Some of you may not know that there are two extant species of warthogs: the Common Warthog *Phacochoerus africanus* (Figure 1) and the Desert Warthog *Phacochoerus aethiopicus* (Figure 2). These two taxa are now recognized as 'good species' by the IUCN Species Survival Commission's 'Pigs, Peccaries, and Hippos Specialist Group' (Grubb & Oliver, 1991; Grubb, 1993; Vercammen & Mason, 1993; IUCN/SSC/PPHSG, 2009), the 'Global Mammal Assessment' (IUCN 2009), and the 'Mammal Species of the World' (Grubb, 2005). *P. africanus* and *P. aethiopicus* are phenotypically and morphologically distinct (Grubb, 1993; Vercammen & Mason, 1993; Kingdon, 1997). They are also genetically distinct, with a divergence time estimated at 4.5 million years ago (Randi *et al.*, 2002). Although the geographic ranges of the two species of warthogs overlap at least narrowly (*e.g.*, Tsavo West National Park, Kenya; Culverwell *et al.*, 2008; de Jong *et al.*, 2009), there is no indication of hybridization.



Figure 1: Adult male common warthog *Phacochoerus africanus* on the plains of the Laikipia Plateau, central Kenya. Note the pointed ears, the cone-shaped warts, the 'diabolo-shaped' head, and the lack of swelling of the suborbital area.



Figure 2: Adult male desert warthog *Phacochoerus aethiopicus* in medium-dense shrub in Tsavo West National Park, southern Kenya. Note the flipped-back ear tips, the hooked warts, the broad, 'egg-shaped', head, and the swollen suborbital area.

This interesting 'situation' raises many new questions relating to the distribution, ecology and behaviour of warthogs while, at the same time, raising new concerns for the long-term conservation of warthogs. In this regard, Grubb & Oliver (1991), Boy (2002), d'Huart & Grubb (2002, 2005), Culverwell *et al.* (2008), and de Jong *et al.* (2009) have written notes and articles in an attempt to draw wider attention to the fact that there is not one, but rather two, species of warthog. In addition, a 'Warthog Photographic Map' website (Butynski & de Jong, 2009) has been established for East Africa. This website shows photographs of the two species of warthog on an interactive Google map: < <http://picasaweb.google.com/wildsolutions/WarthogSightingsInKenya?feat=directlink>> More photos will be uploaded to this map as they become available.

With two species of warthogs now widely recognized, we have several questions and comments for (1) those who manage collections of warthogs in captivity; (2) those who manage warthog collections in museums; (3) those who have obtained, or hope to obtain, warthogs as hunting trophies; and (4) those who maintain the long-term trophy records.

1. Are both species of warthogs now recognized by those zoos that maintain collections of warthogs? Is *P. aethiopicus* kept in any zoo collection and, if so, is this species exhibited as such and managed separately from *P. africanus*? We have looked at the American Zoo and Aquarium Association's (AZA) and European Association of Zoos and Aquaria's (EAZA) websites and see that they have said Taxon Advisory Groups (TAGS) that list *P. africanus* among the species with which they are concerned...but not for *P. aethiopicus*.

2. Might hybrids of *P. africanus* x *P. aethiopicus* exist in some living collections? There are no records of hybrids in the wild but, as you know, hybridization is much more likely to occur under captive conditions. It may well be that these two species are so different that they cannot hybridize even under captive conditions. Or, if they do, that the off-spring do not survive or, at least, are sterile. Live adults of the two species can be readily distinguished by the shape of the suborbital warts and of the ear tips; see photographs and lists of diagnostic characters presented in d'Huart & Grubb (2005), in de Jong *et al.* (2009), and in de Jong & Butynski (2009; the above-mentioned website).

3. Are specimens of warthogs in museum collections correctly labeled as to species? The skulls can be readily differentiated based on the thickness of the zygomatic arches, shape of the sphenoidal pits, and presence/absence of the incisors (d'Huart & Grubb, 2005; Grubb & d'Huart, in press).

4. Do those institutions (*e.g.*, Safari Club International, Rowland Ward, Boone & Crockett Club) that maintain records of trophies obtained in Africa by sport hunters recognize *P. africanus* as distinct from *P. aethiopicus*? If not, it may be necessary to reconsider the species status of some of the trophy warthogs collected from within the known range of *P. aethiopicus*. That is, from the eastern half of Kenya, all of Somalia, and eastern one-third of Ethiopia (d'Huart & Grubb, 2001; de Jong *et al.*, 2009). The species can be readily determined by examining the mounted head and/or skull and applying the diagnostic characters mentioned above (d'Huart & Grubb, 2005; de Jong & Butynski, 2009; de Jong *et al.*, 2009).

5. Are those people who hold record warthog trophies, or who hope to obtain a warthog trophy, aware that there are two species of warthogs?

We also want to point out that the Cape Warthog *Phacochoerus aethiopicus aethiopicus*, once endemic

to southern South Africa, has been extinct since about the 1860s (Grubb, 1985; Grubb & Oliver, 1991; Grubb & d'Huart, in press). The Somali Warthog *Phacochoerus aethiopicus delamerei* is nearly identical to the extinct *P. a. aethiopicus*. (Note that the name "Desert Warthog" is the common name for this species, and that 'Cape Warthog' and 'Somali Warthog' are the common names for the two subspecies.) There are no historic or current records for populations of *P. aethiopicus* from anywhere within the immense region between southern South Africa and southern Kenya (Tsavo). As such, *P. a. delamerei* is the only surviving taxon of this species. If an interest develops in 'reintroducing' *P. aethiopicus* into southern South Africa (after a >140 year absence), the only candidate for the reintroduction is *P. a. delamerei*.

We hope that the above will stimulate some discussion and activity, not only by the trophy hunting community, but also among those who are interested in the study and long-term conservation of both species of warthogs...both *in situ* and *ex situ*.

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The Warthog Debate

(A reply from Fenton Cotterill to Butynski and de Jong's communication)

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The interesting question arises as to whether this historically extinct desert warthog in Africa's SW arid zone was geographically contiguous with *Phacochoerus aethiopicus. delamarei* in the NE arid zone. I doubt that such a contiguous range existed, especially in historical times. One reason relates to the evolution of the Zambezi river, which has been a persistent barrier to dispersals of terrestrial mammals over at least the past 300 000 yr, and likely longer. One's choice of species concept is a prerequisite to make sense of such allopatric puzzles; to all intents and purposes the BSC (Biological Species Concept) is useless, despite its obsolescence across so much of mammalogy. An analogous requirement applies to the concept of the subspecies, for which an ontologically credible concept has yet to be proposed; or at least one that is not crippled by operantism, and can objectively inform science about the existence of any real products of evolution. In contrast, revealing biogeographical and evolutionary resolution is obtained when the ESC is employed for these suids and other mammals, as for fishes (cf Cotterill, 2002, 2003a-c, 2004, 2005; see Mayden, 2002 and de Queiroz, 2005, 2007 among many recent advocations of the ESC).

Beginning with river diversion from sometime in OIS 14 through into OIS 10 (a total period of approx 570 - 300Ka) the flow of the Upper Zambezi River had virtually ceased downstream of N'gonye Falls (Sioma Falls), because it was impounded upstream in West Zambia (flooding the Buluzi depression). Recurrent tectonism, extending SW from the EARS (East African Rift System) within and along the Okavango - Kafue graben is invoked as the ultimate cause of these geomorphological events on the Kalahari Plateau. It is important to emphasize that this ultimate aetiological control of tectonics interfaced with palaeo-climate, notably the colder, drier glacials of OIS 12 and at least part of OIS 10; this was when admittedly limited evidence points to the MegaKalahari sandsea being noticeably active. In fact deep aeolian deposits of "KS" (Kalahari Sands) smothered the Upper Zambezi valley, when river flow was impounded upstream. It follows that the arid corridor was likely active in these "glacial windows" (Moore & Cotterill, 2009, in review).

It was during a protracted period (i.e. approx 570 - 300Ka) that *Connachaetes* would have been able to disperse north, and *Alcelaphus* to disperse south of the Zambezi River (cf Arctander *et al.*, 1999, *Mol Biol. Evol.* 16:1724-1739; Flagstad *et al.*, 2001, *Proc. Roy. Soc. Lond. B* 268B: 667-677) as this dispersal zone was contained upstream of the Victoria Falls, but downstream of N'gonye Falls (upstream of

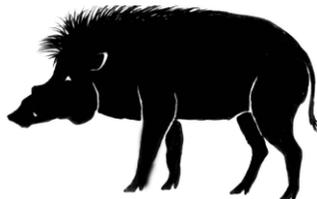
the latter was ~18 000km² Palaeo-Lake Bulozzi); so all the inference from a synthesis of historical data points to focus for dispersals within the Okavango-Kafue graben. This episode was long after the PLM (Palaeo-Lake Makgadikgadi) Stage in NE Botswana, which had ceased to exist before the end of the Early Stone Age (600Ka at least). The segregation between the mtDNA haplotypes of the southern and eastern lineages identified by Muwanika *et al.* (2003) in *P. africanus* reveals a congruent pattern.

This palaeogeographic reconstruction has developed from lechwe research, and latterly fish phylogeographic studies, allied with archaeological reconstructions. It builds on pioneering research by the late Frank Dixey, C. Desmond Clark and Geoffroy Bond (our papers synthesizing all this are in review. Also see Cotterill, 2004, 2005; de Wit & Cotterill, 2004; Moore *et al.*, 2007; Moore & Cotterill, 2009). One can hypothesize that if indeed suids were buffeted by these palaeo-environmental (especially the geomorphological) conditions, there should be residual signals in genomes of extant populations in south-central Africa. If the sampling is sufficiently comprehensive and up-to-date phylogeographic analyses are employed (using software such as BEAST, Migrate, IM etc), then deciphering the intricacies of these historical events makes for at least one interesting PhD, especially as the wonderful fossil record of African suids will allow tamping down variation in molecular dating (clock) estimates. DNA preserved in surviving museum specimens, from South Africa, of the historically extinct *P. aethiopicus* can potentially be extracted and sequenced, and compared with Desert warthogs in NE Africa. These data will expand on the important genetic findings of Randi *et al.* (2002). In closing, I hypothesize that *P. a. delamerei* Lönnberg, 1909 is likely specifically distinct from *P. aethiopicus s.s.*, of which *typicus* A Smith 1834 is a synonym. Their divergence can be expected to mirror dispersal opportunities that existed across the Kalahari plateau in the Mid-Pleistocene, and centred on the evolution of the Zambezi river.

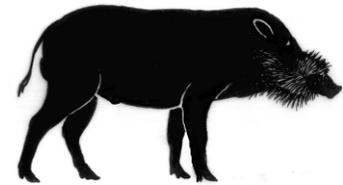
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Papers and communications



Bearded pig (*Sus barbatus*) predation on Borneo Blood Python (*Python curtus*) in the lower Kinabatangan, Northern Borneo

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Bearded pigs (*Sus barbatus*) are widespread throughout Borneo but are declining in number. Adults, 122–152 cm in length, typically 57–83 kg in weight, can reach up to 120 kg or more (Payne et al., 1985). Their weight fluctuates depending on the fruit production in the forest (Wong et al., 2005). The diet of bearded pigs consists mainly of fallen fruits, seeds, roots, herbs, earthworms and small mammals (Payne et al., 1985). However, large sized animal predation by bearded pigs is rarely documented since these events may be difficult to directly observe. This report describes predation on a Borneo blood python (*Python curtus*) by bearded pigs, which was observed directly.

On 16 May 2009 at 0635 hours, one of the authors (IM) heard the unusual excited barking sounds of

bearded pigs at a point 3,900 m from the mouth of the Menanggul River, tributary of the Kinabatangan River, Sabah, Malaysia (118° 30' E, 5° 30' N) (Figure 1) while conducting a boat survey of non-human primates. Immediately after hearing the bark sounds, the boat engine was stopped and the observers landed soundlessly to get closer to the point where the bark was emitted (approximately 25 m from the right side of the riverbank). After entering the forest, five bearded pigs (three adults and two adolescents) were found approximately 5 m from the observers at 0641 hours (figure 2). Since the pigs were extremely excited, devouring chunks of the meat and barking, they did not detect our presence. During the time when they fed on the meat, another ten bearded pigs were spotted at the other side of the riverbank at 0643 hours. Although the ten pigs attempted to cross the river to join in the meat feeding, they gave up and left for the forest at 0647 hours, probably because they saw the boat and sensed human presence. At 0650 hours, the five pigs feeding on the meat detected the observers attempting to get closer and ran away. After the five pigs left, the observers went to check the place where the pigs had been feeding and recognized that the animal the pigs had been eating was a Borneo blood python. Although many parts of the python's body were bitten off by the pigs (figure 3), the length of the python was estimated to be approximately 170 cm long. The dead python was still fresh and bleeding, suggesting that the pigs caught it live.

Although estuarine crocodiles (*Crocodylus porosus*) and clouded leopards (*Neofelis diardi*) are considered to be the main predators of bearded pigs (Matsuda *et al.*, 2008), reticulated python (*Python reticulatus*) are also reported to prey on Sulawesi pig (*Sus celebensis*) (Auriya, 2003). Nonetheless, these observations indicate that pythons, previously considered the predators of the wild pig, can be their prey if they are a small species or immature individuals. There is potential to build on our new findings with more detailed investigations into the feeding ecology and foraging strategies of wild pigs.

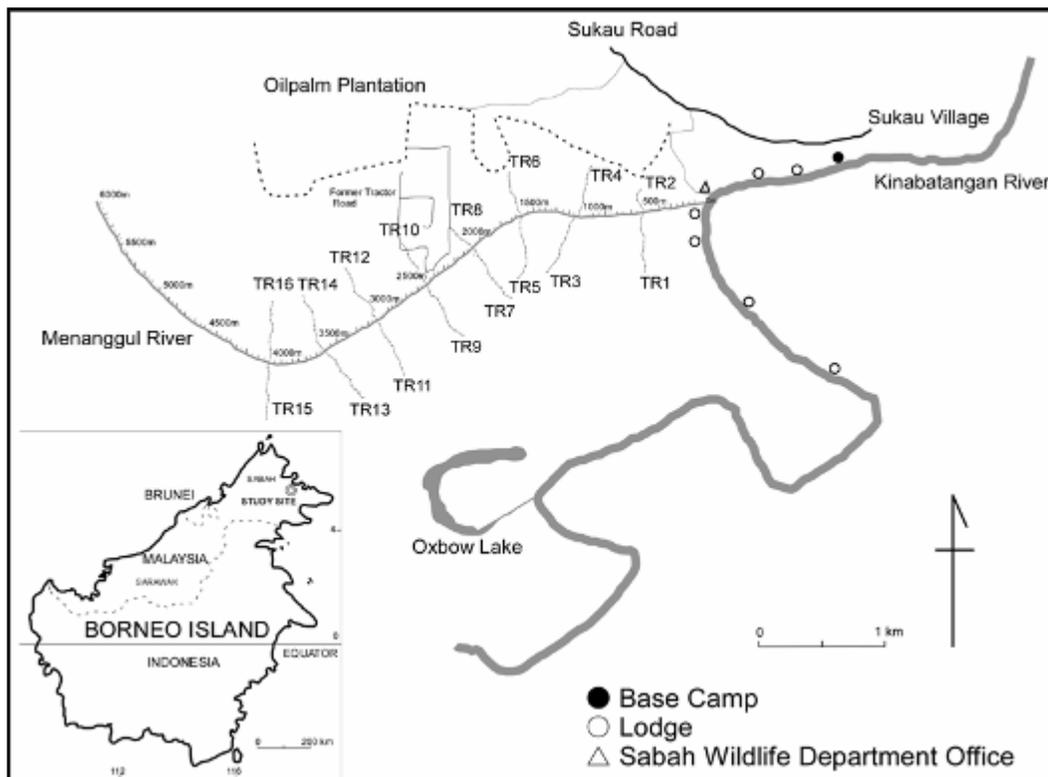


Figure 1: Study site in Sabah, Malaysian Borneo.



Figure 2: The bearded pigs at the feeding site where they were observed by the authors



Figure 3: The body of the blood python with chunks clearly bitten off .

Acknowledgments

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Human – hippo conflicts in Lake Victoria Area, Kenya

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Research in progress: the Hippo Monitoring Project

The Hippo Monitoring Project forms the core of my PhD research at the University of Amsterdam, The Netherlands. It is titled “Wildlife Governance, Community Involvement and Human-Wildlife Conflicts in African Wetlands. A focus on the Hippopotamus in Lake Victoria Area, Kenya”. The work is carried out in close collaboration with the Victoria Institute for Research on Environment & Development, a local NGO in Kisumu, Kenya. In the study, I use the findings of my previous study on the nature of human-wildlife conflicts in densely populated areas bordering the shores of Lake Victoria as baseline data (Post, 2000). Below I will briefly introduce the Hippo Monitoring Project; a more elaborate review of its findings will appear in the next issue of *Suiform Soundings*. This text is only intended to inform the reader about the project and our activities.

The research context

In many African countries wildlife numbers are declining, partly because of habitat loss. At the same time, there is a public outcry about the impact of wildlife on human livelihoods, particularly outside conservation areas where most wildlife lives. Wildlife management strategies that aim to deal with these problems are changing due to the decentralisation and devolution of decision-making powers. Local groups now have a greater say, but it is unclear to what extent they are capable of utilising the newly acquired space and which institutions they use to achieve this end. This falls within the domain of wildlife governance, which lays down the formal and informal rules that shape human-wildlife interactions, covers how and to what end wildlife is managed, how decisions on wildlife utilisation are made, what actors are involved, how they relate to each other, and how legal arrangements on wildlife issues are implemented and enforced on the ground (*c.f.* the definition of forest governance by Ros-Tonen and Kusters, in press). The way wildlife and wetland governance are dealt with in my study is in line with the interactive fisheries governance approach as developed by Bavinck *et al.* (2005).

Focus on hippos in Lake Victoria, Kenya

So far, most studies on human-wildlife conflicts in Africa have zeroed on terrestrial animals, mainly elephants, with little attention being paid to conflicts in and around wetlands, and yet these areas are crucial to sustain human and animal life. Our focus is on human-wildlife conflicts in wetland ecosystems and conflicts with hippos in particular. The *Hippopotamus amphibius* (the common hippo) is a herbivorous keystone species or ‘ecosystem engineer’ that can change the physical structure within the environment (Gutiérrez and Jones, 2008) and can only be found in African wetlands. In spite of hippos’ presence across the continent, there has been a significant decline in their numbers, which are currently estimated at 125,000 (IUCN, 2005). During the period 1995-2004, hippo numbers are said to have reduced by 7-20 percent (Lewison, 2004). In 2005, concern over their conservation status resulted in the listing of the common hippo in CITES-Appendix II, which includes species that may become extinct and restricts their trade. Threats to hippos can predominantly be attributed to habitat loss due to wetland conversion for agricultural development, extensive harvesting of wetland products like papyrus (Fig. 1), and exploitation such as poaching for meat or ivory. Overall, the number of human-hippo conflicts seems to be on the rise as human pressure on freshwater resources and habitats increases. This

study looks at the non-protected wildlife governance regime of Lake Victoria Area, Kenya, the occurrence of conflicts between people and hippos, and ways to mitigate such conflicts.



Figure 1: Harvested wetland products in Nyakach District

Research aims

By focusing on human-hippo conflicts in wetland ecosystems, this study aims to:

- Clarify how the existing wildlife governance regime in Lake Victoria area accommodates human-nature relationships in wetlands;
- Determine how wildlife management and human-hippo conflicts are dealt with in non-protected areas in Kenya;
- Clarify the time-space character of human-hippo conflicts;
- Assess the damage and identify key hippo-conflict zones (based on conflict rates), thus providing input for conflict resolution strategies to be developed in collaboration with local communities and the Kenya Wildlife Service (KWS), which is the legal custodian of all wildlife in Kenya.

Our approach

This study consists of an analysis of conflicts, policies and institutions. This analysis is based on quantitative and qualitative methods like literature reviews, study of legal documents, interviews with key actors in wildlife and wetland governance, focus group discussions, questionnaire surveys within the local communities and the assessment of damage brought about by hippos. The fieldwork took place between late 2007 and September 2009. Most of the work was done between February 2008 and April 2009, during which time five local field monitors assessed the damage inflicted by hippos in four districts bordering Lake Victoria, Kenya, namely Kisumu East, Nyando, Nyakach and Mbita Districts (Fig. 2). Different types of damage are shown in figures 3 (a-c)

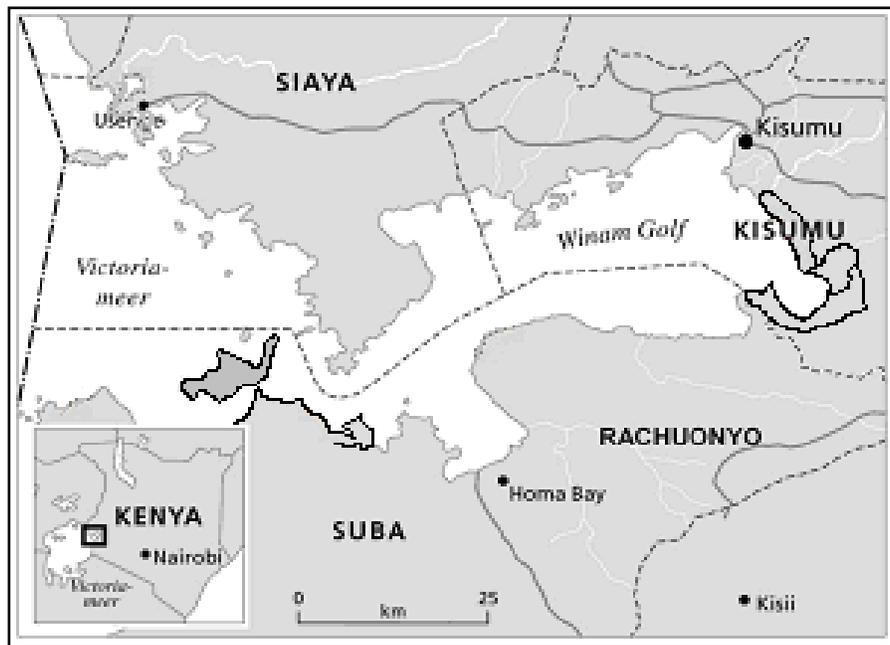


Figure 2: The project area in Nyanza Province in Kenya.



Fig 3(a)



Fig 3(b)



Fig 3(c)

Figures 3 (a-c): Various forms of damage incurred by hippos. (a) A cow killed by a hippo in Kanyagol Village, Nyakach District; (b) Destroyed fishing nets at Rota Beach, Nyakach District; (c) Hippo footprints in a farm in Nyakach District.

Based on our initial findings, we identified sites with the highest recorded numbers of hippo incidents. In these so-called conflict hotspot areas, we held a series of focus group discussions with farmers and fishermen through which we acquired more detailed information on their perceptions about so-called ‘problem animals’, the current approach to human-hippo conflicts, the impact of conflicts on their livelihoods, the coping strategies that people apply to deal with the losses inflicted by hippos, and possible approaches to conflict mitigation. We also looked into the devices that people use to protect their farms and other property, either individually or collectively, and their effectiveness. Figure 4 shows an example of a watch house, in which the farmer stays overnight to guard his ‘shamba’, while figure 5 shows a scarecrow, a device that is commonly put in between the crops.



Figure 4: A hippo watch house in Nyakach District.



Figure 5: A scarecrow in Nyando District.

It became evident that conflicts with hippos are not new to the area; they have existed for many years. Due to human population growth in the area, the strong reliance on farming as a source of income, and cultural practices of land division, there is increasing pressure on the land bordering water bodies. Human encroachment into the wetlands seems to have resulted in a rise in the number of conflicts with hippos. Without exception, participants in the focus group discussions portrayed the hippo as the key problem animal in the project area, with agricultural damage being cited as the main reason, followed by ‘threats to human life’ and damage to fishing equipment.

Lack of reports

The study includes a review of the conservation and management approaches KWS has adopted since its establishment in 1989 and their areas of focus. In our discussions with the local groups it became evident that many people in the project area have insufficient or incorrect knowledge of the role of the Kenya Wildlife Service (KWS); many of them tend to blame the organisation for the frequent occurrence of incidents with hippos. They talk about poor ‘problem animal control’ practices and a lack of interest on the side of the authorities. This is one of the reasons why relatively few people report incidents with hippos; they lack confidence in the authorities and a proper handling of their cases due to political reasons and widespread corruption. I am currently comparing our findings with the KWS records, in order to position hippo incidents in the wider context of problem animal reports in the lake region during the past decade. This will give a notion of the extent to which hippo incidents in the project area are reported.

A second reason for the reluctance to report is related to the encroachment into wetlands. Farmers tend to follow the changing shoreline and river courses and they cultivate their crops on government land that is supposed to be left idle in order to protect watercourses against erosion and provide access to the water for man and beast. Yet people claim these lands are theirs, either because they consider it to be ancestral land to which they are entitled or simply because they need land close to the water where crop cultivation is more diverse and higher harvests can be expected. Land is a sensitive issue in the area, which will have to be addressed properly in order for any proposed strategy to become effective.

Awareness creation

Our ‘awareness creation meetings’ with the communities in the ‘hotspot areas’ and the KWS (fig. 8) can be seen as a major step to bridge the gap between both actors; it fits nicely into the aims of the KWS’s Community’s Wildlife Service (KWS, 2008). Through this department the KWS intends to reach out to the communities and create a more positive image of the organisation and they thus warmly welcomed the meetings. We also conducted a joint series of announcements and talk shows on a regional radio station, in order to point out the need to report incidents with hippos as the Kenya Wildlife Service cannot act upon reports that do not reach them. While we were on air, people had the opportunity to call and ask questions related to hippos or wildlife conservation and problem animal control in general.



Figure 6: An awareness creation meeting in Gem Rae Sub-location, Nyakach District

Local involvement in conflict mitigation

One crucial step in conflict mitigation is to involve local communities in the problem definition and the search for alternatives and locally accepted solutions that are not detrimental to the functioning of the wetlands. By examining such alternatives, we encouraged the riparian communities to discuss hippo issues in a different manner and work towards developing a joint proposal on human-hippo conflict mitigation and hippo conservation in their respective areas. In this way, viable ideas can be exchanged with the Kenya Wildlife Service, VIRED, and the local communities for ultimate implementation on

the ground. The communities have responded positively to this approach and to date six groups have registered themselves under the Ministry of Social Services as “local hippo conservation groups”. This is a first step but it will certainly require more input to bring about a required change and work towards a coexistence of local communities and hippos who share the same area.

Compensation

The study reveals that local communities feel they are entitled to be compensated for hippo-induced damage. In 1989, the government decided to abolish financial compensation for wildlife-induced crop and property losses, thereby doing away with payments for human injury or death caused by wildlife intact. The main argument was that due to the sharp increase in the number of human-wildlife conflicts, it had become too costly for them to operate the system. However, the impact of corruption and false claims should not be ignored. Many local people perceive the absence of compensation as an injustice and it has further alienated them from the wildlife authorities. In the proposed Wildlife Bill, which has yet to be approved of by parliament, compensation for crop and property losses is being reintroduced. The effectiveness of compensation as a tool is captured in the study.

Cultural beliefs

It turned out that cultural beliefs related to hippos are still common in the project area, although they are gradually disappearing as the younger generation is less susceptible to them. To mention a few: hippos are controlled by people (witches) within the community, who can ride them at night, milk them, and send them to your farm in case you quarrel with him or reveal his identity to outsiders. When these ‘hippo owners’ hear about the anticipated arrival of the rangers of the Kenya Wildlife Service, they will hide the hippo so that the rangers are unable to trace it. Some beliefs are related to the clan-structure, along which Luo (the dominant tribe in the project area) society is organised. There are clans in the area that do not eat hippo meat, for the hippo is said to be associated to them one way or another. One of the clans for instance argues that ‘the hippo was once their daughter’ and therefore they cannot kill it nor eat its meat. This can be taken as an avenue for conservation of hippos. Such beliefs are looked into as they continue to play a role in community life and also impact on the way people perceive the wildlife authorities.

The way forward

I am currently analysing the data. Based on our preliminary findings, I have developed a follow-up programme that is currently being discussed with the Kenya Wildlife Service. It encompasses activities like a hippo census in the lake region, the development of a monitoring system that incorporates local communities, the provision of technical support to the recently established local hippo conservation groups, and the development of a Hippo Action Plan. Through the programme, several of the recommendations of the Hippo Monitoring Project will be gradually implemented. Once the data analysis is completed, the recommendations will be more refined.

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Biometric and age estimation of live peccaries in the Southern Pantanal, Brazil

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1. Introduction

Aging and sexing individual mammals is important for studying animal population structure and dynamics (Larson & Taber, 1980). Changes in the age structure or sex ratio are used as indicators to determine population status and health. As part of a long term peccary research project in the Pantanal, we collect demographic and biometric information to investigate white-lipped (*Tayassu pecari*) and collared (*Pecari tajacu*) peccary populations exposed to different levels of cattle and environmental impacts in the southern Pantanal. In addition, we have the opportunity to estimate the growth of peccaries in the wild by obtaining a temporal series of morphological measurements and weights from animals that are marked (with microchip identification tags) and recaptured. Here we present aging techniques and two biometric measurement results for white-lipped peccaries to demonstrate that age classification of peccaries can be applied in the field, and should only be conducted based on tooth wear. We focused our biometric analysis on white lipped peccaries, because there was a greater sample size. Aging classification and the risks of incorrectly aging animals based on field observations of body size, pelage coloration, or weight for white lipped peccary also applies for collared peccaries.

2. Methods

Study area:

Our study occurred at Fazenda Rio Negro (FRN), (19°30' S, 56°12.5' W), a 7647 ha area of the lower-middle Rio Negro of the Brazilian Southern Pantanal.

Capture, Radio-collaring, and Biometrics:

The capture process was facilitated by setting up temporary baiting stations in areas that white-lipped peccaries used frequently. Box traps, wire panel traps (120 l x 90 h x 60 w cm), and portable pig pens

(250 w x 170 h cm) were placed near animal trails with intense white-lipped peccary activity. We baited the traps with salt, corn, “mandioca” (*Manihot* sp.), and native fruits. After setting traps, we checked them every 6 hours. The bait stations and traps were widely spaced throughout the study site in an attempt to capture and study individuals from more than one group of each species.

When a peccary was captured, we estimated its weight and immobilized it in the trap or portable pig pen with zolazepam–tiletamine (Zoletil, 0.9ml/10kg) applied with a jab stick. Some of the white-lipped peccaries were fitted with a MOD 500 model radio collar (Telonics Inc., total weight of battery and collar = 570 g), and collared peccaries with an HLP-31100 model radio collar (Wildlife Materials, weight = 340 g). We also determined the animal's sex, placed it in an age class based on tooth wear (Sowls, 1997; Bodmer *et al.*, 1996), measured weight, and documented the length of nine external biometric parameters (i.e. head-body length, shoulder height, neck circumference, etc.). Aging the peccary is done by gently prying open their mouth and verifying tooth wear (Fig. 1). The animal was then placed back into the trap and was not released until it was fully recovered from the anesthetic. Tiny passive identification tags (PIT) or microchips were implanted subcutaneously in each captured individual (newborn to adult). Each microchip has an identification number that can be read with a scanner. The chip is encased in a smooth, strong biocompatible glass, and it is as small as a single rice grain. We use them as permanent markers (ear tags fall off) to identify individuals throughout their lifetimes. By recapturing and measuring chipped individuals over time, we are able to calculate growth rates, correlate tooth wear age categories with actual age, and estimate mortality for the first time in wild non-hunted peccary populations.



Figure 1. Gently prying open a white-lipped peccary mandible to verify the individuals age category. (Age Class 1, 3rd molar not present)

Aging peccaries:

Based on our observations of captured individuals, we developed an adapted version of the tooth wear age classification system used by Bodmer *et al.* (1997). Instead of four age class categories, based solely on tooth wear, we subdivided the individuals into eight categories based on tooth wear and eruption categories (Table 1). The eruption categories were described by Sowls (1997) for captive collared peccaries, and he provided precise age estimates based on the timing of tooth eruptions and tooth wear. We used the tooth-eruption age estimates of collared peccaries from Sowls (1997) in combination with

our adapted version of tooth wear age classification from Bodmer *et al.* (1997) to estimate the actual ages of white-lipped peccaries. Peccaries have I 2/3, C 1/1, Pm 3/3, M 3/3 X 2 = 38 dental formula (Sowls, 1997). The classification presented below ages white-lipped peccaries until 2 years. Data from recaptures of micro-chipped animals were also used to correlate adult age categories with actual age in years (see below).

Age category classifications from the development and tooth wear (Please see Appendix for pictures of each age class)

1. Class (0.5): newborns with no molars manifested, age \leq 5 months.
2. Class (1.0): young with 1st molar present and young with both first and 2nd molar present, age 6 – 10 months.
3. Class (1.5): young with 3rd molar emerging but not completely erupted, age between 1 – 2 yrs.
4. Class (2.0): animals with a fully erupted 3rd molar, and very superficial wear on the teeth, age approximately 2 years.
5. Class (2.5): animals with some wear on molars but less then age class 3. More wear on premolars compared to age class 2.0, cusps loose sharp points.
6. Class (3.0): animals with some wear on all the molars, but wear more concentrated on premolars. 1st and 2nd premolar considerable reduction in cusps.
7. Class (3.5): premolars and molars quite worn, premolars manifest heavy wear, but molars still show some crests.
8. Class (4.0): molars and premolars with heavy wear, at the gum line, sometimes a broken tooth, and no crests prevalent.

Table 1. Modified age classification from Sowls (1984, 1997) and Bodmer *et al.*, (1996) for peccaries.

Age Classification		
<i>Age using tooth wear</i>	<i>This study</i>	<i>Bodmer (1997)</i>
0.5	Baby	N/A
1	Juvenile	I
1.5	Subadult	I
2	Early adult	II
2.5	Early adult	II
3	Adult	III
3.5	Older adult	IV
4	Older adult	IV

Statistical analysis:

Two by eight factorial ANOVAs were conducted to test if weight or head-body lengths differed among sexes or age categories. If an overall significant difference was detected among age categories, we conducted post-tests to determine which classes differed from each other. For the post-tests, we used Pair-wise post-tests using the Bonferroni adjustment to maintain an experiment wise alpha of 0.05 (Systat, version 7.0 ,1997, SPSS Inc., Chicago, IL, USA).

3. Results

White-lipped Peccary Biometrics:

A total of 233 white-lipped peccaries were successfully trapped, anesthetized, weighed and measured at Fazenda Rio Negro, Mato Grosso do Sul, Brazil. Here, we present results for two biometric traits that best characterizes the animal size, weight, and head-body length. There were no significant differences between females and males for these parameters, so we combined the sexes, used one-way ANOVAs, and Bonferroni adjusted post-tests to compare the age categories. Figures 1 and 2 present the means and standard deviations of weights and head-body lengths for each age class. For both measurements, there was an overall significant difference among age classes ($P < 0.000001$). The Pair-wise post-tests using the Bonferroni adjustment to maintain an experiment wise alpha of 0.05 showed that weights and head-body lengths were significantly different between the younger age categories until class 2 or 2.5, respectively (Figs. 1 and 2). After age classes 2 and 2.5, the differences between the categories were not significant. The average weight for adult white-lipped peccaries (age classes ≥ 2.5) was 32.32 kg, and average head-body length was 111 cm. Adult weights peaked at age class 3, mean = 33.7 kg (SD = 4.0).

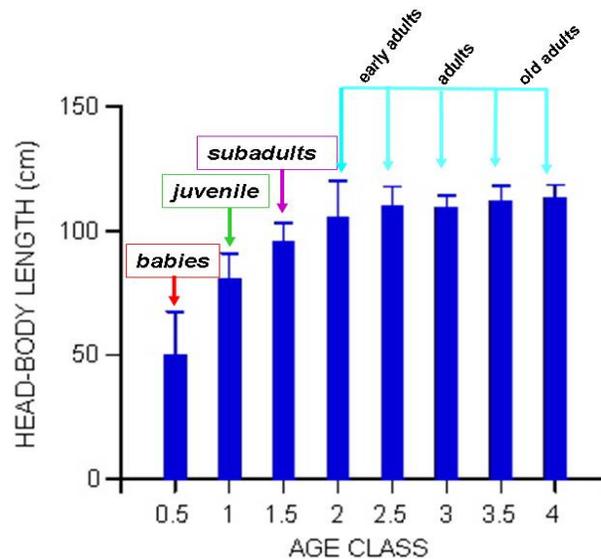


Figure 2: Mean and SD for head-body measurements of white-lipped peccaries at Fazenda Rio Negro, Aquidauana, Mato Grosso do Sul, Brazil (2001 – 2005).

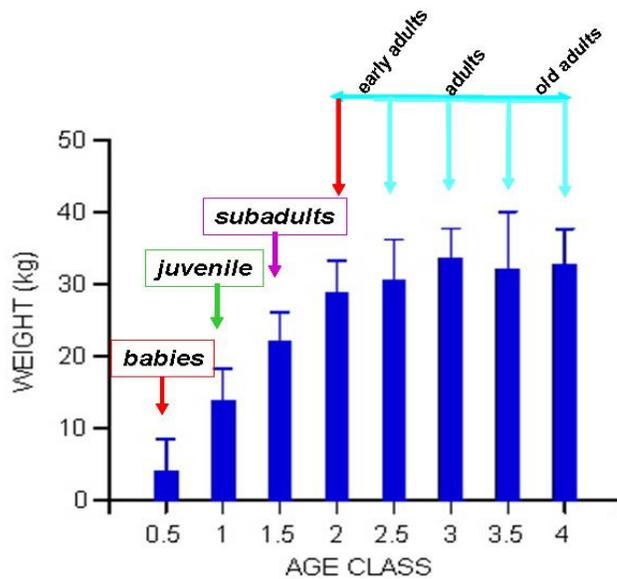


Figure 3: Mean and SD for weights of white-lipped peccaries at Fazenda Rio Negro, Aquidauana, Mato Grosso do Sul, Brazil (2001 – 2005).

Data from recaptures of micro-chipped animals are necessary to correlate adult age categories with actual age in years. Based on repeated age-class estimates from recaptured animals with identification chips, we estimated the duration (in years) of the different age classes. We also re-measured weight, head-body length, etc. of recaptured animals. After enough data are gathered, we will be able to show growth over time of wild white-lipped peccary populations.

For age-class time estimates, data are still preliminary (N is small); in order to obtain enough recaptures, long-term data collection is required as well as some luck to recapture individuals with micro-chips. Figure 3 shows the maximum duration of age-class shifts obtained from recaptures to the present time (blue bars show the maximum time in years from the first capture to the most recent recapture, between age classes, and purple bars show the same within age classes, i.e. the animal’s age class remained the same). For example, within the 2.0 class, 9 recaptures have been obtained, and the maximum duration between the first capture and the most recent recapture was 2.3 years. For the age-class shift from 3.5 to 4.0, only two animals have been recaptured, and the maximum duration was more than 4.4 years.

After more data is obtained, the duration of each age class and age-class shift should reach an upper limit (asymptote), and these can ultimately be used to estimate the duration of age classes based on information from the tooth wear.



Figure 4. Head-body measurements of white-lipped peccary age class based on recaptures in the lower-middle Rio Negro of the Brazilian Southern Pantanal, Aquidauana, Mato Grosso do Sul,

The sex-age structure reflects the current conditions of a population;

- Sex-age composition and changes in ratios are often indicative of habitat quality, health factors or behavioral conditions that directly affect future size of the population;
- Sex-age structure is used to estimate future declines or increases in numbers of animals, and recommend appropriate management to achieve goals.

From the information we have to date, we can make a preliminary estimate of the life span of wild white-lipped peccaries in the Pantanal (Fig. 5). Some age class shifts are not included because recapture data is still needed for that category. Based on information from Sowls (1997) we know that individuals in the 0.5 age class are approximately 5 months old. To date, we have very little recapture data for tooth wear age classes 1 and 1.5. Using the recapture data from individuals marked at the 0.5 and recaptured in the 2.0 tooth wear age class, we obtained a maximum duration time of 1.91 years (Fig. 5). This indicates that individuals beginning the tooth wear age class 2.0 category have a real age of about 2+ years. Tooth wear age class 2.5 begins around 4 years of age and ends around 5.5 years. Tooth wear age-class 3.0 begins around 5.5 years (based on the maximum age of individuals in the 2.5 class, and about 1.5 to 2 years in each age class), and age class 3 ends around 7 to 8 years; age class 3.5 at 7 to 9 years (beginning of age class based on maximum age of 3.0 individuals); and age-class 4.0: 8 to 11 years (Fig. 5). Data are preliminary, and the analysis was conservative in terms of the start of each age class; therefore life span is probably longer. We've been able to test this system with a set of captured and recaptured animals from another region in the Pantanal (N=194 individuals). Recapture data indicates that the 2 year age class shift appears to be reliable (Keuroghlian unpubl. data).

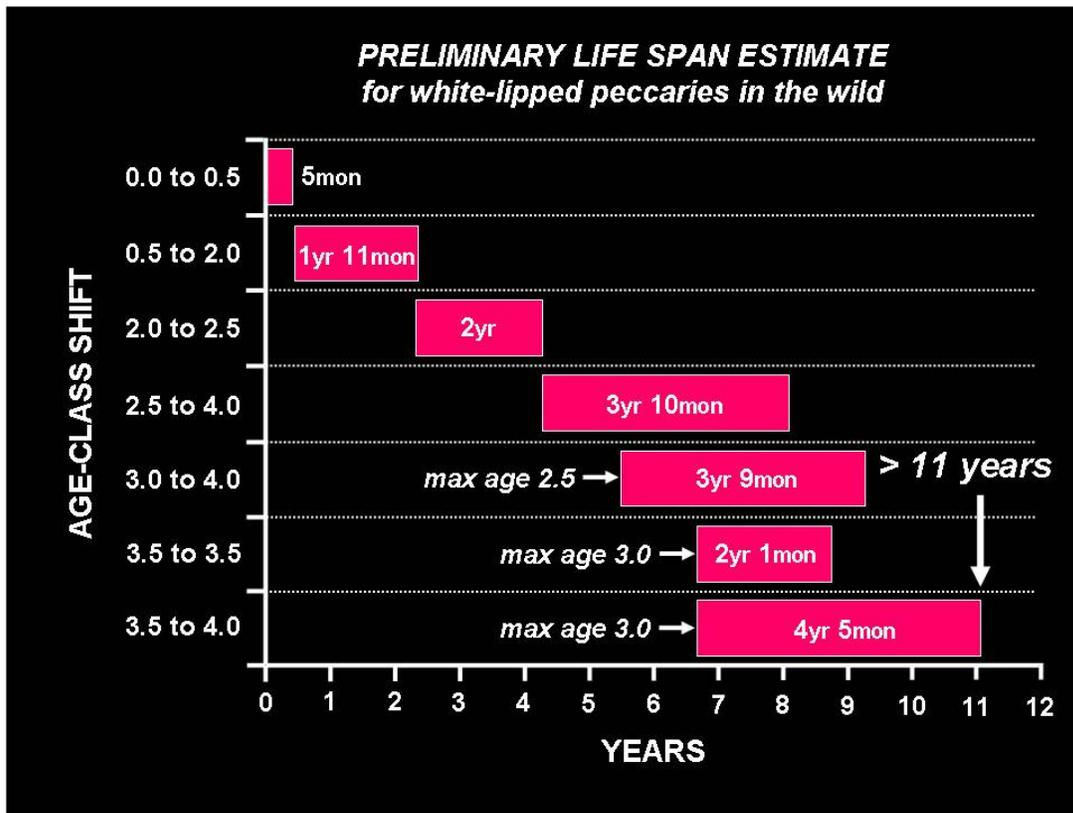


Figure 5. Head-body measurements of white-lipped peccary age class based on recaptures in the lower-middle Rio Negro of the Brazilian Southern Pantanal, Aquidauana, Mato Grosso do Sul, Brazil (2001 – 2005).

Population structure of a non hunted white-lipped peccary population:

Based on five years of white-lipped peccary live capture data, the population at FRN shows a Type I survivorship curve, which is typical for non-hunted wildlife (Fig. 6a) (Shaw, 1985). The FRN population fit the age specific survival expectations of ungulates described by Caughley (1966) in which survival is lowest during the early and late stages of life (Fig. 6b)

4. Discussion:

Population structure and demography:

The Pantanal is a unique place to investigate population structure and mortality rates of white lipped peccaries as it is one of the few non-protected areas in the Neotropics where hunting pressure on white lipped peccaries is low. Data from the Pantanal can provide useful baseline data for comparative purpose with other Neotropical areas where the animals are hunted. These types of data relating age classes based on tooth wear to biometric parameters can be useful for management of animals harvested in other regions or countries where hunting is prevalent. Using regression models, it will be possible to obtain biomass estimates of harvested animals, or peccaries that have died of natural causes.

The demographic data presented in this study can be used to model population dynamics of white lipped peccary populations. White-lipped peccary demography has shown that the population at FRN is similar to a non-hunted population. In this scenario, predation (jaguars and puma were present in the

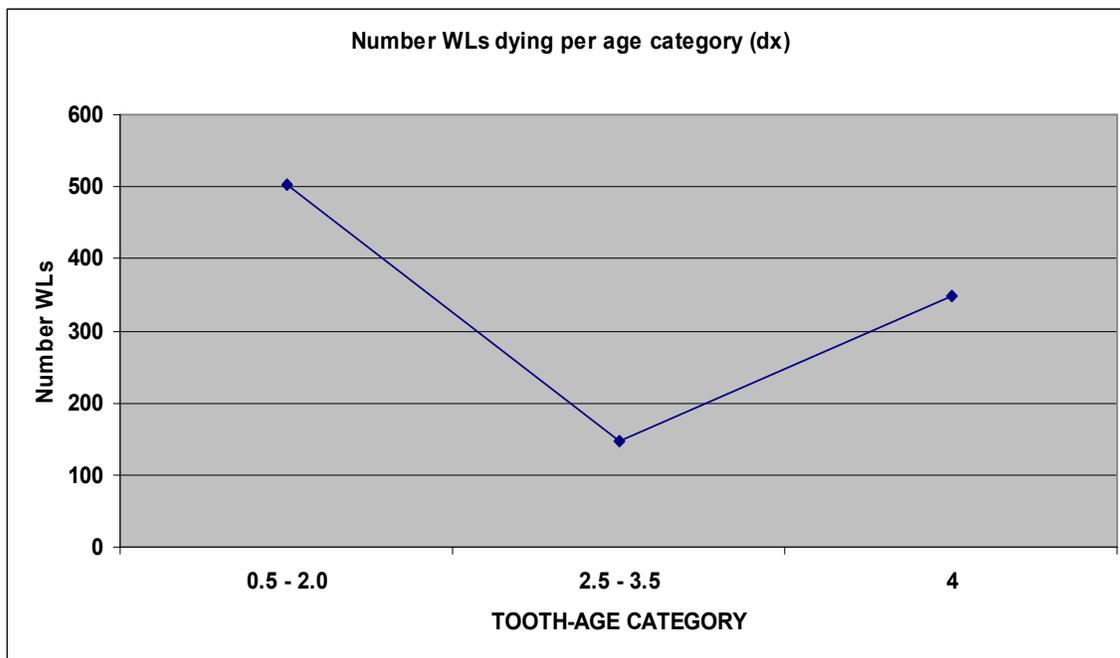
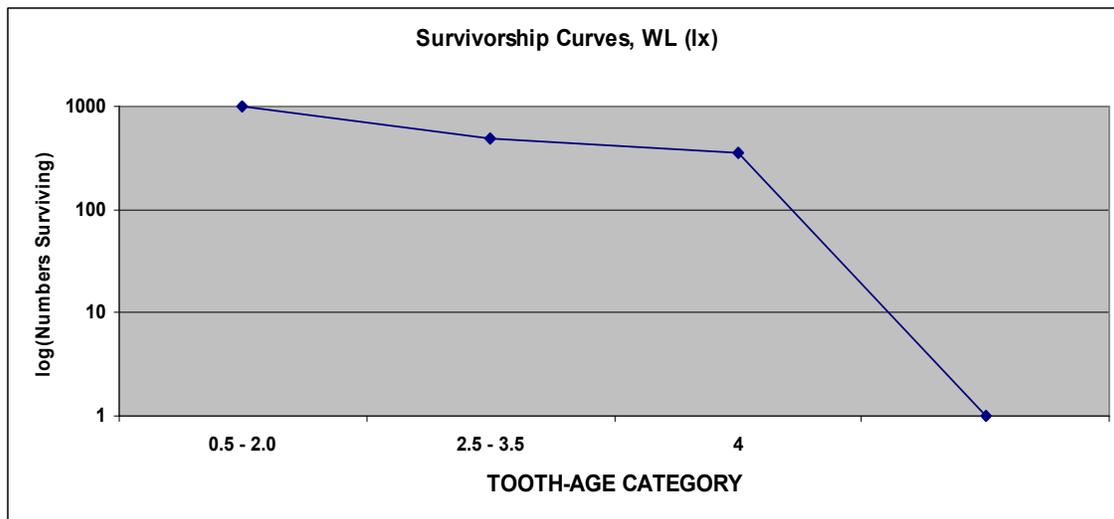


Figure 6. Survivorship curve (l_x) (a) and number of white-lipped peccaries dying per age category (d_x) (b), based on a starting population of 1000 animals, in the lower-middle Rio Negro of the Brazilian Southern Pantanal, Aquidauana, Mato Grosso do Sul, Brazil (2001 – 2005).

study area), and food availability and disease are the main factors that influence mortality rates of different age classes (Knowlton *et al.*, 1999). The data presented here can be compared to other field sites under different anthropogenic pressures or threats. If comparing these data to a collection of skulls, researchers need to take into account that skulls of babies, juveniles and some subadults cannot be easily encountered in the field. Due to their smaller size, baby and juvenile skulls are crushed, decay rapidly, or may be harder to find in the field.

Estimating age

Our statistical analyses indicated that the only reliable age estimator after age class 2 is tooth wear

analysis. The weight and head-body measurements reached an asymptote, and permanent teeth are in place after age class 2.5. Physical traits such as pelage color (adults black and sub adults tan and black) and body measurements are not good indicators once the animal is over 2 years of age. At first glance, we have mistaken adults for sub adults based on the presence of black and tan pelage (a trait thought to be characteristic of only juveniles and sub adults). When the teeth of these individuals were closely examined, it became apparent that they were well beyond sub adult age. Similarly, animals that were all black, and assumed to be adults, were classified as sub adults upon examination of their teeth. Although, we have not systematically collected data on bristle density, we have observed that it declines among older age classes. This appears to be a reliable trait that may improve age estimates. The bristle density around the gland and rump area forms a bare spot (bald), and the density of ticks increases in older age classes, especially class 4. We plan to include estimates of these parameters during future captures.

The methods described in this paper should be used to estimate the age and to classify peccaries by age group. However, tooth wear rates can vary between areas due to diet and environmental conditions. Seed hardness, percentage of fruit in the diet and soil abrasiveness are amongst some of the many factors that may lead to differences in tooth wear between study areas. We recommend that the researcher use this age classification as a basis for other regions, but once the 3rd molar is fully erupted, age classification based on tooth wear may show some differences between habitats. However, these data clearly show the risks of incorrectly aging animals based on field observations of body size, pelage coloration, or weight for peccaries.

5. Acknowledgements

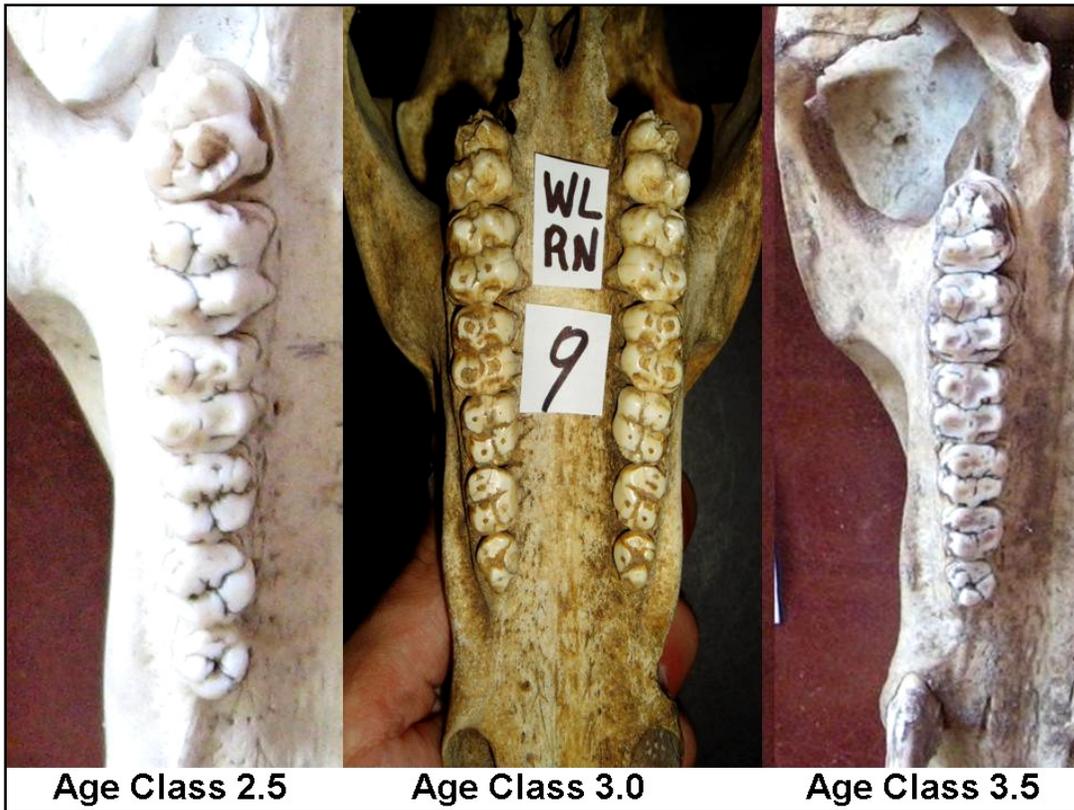
For fieldwork help, logistics, and volunteers, I would like to thank the volunteers from Earthwatch and York High School/"Expedition to the Pantanal". Many thanks to Maria do Carmo (Duca) who has assisted and facilitated teacher fellowship groups on many expeditions. Thanks to the staff at Rio Negro, especially to "Baiano" (Ezidio Arruda), at Fazenda Rio Negro. Special thanks to field assistants: Celso Vicente from Ararauna, and veterinarian Tatiana Freitas. This project was funded by Earthwatch, IBC (Institute for Biological Conservation). CI-Brasil, Rio Tinto, UNIDERP/Fundação Manoel de Barros, and Merrill Magowan also provided financial aid. The authors thank Donald P. Eaton for reviewing the manuscript.

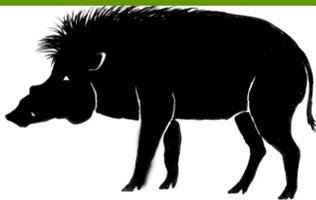
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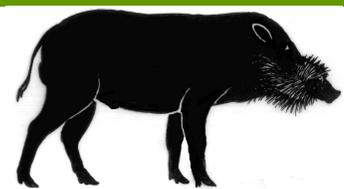
Appendix A: Sequence of tooth eruption and wear for aging white lipped peccaries.







News in Brief



Swine flu science update: 4 January 2010

Carol Campbell

4 January 2010 | EN

<http://www.scidev.net/en/news/swine-flu-science-update-4-january-2010.html>

The WHO director-general, Margaret Chan, has said that the swine flu — influenza A(H1N1) — pandemic may not be conquered until 2011. She said it was "prudent and appropriate" to monitor the evolution of the virus for the next 12 months, *Reuters* reported last week (29 December).

Cases have peaked in the United Kingdom, Canada and the United States, she said, but are still increasing in countries such as Egypt and India.

Keiji Fukuda, the WHO's special advisor on swine flu, said last month (19 December) that logistical and regulatory issues caused delays in distributing A(H1N1) vaccines to the developing world. The organisation had planned to start sending vaccine in November, with Afghanistan, Azerbaijan and Mongolia first in line, said Fukuda.

Chan added that the decision by AstraZeneca and Sanofi-Aventis to recall some A(H1N1) vaccine because it was not potent enough was not related to vaccine safety.

As vaccine becomes increasingly available, the required number of doses is still being debated. *The Lancet* published three studies last month (16 December) from China and Hungary and the United States. All three say that one dose is enough for an adult but that children (under nine in the US study and under 12 in the Chinese study) need two. The Hungarian study did not include children.

But an Australian study, to be published in the *Journal of the American Medical Association* this week (6 January), found that one dose is effective in children older than six months.

The *New England Journal of Medicine* reported last month (31 December) that young people are more likely to catch A(H1N1) — but are not more likely to spread it.

People under 18 are twice as likely to catch swine flu from members of their household than those aged 19–50 but are no more likely to pass it on.

US scientists have mapped the interaction between human and A(H1N1) cells. Their study, published in *Cell* (17 December), will guide future studies, they said.

And a small human protein called IFITM might explain why some people shrug off influenza A(H1N1) while others die. US researchers said that the more IFITM a person has, the better.

Stephen Elledge, lead author of the study, also published in *Cell* (17 December), said the virus replicates 5–10 times more efficiently in the absence of IFITM.

A collaboration between Canadian and Spanish researchers has found that patients with severe A (H1N1) infections have high levels of interleukin-17, a chemical that helps white blood cells fight infection and disease.

The research, published in the journal *Critical Care* (24 December), could lead to the development of a drug that blocks interleukin-17 to prevent severe cases of A(H1N1).

People with underlying health problems, such as a weak heart or cancer, need prompt, intensive treatment including antibiotic and antiviral drugs when they catch influenza A(H1N1), according to an autopsy study of 21 people who died from the virus.

The Brazilian research was published in the *American Journal of Respiratory and Critical Care Medicine* this month (1 January).

Pigs back in the Forest

http://www.bbc.co.uk/herefordandworcester/content/articles/2009/09/16_wyre_forest_pigs_features.html

A small farrow of pigs is being used as an environmentally friendly means to help manage the Wyre Forest. It is hoped they'll reduce the need to use pesticides and machinery to clear the forest.

The ancient woodland of Wyre Forest was once the home to wild pigs, and this new scheme sees domesticated animals being allowed to roam there once more.

The Forestry Commission hope the pigs will reduce the need to use machinery and chemical herbicides to control invasive plants.

The three pigs are now grazing in an enclosed area of woodland dominated by bracken and bramble, and with a relatively open tree canopy - this is an important factor, as it allows light to reach the forest floor, creating better conditions for the re-establishment of a diverse range of plants.

The pigs will remain in the wood until early winter, with the timing of their removal dependent on their impact.

They would then return, if needed, for a similar period the following year.

TB strain in pig new to North Island

<http://www.radionz.co.nz/news/stories/2009/11/03/1245d30fd1db>

Updated at 7:31am on 3 November 2009

Routine surveying in the Tararua district has picked up a strain of bovine tuberculosis in a pig which had not been found before in the North Island.

The survey, carried out to confirm whether the East coast region was free of the disease, looked at the wild animal population in the Akitio and Herbertville areas.

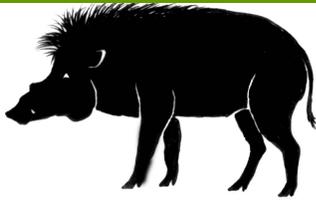
Animal Health Board regional coordinator Terry Hynes says DNA testing has shown that the strain of TB the boar was infected with is similar to that found on the South Island's West Coast.

Mr Hynes says as that particular type had not been seen in the North Island before, it's likely the animal was brought in from elsewhere and illegally released in the area.

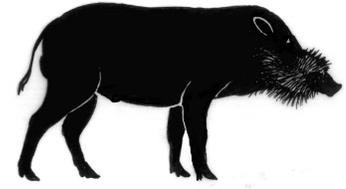
He is urging hunters not to move wild pigs between regions, which he says is common practice in some areas, but can carry fines of up to \$5000.

Mr Hynes says the annual bovine TB testing requirements may still be scaled back, but further surveys may be needed before that can happen.

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New Literature on Suiformes



Abstracts of new papers from our regular contributors and members

Can bite force be used as a basis for niche separation between native peccaries and introduced feral pigs in the Brazilian Pantanal?

Mammalia 73: 369-372, 2009.

Desbiez ALJ and Keuroghlian A.

The white lipped peccary, collared peccary and feral pig occur sympatrically in the Brazilian Pantanal. Bite force has been proposed as a mechanism for niche differentiation between these species. Since measures of bite force are ultimately associated to an animal's ability to crack or grind seeds, bite force was evaluated indirectly by comparing broken and non-broken seeds encountered in faecal samples of the three species. Results showed that peccaries crushed seeds that were swallowed by the feral pig. If bite force is a mechanism of niche differentiation between the introduced feral pigs and native peccaries then it is the powerful bite force of peccaries that enables them to use resources not exploited by the feral pig. Feral pigs may act as seed dispersers.

The response of a landscape species, white-lipped peccaries, to seasonal resource fluctuations in a tropical wetland, the Brazilian pantanal.

International Journal of Biodiversity and Conservation 1: 87-97, 2009.

Keuroghlian A, Eaton DP and Desbiez ALJ.

Local extinctions of white-lipped peccary, due to habitat fragmentation and hunting, have been reported throughout its vast geographical range. Recent studies have shown that their role as fruit predators and dispersers affects the biodiversity of certain forest habitats. Fruits may be reduced in deforested habitats, so documenting fruit availability and use is critical to peccary conservation efforts and forest biodiversity. Our 5 year research was based in the lower- middle Rio Negro, southern Pantanal of Brazil, a well-preserved region where cattle-related impacts are minimal. We have been investigating the habitat and feeding requirements of white-lipped, while surveying resource availability. Based on monthly fruit surveys in different habitats, we know that spatial and temporal variability of fruits is high. Marked periods of fruit scarcity occur during the year and gallery forest fruit counts were the highest. Habitat use trends indicated that there is a strong association between white-lipped peccaries and forested areas, especially gallery forest. White-lipped peccaries depended less on single dominant fruits, and their diets showed greater seasonal variation, i.e. they consumed a much greater diversity of

fruits in the wet season. Fruit richness and quantity was higher during the wet season, (65 spp. - wet; 33 spp. - dry). The dry season could be considered a period of fruit scarcity in terms diversity and quantity. We expect these periods to affect peccary movements and range requirements. The non random use of habitats observed for white-lipped, illustrate the importance of habitat diversity, especially diversity of forest types and their associated fruiting species. Preventing further deforestation of an already naturally patchy habitat are priorities for conservation in the Pantanal.

Some Notes on Biological Aspects of Captive Javan Warty Pig (*Sus verrucosus*).

Biodiversitas 10(3): 124-128, 2009.

Semiadi G, Taufiq R and Nugraha P.

The Javan warty pig (*Sus verrucosus*) is an endemic pig to Java and Bawean Islands, while population on Madura Island is thought to be extinct. The problem in establishing ex-situ captive breeding is the lack of information on biology or physiology. A study on these aspects was conducted in 16 Javan warty pigs and 2 cadavers in Surabaya Zoo, Surabaya. Birth profile was evaluated and blood collections were conducted, as well as analysis on spermatozoa morphology. Data showed that blood parameters were not different among the age groups (juvenile and adult) or sex and within the range of *Sus scrofa*. Extreme values were only obtained from the palette with the female reaching 14.5 x 10³/mm³, while adult male and juvenile pigs were 58-75 x 10³/mm³. Diameter of both testicles with skin intake was 56.42 mm, with the length of left testicle being 83.29 mm and right testicle 78.88 mm. Javan warty pig spermatozoa had longer size for the head and tail lengths compared to average pigs sperms. Litter size was between two to four, with the average of 2.75 litters (SD 0.98). Low litter size in this species is something that has to be concerned from the conservation point of view, therefore a captive breeding population program needs to be considered.

Keywords: Javan warty pig, *Sus verrucosus*, blood parameters, sperm.

Mammalian densities in a neotropical wetland subject to extreme climatic events.

Biotropica in press, 2010.

Desbiez ALJ, Bodmer RE and Tomas WM.

Effective management and conservation of an ecosystem requires information on species assemblages as well as reliable estimates of population sizes to plan, implement and evaluate management strategies. The Brazilian Pantanal is one of the world's largest freshwater wetlands and considered a priority landscape for wildlife conservation. It is subject to pluri-annual extreme dry and wet periods, which cause extreme flood and drought events, which strongly affect wildlife. Using the line-transect method, this study examined the distribution of densities and metabolic biomass of medium- to large-sized non-volant mammals in forest, cerrado and floodplain landscapes, in an area with low anthropogenic influence, in the central area of the Brazilian Pantanal during a prolonged drought. Comparisons with a previous survey conducted during years of average rainfall in part of the study area suggest that population

fluctuations of certain species are closely associated with water due to the drought. Results from this study showed that mammal assemblages varied between landscapes. Forested landscapes have the highest densities of mammals and are the most important in terms of relative energy consumption. In addition, at the time of the study, frugivores were found to have higher energy consumption than browser/grazers across the three landscapes; most fruits are produced in forested areas stressing their importance. By converting forested landscapes into grasslands, the intensification of ranching practices seriously threatens biodiversity and ecological processes in the region.

The spatial and agricultural basis of hippopotamus crop-raiding

Master's Thesis, Columbia University, New York, 2009.

Kendall CJ.

ckendall@princeton.edu

Recently listed by the IUCN as Vulnerable (VUA4cd), the common hippopotamus (*Hippopotamus amphibius*) is under considerable pressure from humans due to habitat degradation and hunting. While human-hippo conflict is known to increase retaliatory killing and culling of hippos, little work has examined the issue. Using interviews, this paper investigates various spatial, ecological, and agricultural factors that influence the vulnerability of farms to hippo crop-raiding in three villages surrounding Ruaha National Park, Tanzania. Findings show a positive correlation between hippo crop-raiding events and a farm's proximity to the river and hippo access points (places where hippos leave and enter the river). Results from this study provide guidelines for future management and conservation of hippos, including identifying key habitat areas to mitigate future conflicts.

Conservation genetics of the Sulawesi warty pig, *Sus celebensis*

Master's Thesis, Catholic University of Leuven, 2009.

Obbels D, Galbusera P, Gillemot S, Larson G, Macdonald A, Burton J and Damayanti CS.

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Sulawesi (Eastern Indonesia) belongs to one of the 25 hotspots for biodiversity in the world. There is a high diversity of endemic species present, which makes the fauna of Sulawesi a priority for nature conservation. The Sulawesi warty pig (*Sus celebensis*) is one of these endemic species, which is threatened by hunting and trade. Moreover increase of the human population, changes in land use and fragmentation are important threats. The genetic structure and diversity of the species on Sulawesi has not been documented yet. In this study historical (100 years old) and modern samples are examined by means of mitochondrial (d-loop) and nuclear DNA (11 microsatellite markers) genotyping. From the mtDNA haplotypes of all samples and the microsatellite genotypes of modern samples the presence of five groups (subclades) is most probable. Sulawesi has arisen from five paleo-islands; the region underwent glacial fluctuations in sea level, which linked neighboring islands during glacial periods. This history seems to be somewhat reflected in the five subclade structure of the Sulawesi warty pig. Based on the

microsatellite genotypes, the historical samples cluster in two groups (north and central & south Sulawesi). A similar structure has been observed in endemic macaques on Sulawesi. As sample number is suboptimal our results have to be interpreted with care. On a higher level, three mtDNA clades (possibly cryptic species) and a Pacific clade (possibly a hybrid with *Sus scrofa*) are present. This suggests several invasions of *S. celebensis* on Sulawesi. There is a lot of variation present in North Sulawesi, which is probably due to the frequent transport. Genetic diversity did not change through time and the historical and modern populations are in Hardy-Weinberg equilibrium. There is a suggestion for inbreeding. Therefore complementary samples are necessary for a full interpretation of the genetic diversity and the historical and contemporary structure of warty pig on the island.

Puberty in male collared peccaries (*Tayassu tajacu*): study of spermatogenesis in animals of different ages

Cardoso D de L.

http://www.ufpa.br/cienciaanimal/pdfs/CA_Ciencia_Animal/CA_Deise_de_Lima_Cardoso.pdf

This study analyzes the development of spermatogenesis in peccaries (*Tayassu tajacu*) and establishes the age they reach puberty, considering testicular biometry and seminiferous tubules, the amount of spermatogenic cells, the morphological description of the stages of the seminiferous epithelium cycle (SEC), the relative frequency on which they surge inside the seminiferous tubules and general spermatogenesis yield. In the experiment, the animals were divided according to age bracket, into five groups, with three animals in each group, G1 (7 to 8 months), G2 (9 to 10 months), G3 (11 to 12 months), G4 (13 to 14 months) and G5 (15 to 16 months). The animals were subjected to orchietomy surgery, to obtain the testicle samples, which were fixed in Alfac solution for 24 hours and histologically processed, where 5 µm cuts were stained in hematoxylin eosin. Based on the tubular morphology method, it was done the quantification of the cell types corrected to its average nucleus diameters of 10 transversal sections at SEC stage 1 for animals with established spermatogenesis and 20 transversal sections for the younger animals without any established spermatogenic activity; and also the classification of the stages of the seminiferous epithelium cycle, by analyzing 100 transversal sections of seminiferous tubules. The data from the testicular biometry, such as, weight, length and width, showed gradual and constant growth with significant statistical differences ($p < 0,05$) and high correlation among themselves. The tubular diameter values presented statistical significance from G1 to G4, and from G4 an accelerated and continuous growth, with no statistical significance ($p > 0,05$). According to the quantitative and morphological analysis of the spermatogenic cells which form the germinative epithelium, the animal age brackets were classified in the following phases impuberal (G1), prepuberal (G2), puberty (G3), pos puberty 1 (G4), and pos puberty 2 (G5). The phase the productive activity started, or, puberty, was determined in the animals when they turned 11 months, when the the greatest growth in the number of spermatogenic cells and a positive correlation with testicular weight occurred. At this stage, the Sertoli cells, presented a significant decrease ($p < 0,05$). During determination of relative frequency of the stages of seminiferous epithelium cycle, eight types of association were observed, according to the tubular morphology method, where the stages with greater and less frequency were 1 and 3 respectively. The pos meiotic phase showed more frequency and the meiotic phase, the lower one, being statistically significant in relation to the other ones. The reproductive efficiency was demonstrated through translated values by the cell ratios between type A spermatogonic cells and round spermatids, being that no significant increase between G3, G4 and G5 was observed ($p > 0,05$); and the rate of Sertoli cells showed a significant statistical difference between all possible comparisons of age

brackets from G3 to G5 ($p < 0,05$).

Eletroejaculation in collared peccaries (*Tayassu tajacu*): seminal characteristics of pre-and post-refrigeration

Kahwage PR.

http://www.ufpa.br/cienciaanimal/pdfs/CA_Ciencia_Animal/CA_Priscila_Reis_Kahwage.pdf

Studies concerning reproductive biology of collared peccary (*Tayassu tajacu*) are worthy to improve creation system. The aims of this research were testing electroejaculation as safety method to collect semen; describing the seminal profile along the year; and testing the capacity for spermatozoa storage under refrigeration. Eleven adults males (76.8 ± 37.8 months, 19.5 ± 2.7 kg) were selected for the measurements of testicular length and width. Eight adults males were used to semen collection (45 ± 13 stimuli, 12 volt, 3 seconds; and resting pulse of 3 seconds). Semen samples were evaluated for physic characteristics (appearance, color, volume, sperm concentration, pH, sperm motility and vigor), and morphological characteristics (sperm viability and sperm defects). Semen samples were split and diluted in two different extenders: BTS (short-term storage) or X-Cell® (long-term storage). Diluted semen samples were maintained under refrigeration at 17°C . The samples were evaluated immediately after dilution (T0), after 24 hours (T24) and 48 hours (T48) of cooling. Animals presented 3.8 ± 0.4 cm on left testicles length, 2.6 ± 0.3 cm on left testicles width and left testicles consistency of 2.3 ± 0.2 ; right testicles presented 3.8 ± 0.5 cm length, 2.7 ± 0.3 cm width and 2.3 ± 0.2 for consistency. The success rate obtained with electroejaculation was 75.21%. The seminal features observed were: volume 0.81 ± 0.86 mL, concentration $137.44 \pm 153 \times 10^6$ spz/mL, pH 7.92 ± 0.73 , motility $52.66 \pm 28.79\%$, vigor 2.2 ± 0.8 , viability $55.84 \pm 28.55\%$, primary abnormalities $22.87 \pm 12.93\%$, secondary abnormalities $9.11 \pm 5.88\%$ and total abnormalities $31.52 \pm 13.81\%$. There were no significant changes in production and quality semen along the months of the year. There was no significant difference between extenders tested concerning to maintenance capacity of seminal parameters during the storage period of storage; however, significant influence of storage time was observed ($P < 0.05$). Diluted semen in BTS presented at T0, T24 and T48, average sperm motility of $56.1 \pm 17.6\%$, $17.9 \pm 23.3\%$ and $7.7 \pm 19.6\%$, the average sperm viability was $60.2 \pm 17.2\%$, $27.9 \pm 23.8\%$ and $11.7 \pm 20.2\%$, and the average total defects were $28.1 \pm 10.8\%$, $37.5 \pm 12.1\%$ and $41.28 \pm 11.4\%$, respectively. Semen samples diluted in X-Cell® presented at T0, T24 and T48 average motility of $54.2 \pm 22.1\%$, $27.0 \pm 28.0\%$ and $14.0 \pm 24.2\%$, average viability of $57.8 \pm 21.7\%$, $33.0 \pm 26.9\%$ and $19.9 \pm 25.6\%$ and total defects were $30.8 \pm 11.2\%$, $41.2 \pm 13.4\%$ and $44.2 \pm 14.4\%$. Thus, electroejaculation is an effective and safe method to obtain seminal samples from collared peccary, the semen of collared peccary has potential for storage and can be maintained under 17°C up to 24 hours.

Bacteriological analysis of semen of collared peccaries (*Tayassu tajacu*) raised in captivity.

Bartha MMP.

http://www.ufpa.br/cienciaanimal/pdfs/CA_Ciencia_Animal/CA_Mario_Mansour_Pinheiro_Bartha.pdf

Realizou-se a análise microbiológica de sêmen de 10 catitus machos criados em cativeiro no período de outubro de 2007 a janeiro de 2009, num total de 84 análises, com o objetivo de identificar a presença e

freqüência de bactérias no mesmo, além de testar a sensibilidade de diferentes antimicrobianos frente aos microrganismos isolados. Nesse período, isolou-se um total de 225 colônias sendo 80 (35,6%) de *Streptococcus* sp., 72 (32%) *Staphylococcus* sp., 64 (28,4%) *Micrococcus* sp., 5 (2,2%) *Corynebacterium* sp. e 4 (1,8%) *Enterococcus* sp.. Nos testes de sensibilidade utilizando onze antibióticos destacaram-se a Gentamicina (92,8%), Amicacina (85,3) entre aqueles mais eficazes frente aos microrganismos isolados. Concluiu-se que apesar da freqüência e dos gêneros dos microrganismos isolados no sêmen a taxa reprodutiva dos animais não foi afetada uma vez que essas bactérias podem ser provenientes da flora normal ou do meio em que os animais vivem, recomendando-se os antimicrobianos mais eficazes contra os microrganismos isolados para serem adicionados no diluidor caso haja necessidade de resfriamento do sêmen desses animais.

The microbiological analysis of semen was conducted from 10 catitus males reared in captivity from October 2007 to January 2009, in a total of 84 test, to identify the presence and frequency of bacteria in it, in addition to testing the sensitivity of different antibiotics against the microorganisms isolated. During this period a total of 225 colonies were isolated, 80 (35.6%) of *Streptococcus* sp., 72 (32%) *Staphylococcus* sp., 64 (28.4%) *Micrococcus* sp., 5 (2.2%), *Corynebacterium* sp. and 4 (1.8%) *Enterococcus* sp. In sensitivity tests, using eleven antibiotics, highlighted to Gentamicin (92.8%), Amikacin (85.3) among those most effective against the microorganisms isolated. It was concluded that despite the frequency and genera of microorganisms isolated in semen, the reproductive rate of animals was not affected, since these bacteria may be from the normal flora or a part of the environment in which animals live. It is recommended that the most effective antimicrobial against the microorganisms isolated, is to add in dilutive if there is a need to cool the semen of these animals.

Veterinary, Genetic and Physiological Studies

Adlhoch C, Wolf A, Meisel H, Kaiser M, Ellerbrok H and Pauli G. 2009. High HEV presence in four different wild boar populations in East and West Germany. *Veterinary Microbiology* 139(3-4): 270-278.

Swine Hepatitis E virus (HEV) can be transmitted from pigs to humans causing hepatitis. A high prevalence of HEV in wild boar populations is reported for several European countries, but actual data for Germany are missing. During the hunting season from October to December 2007 liver, bile and blood samples were collected from wild boars in four different German regions. The samples were tested for HEV RNA by quantitative PCR (qPCR) and anti-HEV IgG antibodies by two different ELISAs and a Line immunoassay. A seroprevalence of 29.9% using ELISA and 26.2% in the Line immunoassay was determined. The seroprevalence rate varied greatly within the analyzed regions. However, qPCR analysis revealed a higher prevalence of 68.2% positive animals with regional differences. Surprisingly, also adult wild sows and wild boars were highly HEV positive by qPCR. Compared to liver and serum samples, bile samples showed a higher rate of positive qPCR results. Sequencing and phylogenetic analysis of a 969 nt fragment within ORF 2 revealed that all isolates clustered within genotype 3 but differed in the subtype depending on the hunting spot. Isolates clustered within genotypes 3i, 3h, 3f and 3e. Within one population HEV isolates were closely related, but social groups of animals in close proximity might be infected with different subtypes. Two full-length genomes of subtypes 3i and 3e from two different geographic regions were generated. The wild boar is discussed as one of the main sources of human autochthonous infections in Germany.

Ballesteros C, Garrido JM, Vicente J, Romero B, Galindo RC, Minguijon E, Villar M, Martin-Hernando MP, Sevilla I, Juste R, Aranaz A, de la Fuente J and Gortazar C. 2009. First data on Eurasian wild boar response to oral immunization with BCG and challenge with a *Mycobacterium bovis* field strain. Vaccine 27(48): 6662-6668.

The Eurasian wild boar (*Sus scrofa*) is considered a reservoir for bovine tuberculosis (bTB) caused by *Mycobacterium bovis* and closely related members of the *Mycobacterium tuberculosis* complex in south-central Spain. The vaccination of wildlife with BCG offers an alternative to culling and to movement restriction for the control of bTB among wildlife reservoirs. In this study, we hypothesized that oral BCG immunization of wild boar would affect the expression of immunoregulatory genes and confer protection against *M. bovis*. Three groups were used to describe the infection, pathological findings and gene expression profiles in wild boar: BCG-vaccinated and *M. bovis*-challenged (vaccinated challenged group; N=6), non-vaccinated and *M. bovis*-challenged (non-vaccinated challenged group; N=4), and non-vaccinated and mock-infected (control group; N=2) animals. *M. bovis* was isolated from 50% (3/6) and 75% (3/4) of vaccinated challenged and non-vaccinated challenged animals, respectively. All four wild boar from the non-vaccinated challenged group developed bTB-compatible lesions 114 days after challenge. In contrast, only 50% of vaccinated challenged wild boar developed lesions. The PBMC mRNA levels of IL4, RANTES, C3, IFN-gamma and methylmalonyl-CoA mutase (MUT) were analyzed at several days post-vaccination (dpi). When vaccinated challenged animals were compared to controls, all five genes were significantly upregulated at the time of *M. bovis* infection at 186 dpi but IFN-gamma levels were also upregulated at 11 and 46 dpi. The C3 and MUT mRNA levels were higher at 46 dpi, and 11 and 186 dpi, respectively, in vaccinated protected wild boar when compared to non-vaccinated challenged animals. At the end of the experiment (300 dpi), the mRNA levels of selected genes were lower in non-vaccinated challenged animals when compared to control wild boar. Exposing wild boar to a dose of 10(4) cfu of *M. bovis* by the oropharyngeal route is an adequate protocol to produce an infection model in this species. Our results suggested that oral BCG immunization of wild boar results in the upregulation of immunoregulatory genes that may be associated with protective response to *M. bovis* infection in this species. More studies on vaccine efficacy, delivery, and safety will be needed to confirm if oral vaccination with BCG could be used in bTB control programs for reducing *M. bovis* infection and clinical disease in wild boar.

Bouts T, Vordermeier M, Flach E and Routh A. 2009. Positive skin and serologic test results of diagnostic assays for bovine tuberculosis and subsequent isolation of *Mycobacterium interjectum* in a pygmy hippopotamus (*Hexaprotodon liberiensis*). Journal of Zoo & Wildlife Medicine 40(3): 536-542.

A 20-yr-old male pygmy hippopotamus (*Hexaprotodon liberiensis*), weighing 250 kg, arrived at Zoological Society London Whipsnade Zoo (United Kingdom) from a captive collection in Portugal. A quarantine health check was performed including a comparative intradermal tuberculosis (IDTB) test. Assessment of the comparative IDTB test at 72 hr revealed a strong positive reaction at the bovine site. Serum was tested with a rapid immunochromatographic assay (TB STAT-PAK (R)) and was positive for tuberculosis antibodies. The tuberculosis tests were repeated 6 wk later with the same positive test outcome. In addition, a broncho-alveolar lavage (BAL) was submitted for mycobacterial culture. The positive IDTB test and TB STAT-PAK (R) results were supported by multiantigen print immunoassay (MAPIA). Based on these results, the animal was suspected to be infected with *Mycobacterium tuberculosis* complex organisms and was euthanized. No gross or histologic Signs Of tuberculosis were found at postmortem examination. *Mycobacterium interjectum* was cultured from the BAL but not

from necropsy samples. The antigens used in the TB STAT-PAK (R) and MAPIA tests are reportedly specific for the *M. tuberculosis* complex, and so it is possible this animal presented with a latent case of tuberculosis or had a previous tuberculosis infection that resolved prior to testing. Cross-reactions with nontuberculous mycobacteria have been described with TB STAT-PAK (R) and MAPIA tests. However, Western blotting analysis using serum from this animal did not recognize *M. interjectum* proteins of equivalent size to the *M. tuberculosis-Mycobacterium bovis* proteins recognized in the MA-PIA. Thus, antigenic cross-reactivity with *M. interjectum* can be deemed less likely, but other nontuberculous mycobacterial proteins cannot be ruled Out. It is therefore possible that false-positive reactions were obtained. These results highlight the difficulty of diagnosing tuberculosis in the absence of pathology and the presence of nontuberculous mycobacteria.

Costard S, Wieland B, de Glanville W, Jori F, Rowlands R, Vosloo W, Roger F, Pfeiffer DU and Dixon LK. 2009. African swine fever: how can global spread be prevented? Philosophical Transactions of the Royal Society of London - Series B: Biological Sciences 364(1530): 2683-2696.

African swine fever (ASF) is a devastating haemorrhagic fever of pigs with mortality rates approaching 100 per cent. It causes major economic losses, threatens food security and limits pig production in affected countries. ASF is caused by a large DNA virus, African swine fever virus (ASFV). There is no vaccine against ASFV and this limits the options for disease control. ASF has been confined mainly to sub-Saharan Africa, where it is maintained in a sylvatic cycle and/or among domestic pigs. Wildlife hosts include wild suids and arthropod vectors. The relatively small numbers of incursions to other continents have proven to be very difficult to eradicate. Thus, ASF remained endemic in the Iberian peninsula until the mid-1990s following its introductions in 1957 and 1960 and the disease has remained endemic in Sardinia since its introduction in 1982. ASF has continued to spread within Africa to previously uninfected countries, including recently the Indian Ocean islands of Madagascar and Mauritius. Given the continued occurrence of ASF in sub-Saharan Africa and increasing global movements of people and products, it is not surprising that further transcontinental transmission has occurred. The introduction of ASF to Georgia in the Caucasus in 2007 and dissemination to neighbouring countries emphasizes the global threat posed by ASF and further increases the risks to other countries. We review the mechanisms by which ASFV is maintained within wildlife and domestic pig populations and how it can be transmitted. We then consider the risks for global spread of ASFV and discuss possibilities of how disease can be prevented.

Dubey JP. 2009. Toxoplasmosis in pigs – The last 20 years. Veterinary Parasitology 164(2-4): 89-103.

Pigs are important to the economy of many countries because they are a source of food for humans. Infected pig meat is a source of *Toxoplasma gondii* infection for humans and animals in many countries. This parasite also causes mortality in pigs, especially neonatal pigs. Most pigs acquire *T. gondii* infection postnatally by ingestion of oocysts from contaminated environment or ingestion of infected tissues of animals. Few pigs become infected prenatally by transplacental transmission of the parasite. Raising pigs indoors in confinement has greatly reduced *T. gondii* infection in pigs but the recent trend of organic farming is likely to increase *T. gondii* infection in pigs. Recently, feeding goat whey to pigs was found to be a risk factor for *T. gondii* infection in organically raised pigs. Currently used molecular and histopathological methods are insensitive for the detection of *T. gondii* in pork because of the low concentration of the parasite in meat destined for human consumption. There is no vaccine to prevent

T. gondii infection in pigs but efforts are being continued to develop a non-viable vaccine. In the present paper, information on prevalence, transmission, diagnosis, and control of porcine toxoplasmosis in the last 20 years (since 1988 when last reviewed by this author) is reviewed. Worldwide reports of clinical and asymptomatic infections in pigs are reviewed. Methods to detect *T. gondii* in pigs are compared. Recent studies on genetic typing of *T. gondii* strains prevalent in pigs are discussed with respect to epidemiology. Because wild pigs are hunted for food for human consumption prevalence in wild pigs is summarized.

Ferreira E, Souto L, Soares AMVM and Fonseca C. 2009. Genetic structure of the wild boar population in Portugal: Evidence of a recent bottleneck. Mammalian Biology 74(4): 274-285.

The present study assesses the degree of genetic structure and the presence of recent genetic bottlenecks in the wild boar population in Portugal. One hundred and ten individuals were sampled after capture during organised legal drive hunts, conducted in 58 municipalities across the continental territory, during the game seasons of 2002/2003 and 2003/2004. Individuals were genetically typed at six microsatellite loci using multiplex PCR amplification. Significant deviations from Hardy-Weinberg equilibrium were found for the total population of wild boar in Portugal. Wild boar population genetic structure was assessed using Bayesian methods, suggesting the existence of three subpopulations (North, Centre and South). Tests were conducted to detect the presence of potential migrants and hybrids between subpopulations. After exclusion of these individuals, three sets of wild boars representative of respective subpopulations were distinguished and tested for the effects of recent bottlenecks. Genetic distances between pairs of subpopulations were quantified using F-ST and R-ST estimators, revealing a variation of 0.138-0.178 and 0.107-0.198, respectively. On the basis of genetic and distribution data for Portuguese wild boar from the beginning of the 20th Century, a model of strong demographic decline and contraction to isolated refuge areas at the national level, followed by a recovery and expansion towards former distribution limits is suggested. Some evidence points to present admixture among subpopulations in contact areas.

Nees S, Schade B, Clauss M, Steinmetz HW, Ehrensperger F, Steck B and Hatt JM. 2009. Polycystic kidney disease in the pygmy hippopotamus (*Hexaprotodon liberiensis*). Journal of Zoo & Wildlife Medicine 40(3): 529-535.

Polycystic kidney disease (PKD) was diagnosed at necropsy in a captive aged female pygmy hippopotamus (*Hexaprotodon liberiensis*), which presented with numerous cysts in both kidneys, the liver, and the duodenum and with one single cyst in the pancreas. There were no premonitory clinical signs of a nephropathy observed prior to its death. Similar findings were made in a male cage mate 6 months later. Both animals had been wild caught. A literature review revealed that another seven cases of PKD have been reported in pygmy hippopotamuses, and an additional screening of records available from the international studbook for the species revealed yet another six cases. In all cases, aged females were affected, and in several instances, affected animals were related to each other. These patterns indicated familiar transmission similar that associated with PKD in humans and other animals. The disease, and especially the presumptive bias in diagnosis toward females, indicated that the male animal of this report was the first case of PKD reported in a male pygmy hippopotamus; thus, further investigation is warranted. The status of the kidneys with respect to PKD should be assessed (including histology) in every deceased pygmy hippopotamus, and whenever possible by ultrasonography in live animals.

Oliveira EG, Santos ACF, Dias JCT, Rezende RP, Nogueira SLG and Gross E. 2009. The influence of urea feeding on the bacterial and archaeal community in the forestomach of collared peccary (*Artiodactyla*, *Tayassuidae*). Journal of Applied Microbiology 107(5): 1711-1718.

This study was carried out to test whether bacterial and archaeal populations, and products of fermentation in each compartment of collared peccary stomach, vary significantly with urea feeding. Bacteria and archaeal population variation among the four stomach compartments were also compared.

Methods and Results: Archaeal and bacterial communities in the forestomach of four individuals per treatment - peccaries fed diets with and without urea - were analysed at molecular level using PCR followed by denaturing gradient gel electrophoresis. Volatile fatty acids profiles in the three different compartments of the forestomach were also compared. The bacterial community composition varied considerably among each compartment and with urea provision, but no variation was observed between archaeal populations. Differences in bacterial communities between treatments - with and without urea - were greater than amongst stomach compartments. The acetate: propionate proportion decreased with urea provision in diet. Some differences in bacterial but not archaeal community composition were observed in each compartment of the collared peccary forestomach.

Conclusions: There are some differences in bacterial but not archaeal populations in each compartment of collared peccary stomach. Use of urea in the diet of peccary can substantially modify the profile of volatile fatty acids released in its forestomach, but does not influence the archaeal community composition. Urea has an important effect on bacterial population DGGE profile present in the peccary's forestomach.

Significance and Impact of the Study: These results demonstrate the ability of the collared peccary to use urea as source of nonprotein nitrogen, and confirm a hypothesis that the collared peccary has a digestive physiology more similar to ruminant than nonruminant animals.

Poteaux C, Baubet E, Kaminski G, Brandt S, Dobson FS and Baudoin C. 2009. Socio-genetic structure and mating system of a wild boar population. Journal of Zoology 278(2): 116-125.

Wild boars *Sus scrofa* have a social organization based on female groups that can include several generations of adults and offspring, and are thus likely matrilineal. However, little is known about the degree of relatedness between animals living in such groups or occupying the same core area of spatial activity. Also, polygynous male mating combined with matrilineal female groups can have strong influences on the genetic structure of populations. We used microsatellite genotyping combined with behavioral data to investigate the fine-scale population genetic structure and the mating system of wild boars in a multi-year study at Chateauvillain-Arc-en-Barrois (France). According to spatial genetic autocorrelation, females in spatial proximity were significantly inter-related. However, we found that numerous males contributed to the next generation, even within the same social group. Based on our genetic data and behavioral observations, wild boars in this population appear to have a low level of polygyny associated with matrilineal female groups, and infrequent multiple paternity. Mortality due to hunting may facilitate the breakup of what historically has been a more predominantly polygynous mating system, and likely accelerates the turnover of adults within the matrilineal groups.

Riksson-Ahomaa MF, Wacheck S, Koenig M, Stolle A and Stephan R. 2009. Prevalence of pathogenic *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* in wild boars in Switzerland. International

Between October 2007 and March 2008, 153 wild boars shot in the Canton of Geneva in Switzerland were sampled. Fifty-one percent of the animals were males and 49% were females. The age of most (81%) animals varied between 6 months and 2 years. Prevalence of enteropathogenic *Yersinia* in tonsils and faeces was studied using culture and PCR methods and in tissue fluid of tonsils using an ELISA system. Prevalence of anti-*Yersinia* antibodies in tissue fluid was 65%. Detection rate of enteropathogenic *Yersinia* in tonsils of 153 wild boars by real-time PCR was 44%. Ail-positive *Yersinia enterocolitica* and inv-positive *Yersinia pseudotuberculosis* were detected in 35 and 20% of the animals, respectively. Both species were detected in 10% of the animals. Isolation rate of enteropathogenic *Yersinia* was low; ail-positive *Y. enterocolitica* and inv-positive *Y. pseudotuberculosis* were found in 9 and 3% of the animals, respectively. Prevalence was shown to be significantly higher in tonsils than in faeces. Furthermore, females were more commonly positive than males. This study shows that the prevalence of enteropathogenic *Yersinia* is high and both enteropathogenic *Y. enterocolitica* and *Y. pseudotuberculosis* are common findings in tonsils of wild boars in Switzerland.

Santos N, Correia-Neves M, Ghebremichael S, Kallenius G, Svenson SB and Almeida V. 2009. Epidemiology of *Mycobacterium bovis* infection in wild boar (*Sus scrofa*) from Portugal. Journal of Wildlife Diseases 45(4): 1048-1061.

AB Tuberculosis has been diagnosed in wild boar (*Sus scrofa*) in several European countries during the last decade; however, almost no information has been reported to date for Portugal. This study aimed to investigate tuberculosis in wild boar in Portugal through characterization of *Mycobacterium bovis* infection and identification of disease risk factors. Tissue samples were obtained from hunted wild boar during the 2005 and 2006 hunting seasons. Samples were inspected for gross lesions and processed for culture. Acid-fast bacterial isolates were identified by polymerase chain reaction and spoligotyping. Associations between tuberculosis in wild boar and several variables linked to wild ungulate diversity and relative abundance, livestock density, and cattle tuberculosis incidence were investigated. *Mycobacterium bovis* isolates were identified in 18 of 162 wild boars from three of eight study areas. Infection rates ranged from 6% (95% confidence interval [CIP95%]=1-21%) to 46% (CIP95%=27-67%) in the three infected study areas; females in our sample were at greater risk of being infected than males (odds ratio=4.33; CIP95%=3.31-5.68). Spoligotyping grouped the *M. bovis* isolates in three clusters and one isolate was a novel spoligotype not previously reported in international databases. Detection of *M. bovis* was most consistently associated with variables linked to wild ungulate relative abundance, suggesting that these species, particularly the wild boar, might act as maintenance hosts in Portugal.

Shender LA, Glock RD and Spraker TR. 2009. Salmonellosis in a free-ranging population of javelinas (*Pecari tajacu*) in South Central Arizona. Journal of Wildlife Diseases 45(4): 941-951.

The javelina, or collared peccary (*Pecari tajacu*), is indigenous to Arizona, New Mexico, and Texas in the United States and ranges throughout Latin America. From June 2004 to April 2005, an estimated 105 javelinas died in a mortality event that occurred in Tucson, Arizona, and neighboring areas. Clinical signs observed in sick animals included emaciation, dehydration, lethargy, and diarrhea. In addition, some animals showed labored breathing and hind limb weakness. We necropsied 34 animals, and enteritis was the most frequent clinical sign, followed by colitis, pulmonary congestion, and pneumo-

nia. The only consistent findings were isolations of *Clostridium perfringens* type A and multiple *Salmonella* serotypes. Although it is likely that these javelinas ultimately succumbed to salmonellosis, it is unclear whether other unidentified underlying factors were involved. This is the first reported case of widespread salmonellosis in free-ranging javelinas.

Souza ALP, Castelo TS, Queiroz JPAF, Barros IO, Paula VV, Oliveira MF and Silva AR. 2009. Evaluation of anesthetic protocol for the collection of semen from captive collared peccaries (*Tayassu tajacu*) by electroejaculation. Animal Reproduction Science 116(3-4): 370-375.

The objective of this study is to verify and compare the effects of acepromazine-tiletamine-zolazepam and propofol used in anesthetic protocols for semen collection by electroejaculation from captive collared peccaries. Ten sexually mature animals were physically restrained and anesthetized by either intravenous administration of tiletamine-zolazepam (2 mg/kg) after acepromazine premedication, or a propofol dose of 5 mg/kg. The onset of anesthetic recovery was determined by the animals regaining consciousness and attempting to stand. Semen was collected by electroejaculation and evaluated for volume, pH, sperm concentration, progressive motility, morphology, percentage of live cells and functional membrane integrity. Six anesthetized animals with the acepromazine-tiletamine-zolazepam protocol showed erection, but semen could be collected in only four (40%) attempts. Of the animals anesthetized using propofol, nine showed erection, and the ejaculates were collected in eight (80%) attempts. Furthermore, propofol afforded rapid recovery of animals, and ejaculates with enhanced sperm motility and functional membrane integrity as compared with those collected by the other protocol ($P < 0.05$). In conclusion, use of propofol for anesthetic restraint of collared peccaries enhanced collection of semen by electroejaculation.

Taxonomic, Morphological, Biogeographic and Evolutionary Studies

Albarella U, Dobney K and Rowley-Conwy P. 2009. Size and shape of the Eurasian wild boar (*Sus scrofa*), with a view to the reconstruction of its Holocene history. Environmental Archaeology 14(2): 103-136.

A large assortment of skulls and skeletons of recent wild boar (*Sus scrofa*) from across the world has been used to collect tooth and bone measurements that can be compared to those from archaeological specimens. The data provide useful information for a reconstruction of the Holocene history of the species. The evidence collected so far highlights the great variability of the species and provides a baseline to be used for the interpretation of ancient material. It is shown that not only the size, but also the shape of teeth and mandibles can help in highlighting patterns of variability in wild boar from different areas. A number of geographic trends are identified in the variation of *S. scrofa* across its range, mainly concerning the differentiation of insular forms, and the existence of South-North and West-East clines. Other factors such as hybridisation with domestic stock, feralisation and human-induced movement of animals may also play an important role. A comparison with ancient material emphasises the existence of similarities as well as differences between modern and ancient populations. Although some of the geographic trends identified on the basis of the analysis of modern material seem to date back to early Holocene times, the morphological history of the species appears to be complex, and in more than one area fluctuations in body size seem to have occurred.

Cucchi T, Fujita M and Dobney K. 2009. New Insights into Pig Taxonomy Domestication and Human Dispersal in Island South East Asia: Molar Shape Analysis of *Sus* Remains from Niah Caves, Sarawak. International Journal of Osteoarchaeology 19(4): 508-530.

Despite the almost ubiquitous presence of Holocene *Sus* remains in Island South East Asia (ISEA), the domestication of pigs and their dispersal in this region remains somewhat confused. Using molar shape geometric morphometric analysis, archaeological *Sus* dental series from the Sarawak caves of Niah (Aceramic, Neolithic) and Lobang Kudih (Ming period), are compared with extant ISEA wild pigs to establish their taxonomic status and to further explore the evidence for local domestication or introduction of allochthonous populations. Results on modern data-sets show that outline analysis of the third lower molar achieves highly significant inter- and intra-specific differentiation among ISEA wild pigs, with a phenotypic divergence structure displaying congruence with molecular phylogenies. Both tooth shape and mtDNA evidence strongly suggest the so-called wild pigs of New Guinea to be the descendants of pigs domesticated in mainland South East Asia and introduced by early farmers to ISEA. None of our data provide clear evidence for a Neolithic introduction of domesticated pigs, or for the local domestication of indigenous bearded pigs, since all Aceramic and Neolithic pigs from Niah cave have been identified as indigenous bearded pig (*Sus barbatus*). Local domestication experiments by foragers have not been ruled out, since evidence of hypoplasia as a marker of domestication processes has been observed. Introduction of allochthonous domestic pigs between the Late Neolithic and the Metal Age is suggested, since this small domestic breed from Lobang Kudih cave displays strong phenetic relationships with *S. scrofa* of New Guinea, recognised by molecular phylogeography as part of the 'Pacific Clade' linked both with Lapita and Polynesian dispersals. Introduction of celebensis-like species has also been suggested. Future studies should incorporate broader time-scale and geographical framework data-sets to strengthen these assumptions.

Conley AJ, Corbin CJ and Hughes AL. 2009. Adaptive Evolution of Mammalian Aromatases: Lessons From Suiformes. Journal of Experimental Zoology Part A-Ecological Genetics & Physiology 311A(5): 346-357.

Estrogen synthesis evolved in chordates to control reproduction. The terminal enzyme in the cascade directly responsible for estrogen synthesis is aromatase cytochrome P450 (P450arom) encoded by the CYP19 gene. Mammals typically have a single CYP19 gene but pigs, peccaries and other Suiformes have two or more resulting from duplication in a common ancestor. Duplication of CYP genes in the steroid synthetic cascade has occurred for only one other enzyme, also terminal, 11 beta-hydroxylase P450 (P450c11). P450arom and P450c11 share common substrates and even physiological functions as possible remnants from a common P450 progenitor, perhaps an ancestral P450arom, which is supported by phylogenetic analysis. Conserved tissue-specific expression patterns of P450arom paralogs in placenta and gonads of pigs and peccaries suggest how functional adaptation may have proceeded divergently and influenced adopted reproductive strategies including ovulation rate and litter size. Data suggest that the porcine placental paralog evolved catalytically to protect female conceptuses from testosterone produced by male siblings; the gonadal paralog to synthesize a novel, nonaromatizable testosterone metabolite (1OH-testosterone) that may increase ovulation rate. This would represent a coevolution facilitating litter bearing as pigs diverged from peccaries. Evidence of convergence between the peccary CYP19 genes and lower tissue expression may therefore represent initiation of loss of the functional paralogs. Studies on the Suiforme aromatases provide insights into the evolution of the steroidogenic cascade and metabolic pathways in general, how it translates into physiological adaptations

(altered reproductive strategies for instance), and how duplicated genes become stabilized or disappear from genomes.

Pickford M. 2008. The myth of the hippo-like anthracothere: The eternal problem of homology and convergence. *Revista Española de Paleontología* 23(1): 31-90.

The notion that anthracotheres had hippo-like body proportions, locomotion and lifestyles has been in the literature for so long, and has been repeated so many times, that it has taken on the aura of unquestionable truth. However, right from the beginning of studies into hippo-anthracothere relationships over a century and a half ago, observations were made that revealed the existence of fundamental differences in dental, cranial and post-cranial anatomy in the two groups. From 1836 to 1991 two skeletal characters (a descending plate at the angle of the mandible, and raised orbits) have overshadowed all others in suggesting close relationships between hippos and a single anthracothere genus (*Merycopotamus*) later to be joined by a second genus, *Libycosaurus*, in 1991 for the descending angle, and 2003 for the raised orbits (Lihoreau, 2003; Pickford, 1991). Close examination of these structures reveals that they are not homologous in the two groups, yet they have played an inordinately stubborn role in interpretations of the relationships between them, featuring in papers as recently as 2005. The rest of the skeleton and many cranio-dental features revealed, as early as 1836, that anthracotheres did not look particularly similar to hippos, either in gross body plan, or in details of the skeletal anatomy, observations that have been confirmed at irregular intervals ever since. Yet, despite the divergent morphology, most authors continued to attribute hippo-like locomotion, behaviour and ecology to the anthracotheres that they studied, whether anthracotheriines or bothriodontines.

Two broad themes have run side by side in the long history of study of hippo-anthracothere relationships, “homology versus convergence” and “early versus late divergence”, early divergence implying the existence of a ghost proto-hippo lineage of some 30 million years duration. Indeed these two themes are linked together, in the sense that proponents of early divergence have tended to interpret the similarities between hippos and anthracotheres as convergences, whereas those who have proposed late divergence usually took the perceived similarities to represent homologies.

All these interpretations were played out within the context of a much broader background debate about monophyly or paraphyly of the artiodactyls, which was actively discussed in the Victorian era just as it is today. More recently, molecular studies have altered the scope of the debate, principally by indicating closer affinities between whales and hippos than between hippos and other artiodactyls. In the search for the ghost lineage that should link hippos to whales, some authors have recently suggested that anthracotheres fill the role «robustly», whereas others have suggested that anthracotheres are not closely related to hippos, whilst yet others have proposed that palaeochoerids or cebochoerids may represent the missing lineage. The aim of this paper is to review the possible role of anthracotheres in the evolution of hippopotamids. It is concluded that they played no part in it, whereas palaeochoerids could well represent the ghost lineage that has evaded scientists for more than a century.

Keywords: Hippopotamidae, Anthracotheriidae, Palaeochoeridae, evolution, homology, convergence, early/late divergence, history, phylogeny.

La idea de que los antracoterios tienen proporciones, locomoción y modo de vida similar a los hipopótamos se encuentra desde hace tiempo en la bibliografía, y se ha repetido en tantas ocasiones que ha alcanzado un aura de verdad incontestable. Sin embargo, desde el inicio de los estudios de las relaciones entre hipopótamos y antracoterios, hace más de 150 años, las observaciones realizadas han revelado que existían diferencias fundamentales entre ambos grupos en la anatomía dental, craneal y postcra-

neal. Desde 1836 a 1991 dos caracteres esqueléticos (rama mandibular prolongada inferiormente en su ángulo y órbitas elevadas) han obscurecido a todos los demás a la hora de sugerir la proximidad entre hipopótamos y un único género de antracoterios (*Merycopotamus*), al que después se le ha unido un segundo género, (*Libycosaurus*), por la prolongación inferior del ángulo de la mandíbula (Pickford, 1991) y por las órbitas elevadas (Lihoreau, 2003). El examen detallado de estas estructuras revelan que nos son homólogas en estos dos grupos, aunque de manera constante hayan jugado un importante papel en las interpretaciones de las relaciones entre ambos grupos, figurando incluso en trabajos del año 2005. El resto del esqueleto y muchos caracteres craneodentales conocidos ya desde 1836 revelan que los antracoterios no son particularmente semejantes a los hipopótamos, ni en la morfología corporal gruesa ni en detalles de la anatomía esquelética; estas observaciones se han confirmado repetidas veces desde entonces. A pesar de esta morfología divergente todavía hay numerosos autores que continúan atribuyendo a los antracoterios, sean antracoterinos o botriodontinos, una locomoción, comportamiento y ecología similar a los hipopótamos.

Dos ideas principales han ido paralelas a lo largo de la historia de los estudios sobre las relaciones entre hipopótamos y antracoterios, “homología *versus* convergencia” y “divergencia temprana *versus* divergencia tardía”; una divergencia temprana implicaría la existencia de un linaje proto-hipopótamo fantasma, con una duración de unos 30 millones de años. Señalar que estas dos ideas están muy ligadas, en el sentido de que los que propugnan una divergencia temprana tienden a interpretar las similitudes entre hipopótamos y antracoterios como convergencias, mientras aquellos quienes propugnan una divergencia tardía usualmente consideran las similitudes percibidas como homologías.

Todas estas interpretaciones también juegan un papel muy importante en un contexto mucho más amplio del debate sobre la monofilia o parafilia de los artiodáctilos, que se viene discutiendo activamente desde la era Vic-toriana hasta la actualidad. Recientemente, los estudios moleculares han alterado el ámbito del debate, principalmente al señalar una mayor afinidad entre las ballenas y los hipopótamos que entre éstos y los artiodáctilos. En la búsqueda de este linaje fantasma que debería enlazar hipopótamos y ballenas, algunos autores han sugerido que los antracoterios no tendrían una relación cercana con los hipopótamos, mientras otros sugieren que los paleoquéridos o ceboquéridos podrían representar el linaje perdido. La idea de este trabajo es revisar el posible rol jugado por los antracoterios en la evolución de los hipopótamos. La conclusión es que los antracoterios no juegan ningún papel en ella, además los paleoquéridos bien podrían representar el linaje fantasma, que se ha evadido a las pesquisas de los científicos durante más de un siglo.

Palabras clave: Hippopotamidae, Anthracotheriidae, Paleochoeridae, evolución, homología, convergencia, divergencia temprana/tardía, historia, filogenia.

Schreve DC. 2009. A new record of Pleistocene hippopotamus from River Severn terrace deposits, Gloucester, UK-palaeoenvironmental setting and stratigraphical significance. Proceedings of the Geologists Association 120(Part 1): 58-64.

A new Pleistocene vertebrate assemblage from fluvial deposits of the River Severn in Gloucester, England, has yielded the remains of hippopotamus (*Hippopotamus amphibius*), a new record for this terrace system, with additional material from probable bison (cf. *Bison priscus*) and elephant (*Elephantidae* sp.). The presence of these taxa indicates fully temperate climatic conditions and the occurrence of hippopotamus, a significant biostratigraphical indicator for the British Late Pleistocene, suggests an age for the assemblage within MIS 5e (the Last Interglacial). This would contradict the older MIS 7-6 age for the gravel body that is currently accepted on the basis of deposit mapping and imply a more complex mode of deposition than presently envisaged in the valley.

Vigne JD, Zazzo A, Saliege JF, Poplin F, Guilaine J and Simmons A. 2009. Pre-Neolithic wild boar management and introduction to Cyprus more than 11,400 years ago. Proceedings of the National Academy of Sciences of the United States of America 106(38): 16135-16138.

The beginnings of pig domestication in Southwest Asia are controversial. In some areas, it seems to have occurred abruptly ca. 10,500 years ago, whereas in nearby locations, it appears to have resulted from a long period of management of wild boar starting at the end of the Late Pleistocene. Here, we present analyses of suid bones from Akrotiri Aetokremnos, Cyprus. This site has provided the earliest evidence for human occupation of the Mediterranean islands. Morphological analysis and direct radio-carbon dating of both degraded collagen and apatite of these bones reveal that small-sized suids were living on Cyprus 11,400-11,700 years ago. We demonstrate that these suids were introduced by humans and that, at this early date, their small size must result from island isolation. This sheds light on the early Holocene colonization of Cyprus and on pre-Neolithic Mediterranean seafaring. We further argue that wild boar were managed on the mainland before their introduction to Cyprus (i.e., before the beginning of the Neolithic and at least 1 millennium before the earliest known morphological modifications attributable to domestication). This adds weight to the theory that pig domestication involved a long period of wild boar management that started about the time of the Pleistocene/Holocene transition.

Ecology and Conservation Studies

Bueno CG, Alados CL, Gomez-Garcia D, Barrio IC and Garcia-Gonzalez R. 2009. Understanding the main factors in the extent and distribution of wild boar rooting on alpine grasslands. Journal of Zoology 279(2): 195-202.

Wild boar *Sus scrofa* L. rooting is a large and frequent disturbance, very extended all over the world. However, its impact in some sensitive habitats, such as alpine and subalpine grasslands remains unknown. These grasslands are considered important sites for biological conservation and traditional grazing activities, and are frequently affected by wild boar rootings. In this study, we selected three study sites representing a range of scenarios in Pyrenean alpine and subalpine grasslands, with differing protection status and grazing management. We assessed the extent of wild boar rooting, and determined the main variables that influence their distribution, taking into account the interactions among them. Our results showed that wild boar rooting significantly affected alpine and subalpine grasslands in the Pyrenees especially in protected non-hunting areas (up to 12% of the surface). The distribution of disturbed areas was influenced by a hierarchical suite of variables, among which vegetation, that is certain plant communities, was the most important. The apparent preference for dense grasslands might be associated with its soil depth, soil hardness and diversity of feeding resources. The importance of other variables, such as topography, distance to primary resources or grazing management, was site dependent. A broad understanding of the effects of variables and their relationships provide insights into the actual factors affecting the rooting selection. We hypothesize that the selection of feeding habitat, followed by the conditions of the soil to be uprooted and human management, are the main underlying factors that shape the distribution of wild boar rooting in alpine and subalpine grasslands.

Fedriani JM and Delibes M. 2009. Functional diversity in fruit-frugivore interactions: a field experiment with Mediterranean mammals. Ecography 32(6): 983-992.

Using field seed sowings, we assessed how four mammal species (*Meles meles*, *Vulpes vulpes*, *Sus*

scrofa, and *Oryctolagus cuniculus*) influenced seed germination in three fleshy-fruited Mediterranean shrubs (*Corema album*, *Pyrus bourgaeana*, and *Rubus ulmifolius*). We predicted that gut passage and removal away from mother plants would enhance the quantity, speed, and asynchrony of seed germination. Results showed that percent germination was altered by gut passage, but that the magnitude and even the direction of such effects varied according to plant and disperser species. Likewise, dispersal away from mother plants affected the percentage and germination speed in some species but not others. Gut passage increased asynchrony of germination in *Rubus* and *Pyrus*, and removal from the mother plant increased asynchrony in *Rubus*, which likely enhances plant fitness in unpredictable environments. Gut passage generally had a stronger effect on germination than removal away from mother plants, but for some species both factors were similarly influential. Therefore, the combined effects of both seed dispersal services varied individually among fruit and frugivore species, leading to unusually high functional diversity in this seed dispersal mutualism.

Hayes R, Riffell S, Minnis R and Holder B. 2009. Survival and Habitat Use of Feral Hogs in Mississippi. *Southeastern Naturalist* 8(3): 411-426.

Sus scrofa (Feral Hog) can cause extensive damage to agricultural crops and native vegetation, is a potential disease vector, and competes with other wildlife for food resources. Without site-specific information about survival and habitat use, habitat management and control efforts may not be effective. We examined home-range size, habitat use, and survival of 29 Feral Hogs in central Mississippi using radio telemetry. Dry-and wet-season survival rates were 80.8% and 41.4%, respectively. Hunting (primarily during the wet season) was the major cause of mortality. Dry-season home ranges were larger (6.4 km²) than wet-season home ranges (3.0 km²). During the dry-season, Feral Hog home ranges (2nd-order selection) were associated with dense vegetation types (seasonally flooded old fields, old fields, and managed openings). During the wet season, old fields and agricultural fields were selected, but seasonally flooded old fields and managed openings were not. Within home ranges (3rd-order selection), hogs selected old fields and managed openings during the dry season. All habitats were used randomly within home ranges during the wet season. Flooding of preferred habitats, changes in food availability, and hunting pressure likely caused these changes in habitat use and home-range placement.

McShea WJ, Stewart C, Peterson L, Erb P, Stuebing R and Gimán B. 2009. The importance of secondary forest blocks for terrestrial mammals within an Acacia/secondary forest matrix in Sarawak, Malaysia. *Biological Conservation* 142(12): 3108-3119.

With the rapid conversion of tropical forests in Asia to plantation forests for timber or biofuel production there is a need to determine if these forests serve any viable role in wildlife conservation. We used infrared trip cameras to survey for large terrestrial mammals within an Acacia/secondary forest matrix being created for pulpwood production in Sarawak, Malaysia. We detected at least 27 species of mammals within the matrix and 18 species were detected in both Acacia and secondary forest. Using occupancy modeling to determine important covariates for seven mammal species within the project area, six of these species were sensitive to forest type, and most were sensitive to the amount of secondary forest within 1 km of the sample point. For four species (sun bear, *Helarctos melayanus*; common porcupine, *Hystrix brachyura*; mousedeer, *Tragulus* spp.; and pig-tailed macaque, *Macaca nemestrina*), the mean distance of detection from large secondary forest blocks was significantly closer than expected from the distribution of sample points. Most species used Acacia forest less frequently than sec-

ondary forest, possibly for transit or foraging, with the exception of bearded pigs (*Sus barbatus*), sambar (*Rucervus unicolor*), and civets which were more common in Acacia stands. The amount of secondary forest preserved within forest plantations seems to be the best measure of conservation potential for these industrial forests. Forest plantations can provide a conservation value if managed properly and those retaining significant amounts of secondary forest should be eligible for a base level of certification as they comprise a significant portion of the landscape in this region.

Nogueira SLG, Nogueira SSC and Fragoso JMV. 2009. Ecological impacts of feral pigs in the Hawaiian Islands. Biodiversity & Conservation 18(14): 3677-3683.

The foraging habits of exotic ungulate species can directly and indirectly affect native plant and animal distribution and abundance patterns. Most of the studies on feral pig interactions with other biota in the Hawaiian Islands have been published as difficult to access reports to governmental and nongovernmental organizations, graduate student theses, and a few in peer reviewed journals. In this paper we discuss the origins of pig introductions to Hawaii, their feralization process, population expansion, and interactions with native and non-native biota. We also consider the environmental effects triggered by pigs on local ecosystems and biotic communities. Feral pig activities can reduce the abundance of native plant species, enhance conditions for the establishment of invasive non-indigenous plants, and perhaps indirectly negatively impact native forest bird species. Pig foraging and traveling patterns may also lead to physical alteration of ecosystems by increasing soil erosion that may lead to watershed degradation. However, much remains to be learned about the strength and significance of aforementioned interactions and their long-term effects on Hawaiian biota and ecosystems due to some confounding events. Elucidating the dynamics and long-term ecological effects generated by pigs is a crucial step towards increasing our understanding of and more effectively managing biotic interactions.

Reyna-Hurtado R. Rojas-Flores E. Tanner GW. 2009. Home range and habitat preferences of white-lipped peccaries (*Tayassu pecari*) in Calakmul, Campeche, Mexico. Journal of Mammalogy 90(5): 1199-1209.

The white-lipped peccary (*Tayassu pecari*) is a neotropical ungulate that forms some of the largest groups living in dense tropical forest. Populations of this species have declined throughout Mesoamerica during the last 50 years at alarming rates. Home-range and habitat preferences of this species have been documented in Brazil and Costa Rica for humid tropical forest. Here we studied home-range features and habitat preferences of white-lipped peccaries; for a seasonally dry tropical forest of the Yucatan Peninsula-the Calakmul Biosphere Reserve-where water and food can be temporarily scarce or even absent. By using radiotelemetry and direct observations for 18 months of individuals in 4 groups, we documented some of the largest home ranges reported for some of the smallest group sizes documented for this species. Dry-season home ranges were constrained to the close vicinity of a few available water sources, whereas during the rainy season peccary groups were more mobile and traversed long distances. Compositional analyses of habitat preferences indicated that groups preferred ponds and Medium Sub-Perennial Forest in combination with Low Flooded Forest, whereas the least preferred was the Dry Forest. Apparently, the combination of ranging over large areas to access widely dispersed resources while living in smaller groups and sharing space allows white-lipped peccaries to survive in Calakmul.

Sabrina S, Jean-Michel G, Carole T, Serge B and Eric B. 2009. Pulsed resources and climate-induced variation in the reproductive traits of wild boar under high hunting pressure. Journal of Animal Ecology 78(6): 1278-1290.

Identifying which factors influence age and size at maturity is crucial for a better understanding of the evolution of life-history strategies. In particular, populations intensively harvested, hunted or fished by humans often respond by displaying earlier age and decreased size at first reproduction. Among ungulates wild boar (*Sus scrofa scrofa* L.) exhibit uncommon life-history traits, such as high fertility and early reproduction, which might increase the demographic impact of varying age at first reproduction. We analysed variation in female reproductive output from a 22-year long study of an intensively hunted population. We assessed how the breeding probability and the onset of oestrus responded to changes of female body mass at different ages under varying conditions of climate and food availability. Wild boar females had to reach a threshold body mass (27-33 kg) before breeding for the first time. This threshold mass was relatively low (33-41% of adult body mass) compared to that reported in most other ungulates (about 80%). Proportions of females breeding peaked when rainfall and temperature were low in spring and high in summer. Climatic conditions might act through the nutritional condition of females. The onset of oestrus varied a lot in relation to resources available at both current and previous years. Between none and up to 90% of females were in oestrus in November depending on the year. Past and current resources accounted for equivalent amount of observed variations in proportions of females breeding. Thus, wild boar rank at an intermediate position along the capital-income continuum rather than close to the capital end where similar-sized ungulates rank. Juvenile females made a major contribution to the yearly reproductive output. Comparisons among wild boar populations facing contrasted hunting pressures indicate that a high demographic contribution of juveniles is a likely consequence of a high hunting pressure rather than a species-specific life-history pattern characterizing wild boar.

Siemann E, Carrillo JA, Gabler CA, Zipp R and Rogers WE. 2009. Experimental test of the impacts of feral hogs on forest dynamics and processes in the southeastern US. Forest Ecology and Management 258(5): 546-553.

The foraging activities of nonindigenous feral hogs (*Sus scrofa*) create widespread, conspicuous soil disturbances. Hogs may impact forest regeneration dynamics through both direct effects, such as consumption of seeds, or indirectly via changes in disturbance frequency or intensity. Because they incorporate litter and live plant material into the soil, hogs may also influence ground cover and soil nutrient concentrations. We investigated the impacts of exotic feral hogs in a mixed pine-hardwood forest in the Big Thicket National Preserve (Texas, USA) where they are abundant. We established sixteen 10 m x 10 m plots and fenced eight of them to exclude feral hogs for 7 years. Excluding hogs increased the diversity of woody plants in the understory. Large seeded (>250 mg) species known to be preferred forage of feral hogs all responded positively to hog exclusion, thus consumption of *Carya* (hickory nuts), *Quercus* (acorns), and *Nyssa* seeds (tupelo) by hogs may be causing this pattern. The only exotic woody species, *Sapium sebiferum* (Chinese tallow tree), was more than twice as abundant with hogs present, perhaps as a response to increased disturbance. Hogs increased the amount of bare soil by decreasing the amounts of plant cover and surface litter. Plots with hogs present had lower soil ON, possibly due to accelerated rates of nitrogen mineralization. These results demonstrate that hogs may influence future overstory composition and reduce tree diversity in this forest. Management of hogs may be desirable in this and other forests where large-seeded species are an important component of the eco-

system. Further, by accelerating litter breakdown and elevating nitrogen in the soil, hogs have the potential to impact local vegetation composition via nitrogen inputs as well.

Spear D and Chown SL. 2009. Non-indigenous ungulates as a threat to biodiversity. Journal of Zoology 279(1): 1-17.

Non-indigenous ungulate species pose a problem for conservation. They can be socially and economically valuable, but are also potentially harmful to biodiversity. Therefore, their introduction requires an explicit assessment of risk relative to benefit. To conduct such risk assessments, information regarding the impacts of non-indigenous ungulates on biodiversity is required. Here, we review the available evidence for the biodiversity impacts of non-indigenous ungulates. Hybridization, exploitation and apparent competition, vegetation impacts, predation, facilitation, trophic cascades and soil system functioning were assessed using a hierarchical set of criteria for the strength of the evidence. Strong evidence was lacking for risks posed by competition. Numerous reports exist of hybridization in captivity between ungulate species that normally do not co-occur, but conclusive evidence for introgression in the wild was restricted to one case. Strong evidence (using exclosure experiments) for the impacts of introduced ungulates on vegetation structure and composition was found and in some cases introduced ungulates caused the extirpation of plant species. Predation by *Sus scrofa* is a substantial threat to island faunas and systems, and impacts on soil system functioning elsewhere have also been found. Facilitation by ungulates has been shown to be substantial in promoting invasive plant species. By contrast, little evidence exists for apparent competition. The largest impacts from introduced ungulates are likely to be in cases where they perform novel functions in the new environment. However, to determine which types of impacts are likely to be most problematic, further evidence is required, ideally from well-designed field experiments.

Suarez E, Morales M, Cueva R, Bucheli VU, Zapata-Rios G, Toral E, Torres J, Prado W and Olalla JV. 2009. Oil industry, wild meat trade and roads: indirect effects of oil extraction activities in a protected area in north-eastern Ecuador. Animal Conservation 12(4): 364-373.

Starting in 1994, a wholesale wild meat market developed in north-eastern Ecuador, involving Waorani and Kichwa people in the area of influence of a road built to facilitate oil extraction within Yasuni National Park. Between 2005 and 2007, we recorded the trade of 11 717 kg of wild meat in this market, with pacas *Cuniculus paca*, white-lipped peccaries *Tayassu pecari*, collared peccaries *Pecari tajacu* and woolly monkeys *Lagothrix poeppiggi* accounting for 80% of the total biomass. Almost half of the wild meat brought to the market was transported by dealers for resale at restaurants in Tena, a medium-sized town 234 km west of the market. Prices of wild meat were 1.3-2 times higher than the price of meat of domestic animals, suggesting that it is a different commodity and not a supplementary protein source in the urban areas where it is consumed. The actual price of transportation between the local communities and the market was a significant predictor of the amount of meat sold in Pompeya. Based on this relationship the Waorani hunters sold exceptionally larger amounts of wild meat than would be expected if they would not have the transportation subsidies provided by the oil companies. Although the scale of this wild meat wholesale market is still relatively small, its dynamic reflects the complex interactions that emerge as the overriding influence of oil companies or other private industries modify the culture and subsistence patterns of marginalized indigenous groups, increasing their potential impacts on wildlife and natural ecosystems.

Tejeda-Cruz C, Naranjo EJ, Cuaron AD, Perales H and Cruz-Burguete JL. 2009. Habitat use of wild ungulates in fragmented landscapes of the Lacandon Forest, Southern Mexico. Mammalia 73(3): 211-219.

Habitat use of five ungulate species was assessed in two fragmented sites in the Lacandon Forest, Southern Mexico. Differential habitat use was expected according to the habitat requirements of each species. Repeated track counts were carried out from September 2005 to December 2006 along 19 line transects totaling 683 km, obtaining 2271 ungulate records. We found that Baird's tapir and the white-lipped peccary are actually rainforest specialists avoiding disturbed habitats in the Lacandon Forest, while the red brocket deer, the collared peccary, and the white-tailed deer show different degrees of success in using habitat mosaic derived from human activities. Given that fragmentation patterns have an effect on habitat use of ungulate species in our study area, more information about the effects of landscape configuration on the distribution and abundance of those species is needed. In order to favor conservation of the ungulate species array in the Lacandon Forest, we recommend enforcement of mature rainforest protection and maintenance of heterogeneous landscapes in human settlements through traditional agricultural practices, agroforestry, and intensive pastureland management.

Thurfjell H, Ball JP, Ahlen PA, Kornacher P, Dettki H and Sjoberg K. 2009. Habitat use and spatial patterns of wild boar *Sus scrofa* (L.): agricultural fields and edges. European Journal of Wildlife Research 55(5): 517-523.

Rapidly increasing populations of wild boar in Sweden and Europe cause much damage to crops, and there is a critical need for more knowledge about their habitat utilization, especially of agricultural fields. In our study, we first assess the spatial pattern of damage in relation to the edges of agricultural fields. Next, with the aid of global positioning system collars, we studied the pattern of movement of wild boar on agricultural fields. Finally, in order to understand the role of agricultural fields, we studied how habitat selection may vary throughout the year. We found edge effects on damage patterns in agricultural fields. During winter and spring, we found wild boar not only to follow edges, but also to move along narrow landscape elements within agricultural fields. In our habitat analysis, we found strong avoidance of exposed agricultural fields throughout the year, but significantly less when crops are ripe.

Weeks P and Packard J. 2009. Feral Hogs: Invasive Species or Nature's Bounty? Human Organization 68(3): 280-292.

Invasive species have been identified as an international conservation crisis. Federal land managers have been mandated to control invasive species on their lands and to restore native species. Such action can have consequences for local communities that have incorporated the non-native species into their culture and economy. Previously managed by local stockmen as free-ranging livestock, feral hogs are now perceived by conservation professionals and advocates as an invasive species that threatens native plants and animals. We use the public scoping process associated with a proposed feral hog (*Sus scrofa*) management plan for a National Park Service managed biological preserve to examine how the scientific conceptualization of hogs as an invasive species undermines traditional claims to natural resources. We then offer some potential models of how elements associated with traditional stockmen culture might augment scientific management.

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The newsletter of the IUCN/SSC Wild Pigs, Peccaries and Hippos Specialist Groups (previously Asian Wild Pig News)

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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 long-term conservation of wild pigs, peccaries and hippos and, where possible, the recovery of their populations to viable levels.

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

Within the Suborder Suiformes, pigs belong to the Family Suidae, peccaries to the Family Dicotylidae and hippopotamuses to the Family Hippopotamidae.

This newsletter is electronically available at:

<http://data.iucn.org/themes/ssc/sgs/pphsg/Suiform%20soundings/Newsletter.htm>

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