# Suiform Soundings

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## **PPHSG Newsletter**





This newsletter is electronically available at: http://iucn.org/ themes/ssc/sgs/pphsg/home.htm

## **Suiform Soundings**

is the newsletter of the IUCN/SSC Pigs, Peccaries, and Hippos Specialist Group (PPHSG). The newsletter is sponsored by The Nature Conservancy-East Kalimantan Program and the Center for International Forestry Research







Photo front page: Recently, a cleaning symbiosis between the Southern Ground Hornbill *Bucorvus leadbeateri* and the African Warthog *Phacochoerus aethiopicus* was discovered and photographed in the Mabula Private Game Reserve, S. Africa. Photo by Hendri C. Coetzee

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## Editorial—Working towards a new PPHSG Action Plan

Following the publication of issue 5(2) of Suiform Soundings, the PPHSG discussed using the newsletter to invite regional groups to contribute data on each species (distribution, threats, conservation programs etc.). We have already received a lot of this information in previous issues of the newsletter, which provides a basis. But there is a lot more information available that we do not yet have. We have come up with various different approaches and still need to work out the best way to do this.

A first step would be to identify would-be respondents. We could give each of these the relevant species' chapters (including the range maps) of the 1993 Action Plan. The idea here is to provide a simple summary of what we knew then, so that respondents could use this as a guide for providing any important new information and new or updated recommendations for future research and conservation action.

Respondents could also be invited to correct, amend and update the existing chapters which would result into a collectively amended and updated Plan. However, the new Action Plan would not simply be an updated version of the original. There is a considerable amount of new information: several new species have been described since 1993, and there have been various insightful field studies on ecology and conservation threats.

One option would be to publish updated species' chapters electronically, either in Suiform Soundings or as stand-alone documents, as an additional exercise to producing a new format Action Plan. SSC requires that Action Plans are published in book form, but we consider it important to have online information as well.

We like the idea of publishing new 'species' chapters' as these are completed, though this would presumably mean that we'd have to set separate and different deadlines for each species' chapter in order to spread publication of these chapters over the whole development period. This may or may not be a problem, but it is one that might invoke difficult and (potentially) unequal decisions. For these reasons we would like to suggest that

Following the publication of issue 5(2) of Suiform Soundings, the PPHSG discussed using the newsletter to invite regional groups to contribute data on each species (distribution, threats, conservation programs etc.). We have already received a

> One of the ideas to elicit information is to use questionnaires requesting specific information (georeferenced sighting records, threat records, etc.). As any such returned questionnaires are likely to contain data that are interesting and important, but which are unlikely to be reiterated in any detail in the final species' chapters, we will offer to publish new information received in returned questionnaires. This would likely be a great added inducement to the chances of their responding if their particular 'snippets' of information were likely to be published.

> The questionnaires need to be designed in such a way that important new data can be lifted out and reproduced in new 'briefly' sections; i.e. "New information on....." (e.g. categories relating to 'taxonomy', 'distribution', 'ecology', 'behaviour', 'threats' or whatever), that are published as 'acrossspecies' notes, duly accredited to source informants. By these means, it wouldn't matter if contributors didn't have any new data on any particular species or heading category, and we could just publish whatever new 'snippets' we receive in whatever heading categories might apply at the time of issue. The key will be to design these questionnaires well in a way that entices respondents to spend half an hour providing their crucial inside information. This will require translation in different languages to cater to the needs of local researchers. This in return, will require local coordinators in countries or regions with their own language.

> Over the next few months we hope to start this initiative, by identifying regional and country coordinators, developing a timing and method framework, and prepare digital chapters of the 1993 Plan and the questionnaires. We look forward to your cooperation in this important conservation needs assessment and planning exercise.

Erik Meijaard and William Oliver

## **Tribute to Dr. Keith Eltringham**

"During the time when I was living and working in Queen Elizabeth National Park in Uganda, hippos were an inescapable part of my life... I became used to falling asleep to their accompanying grunts and snorts and sometimes to be awoken by the sound of munching from one that had wandered into my garden... I soon fell under the sway of these irascible and dangerous, yet loveable, creatures..."

Dr. Keith Eltringham, Hippos

On January 19, 2006, the common hippo community lost one of it's leaders. Dr. Eltringham was a true hippo expert, publishing *The Hippos: Natural History and Conservation* in 1999, drawn in large part from his own research and experiences in Uganda and throughout Africa. Although it's clear that hippos exert a large force within an ecosystem, documenting the effects of hippos at the ecosystem or community level is challenging. Dr. Eltringham's research was one of the first that documented the ecological role that common hippos play within the herbivore community. Dr. Eltringham also served as the Chair of the Hippo Specialist SubGroup for many years and was one of the driving forces behind the first IUCN Action Plan and first population assessment for common hippos, published in 1993.

Dr. Eltringham was a dedicated mentor to many students worldwide, with particular focus on facilitating growth and capacity building in developing conservation communities. He was the director of the Nuffield Unit of Tropical Animal Ecology in Uganda for six years, and then was appointed as Chief Research Officer for Uganda National Parks. He served as an associate editor on the African Journal of Ecology (then the East African Wildlife Journal) for more than twenty years. Dr. Eltringham also spent over 30 years as a lecturer in wildlife ecology at the University of Cambridge.

Dr. Eltringham was also a pioneer of aerial survey of animal populations, first waterfowl in Gloucestershire and later African mammals. This work began in the late 1950s when - trained in zoology and aviation - he was engaged as a "pilot-biologist" for the Wildfowl Trust at Slimbridge, the conservation organization founded by the ornithologist and artist Peter Scott in 1946. One of his lasting contributions, as well as his passion, was his innovative aerial census techniques. His census efforts were critical in documenting and raising awareness of the rampant poaching during Idi Amin's rule.

The IUCN Hippo Specialist SubGroup and the hippo community worldwide is indebted to Dr. Eltringham for his dedication, passion, and expertise.

## Peccary workshop, Ilhéus, Brasil

Dear peccary colleagues

The peccary sub-group of the IUCN PP&H Specialist Group is organizing a workshop that will be held during the **VII International Meeting on Wildlife management in Amazonian and Latin America,** Ilhéus (Bahia, Brasil), September 3 – 7, 2006. <u>www.viicongresso.com.br</u>

## The goal of this workshop is to strengthen the community of researchers and people interested in peccaries and to advance forwards towards the conservation of peccaries.

The specific objectives of this workshop are a) have an update about the diverse studies and projects that are currently being developed, b) set priorities for future research relevant for peccary conservation and to c) improve the efficiency of future peccary field studies.

The workshop will take 4 hours and will consist of:

<u>First section:</u> Presentations on:

## An update on activities and goals of the Mayor Programmes on Peccaries

These are long-term, multi-institutional and multi-purpose programmes

1) Priority Setting Programme for White-lipped Peccary

2) Peccary Pelt Certification Programme

3) The EU INCO Peccary Programme (To be confirmed)

Second section:

Presentations and group work on:

## a) Update on information necessary for the conservation of peccaries

Identification of where we are in terms of studies and projects related with the conservation of peccaries: what we know so far, what is being done currently, what are the priorities for future research.

## b) Review of field methodologies for the study of peccaries

Analysis of diverse methods that have been used to study peccaries in the field. Efficiency of different methods and technologies, advantages and disadvantages. Recommendations for future studies.

As results of the workshop we pretend to have:

- List of ongoing projects and researches
- Contact Information of peccary researchers
- Identified research priorities

Recommendations for field studies methodologies

## **Pre-workshop collaboration**

To have an efficient use of the time and obtain maximum benefits for everybody, we need preworkshop collaboration of people working with peccaries, regardless of their plans to assist to the workshop. In this regard, we will soon be sending emails asking for specific information: Mariana Altrichter will be doing the update on projects and studies dealing with the conservation of peccaries, and Rafael Reyna will be compiling information on field studies methodologies.

Please send this invitation to everyone you know who may have interest in participating in this project. Results of the workshop will be distributed to all the people who collaborate sending information.

Thanks very much, and we look forward to seeing you in the workshop,

Richard Bodmer, Andrew Taber, Mariana Altrichter, Rafael Reyna

Estimados pecariologos,

El sub-grupo pecaríes del grupo de UICN esta organizando el taller pecaríes que se llevará a cabo durante el **VII Congreso Internacional sobre Manejo de Fauna Silvestre en la Amazonía y América Latina**, que ocurrirá en Ilhéus (Bahia, Brasil) del 3 al 7 de septiembre de 2006 <u>www.viicongresso.com.br</u>

La meta del taller es fortalecer la comunidad de investigadores e interesados en pecaríes y avanzar hacia adelante en la conservación de pecaríes.

El objetivo específico de este taller es difundir los diversos estudios y proyectos que se están llevando a cabo, actualizar la información existente e identificar la que es prioritaria obtener en futuras investigaciones, y compartir nuestras experiencias de campo con el fin de hacer las futuras investigaciones más eficientes.

El taller durará 4 horas y se harán las siguientes actividades:

Primera sección:

Presentaciones sobre:

## Actualización de actividades y metas de los Programas Mayores de Pecaríes

Estos son programas de larga duración, multi-institucionales y multi-propósitos.

- 1) Priority Setting Programme for White-lipped Peccries
- 2) Peccary Pelt Certification Programme
- 3) The EU INCO Peccary Programme (A confirmar)

## Segunda sección:

Presentaciones y trabajos grupales sobre:

a) Actualización de información necesaria para la conservación de pecaríes Identificación de dónde estamos en términos de estudios y proyectos relacionados a la conservación de pecaríes: que conocemos hasta ahora, que se está haciendo actualmente, cuales son las prioridades para investigaciones futuras.

## b) Revisión de metodologías para investigación de pecaríes

Recopilación de los diversos métodos que se han aplicado en el estudio de pecaríes en campo. Eficiencia de los métodos, tecnologías, ventajas y desventajas. Recomendaciones para futuros estudios.

## Como resultado del taller pretendemos obtener:

- Lista de proyectos e investigaciones actuales
- Información de contacto de los investigadores de pecaríes
- Identificación de prioridades de investigación

Recomendaciones para métodos de estudios de campo

## Colaboración pre-taller

Para poder ser eficientes en el manejo del tiempo del taller y sacar máximo beneficio para todos, necesitamos de la colaboración pre-taller. Esta colaboración la necesitamos de todos aquellos que están trabajando con pecaríes, independientemente de sus planes para asistir al taller. Por esto les estaremos enviando mensajes pidiendo información específica. Mariana Altrichter realizará la actualización de proyectos y estudios relacionados con la conservación de pecaríes y Rafael Reyna estará a cargo de recopilar información sobre metodologías de campo.

Por favor difundan este mensaje a todos aquellos que conozcan puedan tener interés en participar en esta actualización. Los resultados del taller serán distribuidos entre todos los que colaboraron enviando información.

Desde ya muchas gracias y esperamos verlos a todos en el taller,

Richard Bodmer, Andrew Taber, Mariana Altrichter, Rafael Reyna

Prezados pesquisadores de taiassuídeos,

O sub-grupo de pecarídeos do grupo de UICN está organizando um workshop de taiassuídeos que será realizado durante o **VII Congresso Internacional sobre Manejo de Fauna Silvestre na Amazônia e América Latina**, que ocorrerá em Ilhéus (Bahia, Brasil) de 3 a 7 de setembro de 2006 <u>www.viicongresso.com.br</u>

A meta desse workshop é fortalecer a comunidade de pesquisadores e interessados em taiassuídeos e avançar na conservação desses animais.

O objetivo específico deste workshop será difundir os diversos estudos e projetos que estão sendo realizados, atualizar a informação existente e identificar o que é prioritário obter em pesquisas futuras, e compartilhar nossas experiências de campo com o intuito de torná-las mais eficientes.

O workshop terá a duração de um (01) dia completo, com as seguintes atividades: <u>Manhã:</u>

Apresentações sobre:

## Atualização de atividades e metas do Mayor Programmes on Pecaríes

Estes são programas de longa duração, multi-institucionais e multi-propósitos.

- 1) Priority Setting Programme for White-lipped Peccary,
- 2) Peccary Pelt Certification Programme
- 3) The EU INCO Peccary Programme (a confirmar).

Tarde:

Apresentações e trabalhos grupais sobre:

## a) Atualização da informação necessária para a conservação de pecaríes

Identificação de onde estamos em termos de estudos e projetos relacionados a conservação de porcosdo-mato: o que conhecemos até agora, o que se está fazendo atualmente, quais são as prioridades para futuras pesquisas.

## b) Revisão de metodologias para pesquisas com pecaríes

Recopilação dos diversos métodos que são utilizados em estudos de porcos-do-mato no campo. Eficiência dos métodos, tecnologias, vantagens e desvantagens. Recomendações para futuros estudos. **Como resultado do workshop pretendemos obter:** 

- Lista de projetos e pesquisas atuais
- Informação de contato dos pesquisadores de taiassuídeos
- Identificação de prioridades de pesquisa

Recomendações para métodos de estudos de campo

## Colaboração pré- workshop

Para poder sermos eficientes no manejo do tempo do workshop e conseguir extrair o máximo beneficio para todos, necessitamos da colaboração de todos pré-workshop. Esta ajuda nos necessitamos de todos aqueles que estão trabalhando com pecaríes, independentemente de seus planos de participar do workshop. Por isto nos estaremos enviando mensagens pedindo informações específicas. Mariana Altrichter realizará a atualização de informações necessárias para a conservação de pecaríes e Rafael Reyna estará incumbido de recopilar essas informações sobre metodologias de campo.

Por favor, difundam esta mensagem a todos aqueles que vocês conhecem e que possam ter interesse em participar desta atualização. Os resultados do workshop serão distribuídos entre todos os que colaboraram enviando informações.

Desde já agradeço e esperamos vê-los no workshop,

Mariana Altrichter, Richard Bodmer, Andrew Taber, Edsel A. Moraes Jr.

## **Final announcement**

# 6<sup>th</sup> International Symposium on Wild boar (*Sus scrofa*) and on sub-order *Suiformes*

The Ministry of the Interior of the Republic of Cyprus invites you to attend the:

6<sup>th</sup> International Congress of Wild Boar, which will be held at the historic Holy Monastery of Kykkos (a cultural and religious center), located on Troodos Mountains (a biodiversity hotspot), from the **25-28 of October 2006**,

## with the endorsement of the IUCN Invasive Species Specialists Group,

under the patronage of the Minister of the Interior of the Republic of Cyprus Mr. Andreas Christou and the support of his Holiness the Bishop of Kykkos Monastery Nikiforos.

## Scientific Committee:

Prof Mick Clout, New Zealand; Prof. Boguslaw Bobek, Poland; Dr. Peter Heise Pavlov, Australia; Mr. C. Papamichael, Cyprus; Prof. Carlos Fonseca, Portugal; Prof. András Nahlik, Hungary; Prof. Bruno Masala, Italy; Prof. Laura Manca, Italy; Prof. S. Naitana, Italy; Dr Giovanna Massei, UK; Prof. D. Savva, UK; Prof. M. Victoria arruga, Spain; Dr Eric Baubet, France; Prof. Efstathios Tsachallides, Greece; Dr John A. Bissonette, USA; Prof Paul Krausman, USA; Dr Eleftherios Hadjisterkotis, Cyprus

### **Organizing committee:**

Dr Lazaros S. Savvides; Mr. C. Papamichael; Dr G. Koullapis; Dr E. Hadjisterkotis; Mrs. Ageliki Serghiou; Mr. Prodromos Serghiou; Mr. Stergios Palpanis

The coordinator of the meeting is Dr Eleftherios Hadjisterkotis, Officer of the Game and Fauna Service of the Ministry of the Interior of the Republic of Cyprus, former president of the International Union of Game Biologists (1999-2001) and member of the IUCN Invasive Species Specialists Group.

<u>Preregistration</u> 80 Euros for non-students, 60 Euros for students, 75 Euros for accompanying persons, and 20 Euros for transportation from the airport to the conference center, about 2 hours drive from Larnaca airport. After August 30, the registration fees will be 150 Euros for non-students, 100 Euros for students and 120 Euros for accompanying persons. Registration fees cover all administrative cost, printing of conference materials, refreshment breaks, lunches, a full day excursion, etc. Please send a bankers draft payable to: Permanent-Secretary, Ministry of the Interior.

Mail abstracts, computer diskette, registration form, and payment to:

6<sup>th</sup> International Symposium on Wild boar,

Ministry of the Interior,

1453 Nicosia, Cyprus.

**ABSTRACTS:** Participants wishing to present a paper are kindly requested to submit an abstract in English by e-mail to Dr. E. Hadjisterkotis (<u>hjsterkotis@cytanet.com.cy</u>), **no later than September 10**, indicating whether it is for an oral presentation or for a poster. Abstracts submitted for oral presentations are subject to acceptance by the scientific committee. Use 11 or 12 point on a computer in word for windows, single spacing, maximum 1500 characters with spaces, in the following style:

## **Oral presentations:**

Language:

The official language of the symposium will be English. A power point projector and overhead projector will be available.

## **Poster Presentations**

The number of posters is not limited. Posters must fit onto a display of a 100X100 cm. Panels should be pre-prepared so that they can be attached by tacks or tape to the poster boards. Posters are limited to 2 per senior author. Authors are requested to use bold lettering that can be read from a distance 1.5 meters.

## Abstract example:

SUCCES OR FAILURE OF THE INTRODUCTION OF WILD BOAR -Sus scrofa- IN CY-PRUS: a case study on an island

Eleftherios Hadjisterkotis<sup>1</sup>, Peter M. Heise-Pavlov<sup>2</sup>

<sup>1</sup>Ministry of the Interior 1453 Nicosia, Cyprus.<u>hjsterkotis@cytanet.com.cy</u>

<sup>2</sup>PAVECOL, Wildlfe Management Consultants, 211 Turpentine Road, Diwan, via Mossman. 4873 Queensland. Australia.

Wild boar (*Sus scrofa* L.) was introduced in the island of Cyprus in 1990, when five animals were imported from Greece for game farming.....

## ACCOMMODATION

Accommodation according to availability at the graphic mountainous villages of Kampos and Milikouri.

Single room 25 Cyprus pounds.

Double room 15 Cyprus Pounds. Ten Cyprus pounds are about 17 Euros.

## For more information and abstract submission please conduct:

Dr Eleftherios Hadjisterkotis,

Ministry of the Interior, Nicosia, 1453 Cyprus.

Tel. : 00357 99341619 mobile

00357 22867619 Office

E-mail: <u>hjsterkotis@cytanet.com.cy</u>

**TRANSPORTATION:** All participants must arrive at Larnaca Airport. A car will be available to transfer the participants on the 25<sup>th</sup> of October from the airport to their accommodations. A car will be available on the 29<sup>th</sup> of October to transfer the participants back to the airport.

**CLIMATE:** The weather in October is cool but pleasant. Average minimum / maximum temperatures for the month are 15 / 30 °C. Depending on the weather a light sweater or a coat may prove comfortable particularly in the evening. A light raincoat or an umbrella is recommended, although might not be necessary.



## Present status of the Formosan wild boar (Sus scrofa taivanus) in the Kenting National Park, southern Taiwan

Kurtis Jai-Chyi Pei

Institute of Wildlife Conservation, National Pingtung University, 1, Shuehfu Road, Neipu, Pingtung 91201, Taiwan. Email: <u>kcjpei@mail.npust.edu.tw</u>

The Kenting National Park is located on the Hen-tzuen Peninsula in the southernmost part of Taiwan. Intensive agricultural development and tree plantation in the past 300-400 years have resulted in clearance or fragmentation of tropical and subtropical evergreen forests in this area, especially on the eastern and southern part (Fig. 1). Today, as many as 4 to 5 million visitors come to this national park every year, with most of their activities also concentrated in the eastern and southern parts.

The status of larger terrestrial mammals was studied in this national park during 1998 and 2000-2002 using camera traps, which collected information at 78 locations (Pei 2003). A total of 103,852 effective camera working hours were completed and 51 wild boar (*Sus scrofa taivanus*) pictures were taken, which was rela-

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tively low compared to 125 pictures of the sika deer (*Cervus nippon taiouanus*), 395 pictures of the Formosan macaque (*Macasca cyclopis*) and 165 pictures of the gem-faced civet (*Paguma larvata thaliana*). However, their abundance was still higher than in the mature broadleaf forest further north (see Pei and Chiang 2002).

Wild boar occurred in most areas in the Kenting National Park, except in the eastern and southern parts (Fig. 2). Population density is higher in the central part of the Park where more forest edge habitat exists. No change in their abundance was detected between 1998 and 2000-2002..

Although pigs were active at all hours, they were more active in the evening (Fig. 3), which is different from what was found by Pei and Chiang (2002) in the mature broadleaf forest where 88% activities occurred in the daytime hours. This ac-



Above: Camera trap picture of Formosan Wild Boar (Sus scrofa taivanus) taken in the Kenting National Park, Taiwan.

tivity pattern shift is most likely due to the intensive activities of visitors occurring in the daytime.

### References

Pei, K. J. C. and P.J Chiang. 2002. Present statuts and conservation of Formosan clouded leopard and other medium-to-large mammals at Tawu Nature Reserve and vicinities (1). Council of Agriculture, Forest Bureau Cons. Res. Series No. 90-6. 60 pp.

Pei, J. C. 2003. Mammal Survey for the Kengting Ascended Coral-reef Nature Reserve (2/2). Final report to the Taiwan Forestry Research Institute. 18 p.



Fig. 1 (above). Land-use types and zoning of the Kenting National Park.





Fig. 2. The spatial distribution patterns for the Formosan wild boar in the Kenting National Park, based on the number of pictures taken by camera trappers. Darker color indicated areas where more pictures were taken per 1,000 camera working (effective) hours; which is also an index of abundance (Pei 2003).

Fig. 3. Daily activity pattern of the Formosan wild boar (*Sus scrofa taivanus*) in the Kenting National Park. Data were collected by camera trappers during 1998, 2000-2002 (Pei 2003). OI= number of pictures taken/1,000 working hours.

## Management of Bearded Pigs (*Sus barbatus*) in the Planted Forest Zone, Bintulu, Sarawak, Malaysia

Diana J. Junau<sup>1</sup>, C.H. Diong<sup>2</sup> and Robert B. Stuebing<sup>3</sup>

<sup>1,3</sup>Grand Perfect Sdn. Bhd., Conservation Department, No 144, Lot 3430, 1<sup>st</sup> Floor, Parkcity Commerce Square, Jalan Tun Ahmad Zaidi, 97000 Bintulu, Sarawak, Malaysia.

<sup>2</sup>NIE, Nanyang Technological University, 1 Nanyang Walk, Singapore 6376165.

The bearded pig, Sus barbatus barbatus is endemic to Borneo. It reportedly occupies predominately evergreen tropical rainforests, ranging from beaches to upper montane areas, including many offshore islands. However, it appears to be common in a wide variety of both primary and disturbed habitats. Bearded pig populations are highly mobile and demonstrate periodic population eruptions, and mass migrations over long distances have been reported from many parts of Borneo. However, documentation on the actual nature of these movements and the distances involved is still poor, and has tended to remain anecdotal. A Wildlife Master Plan prepared by the Wildlife Conservation Society and the Forest Department Sarawak in 1996 reported that, bearded pig represents at least 70% by weight of all wild meat consumed by rural communities. Despite this important role as a source of rural protein, the bearded pig is also a serious pest of traditional agriculture, e.g., by raiding rural vegetable gardens. Farmers routinely set out large numbers of snares to deter such raids, and at least some of the pigs caught may not be collected.

The bearded pig is protected under the Sarawak Wildlife Protection Ordinance, 1998 (Part IV of the Ordinance – Protection of Wildlife) specifically the Trade Ban (Section 33) that prohibits the hunting or selling of wildlife species or wild meat (excluding fish). However, "rural people" are permitted to hunt the bearded pig for their "own consumption", provided that they do not keep more than 5kg of meat in their possession.

Grand Perfect Sdn Bhd (GP) is the principal contractor for the Forest Department of Sara-wak's Planted Forest Project, in which approximately 40% of 500,000 ha will be developed for

plantation of *Acacia mangium*. It consists of three major river systems, the Kemena, Tatau and Balingian. Within the Planted Forest Zone (PFZ), Grand Perfect has set aside special conservation zones comprising about 150,000 ha including steep lands, river buffers and protected wetlands. A total of 254 longhouses (approx. 5000 families) reside in or near the area of the PFZ. Although about 90% are ethnically Iban, there are settlements of Punan and Beketan peoples comprising the remaining 10%.

Bearded pigs continue to be a major protein source. This free resource is therefore important to the livelihoods of local communities. If pigs disappear or decline, protein replacements will have to be derived from domesticated animals or sourced from markets. Since the relationship between pig hunting, pig ecology, and forest ecology is poorly understood, GP Conservation has begun a long-term investigation of the ecology of Sus barbatus in the PFZ for the purpose of managing local bearded pig populations. This project is being conducted under the supervision of Dr. C.H. Diong of the Nanyang Technological University (NTU), Singapore, in accordance with a Memorandum of Understanding with Grand Perfect Sdn Bhd. Data from skulls, jaws and teeth from pigs killed by local hunters will be used to assess age structure, while the collection of detailed morphometric and reproductive data from carcasses can help to provide some new insights into the population dynamics of this important species.

Current samples of skulls and lower jaws collected from 25 of the 254 longhouses within the PFZ in 2005 total more than 82 complete skulls and about 317 mandibles, representing a current total of 399 bearded pig individuals. Tissue samples are also collected for collaborative genetic studies with NTU.

## **'Oxpecker' ground hornbills: a new symbiotic interaction between the Southern Ground Hornbill and African Warthog**

## Hendri C. Coetzee

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The main objective of this study is to document the symbiotic or, more specifically, cleaning symbiosis between the Southern Ground Hornbill Bucorvus leadbeateri and the African Warthog Phacochoerus aethiopicus. Symbioses between a group of ground hornbills and a group of warthogs were observed at Mabula Game Reserve between 2001 and 2002 (n = 10). The re-introduced group of Southern Ground Hornbills at Mabula Private Game Reserve was partially habituated, due to being hand-reared and later followed by a trained bird-shepherd to protect them from predators. They were followed daily, from first light in the morning until they roosted in the evening. A distance of 5-30 m was always kept from the birds and a pair of 10x50 binoculars used in case the group flew off or moved further than 30 m away. A homemade, portable bird-hide was also used so as not to disturb the warthogs. The warthogs were part of a wild group that occupied a known home range within the study area and always disappeared at the first sight of humans.

The warthogs solicited 6/10 of all interaction, by walking right up to the hornbills, before lying down on their sides to be cleaned. In only 4/10 interactions did the ground hornbills initiate the interaction. Lying on their flanks as opposed to

sitting or standing was preferred by the warthogs in most interactions (8/10). More cleaning occurred around the anterior head and neck than the posterior parts of the warthog's body. Some adult warthogs tolerated the hornbills probing their ears and also around the more delicate areas under their tails. The hornbills never focused on a single area of the warthog's body alone, but moved around the warthog in a circular pattern, pecking at anything that resembled a parasite or insect. It is assumed that ticks, fleas and mites are mostly taken. In 7/10 of the interactions, two or more birds concentrated on a single warthog. One-to-one interactions were only observed between the older, wild male bird that led the group and the dominant female warthog in the group. The hornbills interacted more with adult female warthogs (7/10) than with males (2/10) and immatures (1/10). Minimal aggression was displayed and was observed only once, when a female warthog chased a hornbill away from a piglet before lying back down again. All interactions were recorded during the dry winter months, when food supplies were at their lowest, and between 12h00 and 14h00 in the afternoon. The hornbill-warthog interaction was never observed during any other part of the day or during summer, when food was more abundant.

Since no evidence was found to suggest that this interaction may occur in other areas where ground hornbills and warthogs co-exist, this could mean that the interaction is simply a phenomenon that evolved at Mabula as a result of mutual interspecific curiosity. The quality and quantity of the food source is too poor to guarantee a long-term stable relationship, but it does benefit the warthogs in the sense that they are temporarily rid of unwanted ectoparasites.



## Contraction of bearded pig Sus barbatus distribution in Peninsular Malaysia

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The present distribution of the bearded pig extends from Peninsular Malaysia, Sumatra and Borneo (Groves 2001). Archeological evidence seems to suggest that the bearded pig was fairly abundant and widespread in the Malayan Peninsula (now Peninsular Malaysia and southern Thailand) about 1500 to 2000 years ago (Gibson-Hill 1950). However, the habitat loss especially of the lowland rainforest in the 20<sup>th</sup> century meant contraction in the distribution of many land mammals. According to the IUCN/SSC Pigs, Peccaries, and Hippos Specialist Group Action Plan, bearded pigs were found only in the North central and southern Peninsular Malaysia (Caldecott et al. 1993). These areas refer to Taman Negara National Park area and the southern most state of Johor. Like many other threatened species, little information exists on their actual distribution in Peninsular Malaysia. Field status surveys to determine the distribution and status of the bearded pigs in Sumatra and Malay Peninsula was suggested as priority research in the action plan (Caldecott et al. 1993), but have not been taken up.

Taman Negara is Peninsular Malaysia's premier

national park. At 4,343 km<sup>2</sup>, it is the largest protected area in Malaysia and one of the largest in Southeast Asia. All the endangered large mammals in Peninsular Malaysia are still found in Taman Negara. Since all other protected areas are smaller than 1,000

Figure 1. Locations of the three study sites (orange) in Taman Negara National Park (red) where an intensive camera-trapping study was conducted between 1998 and 2001. km<sup>2</sup>, only Taman Negara is large enough to support viable populations of wide-ranging large mammals such as tigers (Kawanishi *et al.* 2003; Kawanishi and Sunquist 2004).

Herds of bearded pigs were seen in the south of Taman Negara as recently as 1981 (Johns 1983), and this extensive forest block presumably represented an important refuge for the bearded pig (Caldecott et al. 1993). However, the intensive ecological study on tigers jointly conducted by the University of Florida and Department of Wildlife and National Parks (DWNP) between 1998 and 2001 failed to document the presence of the bearded pig in the park (Kawanishi and Sunquist 2004). Motion-triggered remote cameras were deployed at 135 locations throughout the three study sites of ca. 200km<sup>2</sup> each (Figure 1). A total of 4,533 wildlife photographs were collected during 14,054 trap-nights where one trap night was defined as a 24-hour period during which one camera trap was functioning. No photographic capture of bearded pig was registered while three of the most abundant ungulate species in the study sites, wild boar (Sus scrofa), barking deer (Muntiacus muntiac), and tapir



Suiform Soundings



Figure 2. Locations of all the camera-trapping studies carried out in Peninsular Malaysia by Department of Wildlife and National Parks Peninsular Malaysia, Danish Cooperation for Environment and Development, University of Florida, Wildlife Conservation Society, WWF-Malaysia between 1997 and 2005.

(Tapirus indicus) all had more than 500 photographs each. Because the study does not assume the detection probability of 100%, no detection does not necessary mean absence. For example, secondary sign of the critically endangered Sumatran rhinoceros was documented during the despite photographic evidence study no (Kawanishi et al. 2004). Bearded pigs could occur in other parts of Taman Negara or even in the study sites at extremely low densities. Khadijah (1990) reported the presence of the bearded pig in Taman Negara, but no details were given except that S. scrofa was more widespread. Interviews with a few senior rangers at Taman Negara Pahang headquarters in Kuala Tahan revealed no information on S. barbatus (Kawanishi unpubl). There is very little research or any attention paid to any pig species in Malaysia except when they raid crops.

Elsewhere, prior to the 1950s, mass movements and presence of bearded pigs were reported from Hilir Perak District (southern Perak), central to southern Pahang, Pekan District (eastern Pahang), Johor, and Negri Sembilan (Allen 1948; Kempe 1948; Hislop 1949). In 1957, 74% of Peninsular Malaysia was still forested. (Myers 1980). Hilir Perak and Pekan Districts were peat swamp and alluvial riverine forests and the rest of the movement range was mostly lowland (<300m ASL) dipterocarp and riverine forests rich in flora and fauna. By 1972 the forests of Johor and Negri Sembilan were no longer connected and by the late 1980s much of the rich lowland forests in central Johor and south western Pahang were converted to large-scale oil-palm plantations as this area had the highest potential primary productivity (Aiken *et al.* 1982). Only the peat swamp in Pekan and a chain of forest reserves from southern Pahang (Rompin and Lesong) to eastern Johor (Endau Kluang, Endau Kota Tinggi, Gunung Arong, Mersing, Jamaluang, Lengor and Kluang areas) with Endau Rompin State Park in the middle maintain the forest cover today in the region. These are the areas where bearded pigs are still expected to occur.

Other camera-trapping studies on tigers conducted by DWNP, Danish Cooperation for Environment and Development (DANCED), Wildlife Conservation Society and WWF-Malaysia between 1997 and 2005 in 13 study sites of known tiger habitat (Figure 2) covered ca. 1,100 km<sup>2</sup> of various forest types and collectively expended more than 22,000 trap nights (Laidlaw et al. 2000; DWNP/DANCED 2002; Mohd Azlan and Sharma 2003; Wildlife Conservation Society unpubl; Mark Ryan, WWF-Malaysia pers. comm.; Ahmad Zafir, WWF-Malaysia pers. comm.). It also included an additional sampling site of 40 km<sup>2</sup> in central Taman Negara. Of a combined total of over 6,000 wildlife photographs, there was only one photograph of a bearded pig from Lenggor Forest Reserve in Johor (Figure 3; DWNP unpublished data). As the studies focused on priority tiger habitats in the northern forest complex and Taman Negara, the Lenggor was the only sampling site south of the Pahang river, which from the earlier records appeared to be the main bearded pig habitat.

The 24 specimens of bearded pigs collected from Peninsular Malaysia for the phylogenetic study of Southeast Asia wild pigs (Lucchini et al. 2005) were from Gajah Village, Kahang and Jamaluang areas in Johor (Diong Cheong Hoong, Nanyang Technological University, Singapore, in *lit.*). Furthermore, a DWNP ranger in Jamaluang reported sighting of a bearded pig in Endau Rompin Johor (Sandie Choong, DWNP, pers comm.). Mangroves and intertidal mudflats of Pulau Kukup and Tanjung Piai in southwestern tip of Johor also seem to support bearded pigs (<u>http://www.ramsar.org/profile/</u> profiles\_malaysia.htm). A closer look at the remnant forests in Johor is likely to produce more information on their presence. Likewise, interview with DWNP state or district rangers and review of DWNP unpublished reports may reveal further information on their presence in other states as they are often involved in shooting nuisance pigs.

Annual inventory surveys carried out by DWNP in a number of forest blocks rely on secondary sign such as tracks for species identification where pig tracks are not differentiated to the species level. Both pig species are protected game species under the Protection of Wildlife Act (1972) and can be hunted with license for meat or as a measure of pest control. The two species of pigs are again not differentiated by hunters. If indeed the bearded pig is now found only in Johor, special management interventions may be necessary to protect the species from extinction in Peninsular Malaysia. A study to determine the status and distribution of the species is necessary first to clearly identify what further actions may be required.

Although habitat loss and disruption have almost certainly contributed to the bearded pigs apparent rarity in Peninsular Malaysia, competition with wild boar may also be a significant factor. The recent survey of Javan warty pigs *Sus verrucosus* (Semiadi and Meijaard 2006) suggests that there may be competitive exclusion of warty pigs by wild boar. This idea is further supported when one compares the recent data with earlier surveys



Figure 3. Photograph of a bearded pig taken by a camera trap in Lenggor Forest Reserve, Johor in 1999 by Department of Wildlife and National Park Peninsular Malaysia.

of warty pigs and wild boar (Blouch 1983, 1988). Of all the populations of bearded pig, only the Bornean population seems to still be relatively healthy, and it is important to note that they are the only suid on the island.

The only apparent captive population of Peninsular Malaysian bearded pigs seems to be the herd of 7 males and 10 females at Singapore's Night Safari. There are two captive herds of bearded pig in Peninsular Malaysia, 8 individuals at Zoo Taiping and 14 at Zoo Negara in Kuala Lumpur (K. Lazarus & Mohamad Bin Ngah, pers. obs.) but these two herds are all of Bornean origin. The Singapore animals stem from three wild importations totaling 2 males and 2 females in 1991 from Johor. Should further research indicate that a limited reintroduction of captive-bred animals was deemed appropriate as part of a broader conservation plan, the Singapore stock could provide animals for release. At the very least, it is probably advisable that a more robust captive population should be established

Although reintroduction of mammals is often a complex process, the expanding wild population of wild boar and wild boar/domestic pig hybrids in southern England gives an indication that suid reintroductions may be relatively easy. After an absence of 300 hundred years, starting in the 1980s there were a number of escapes from wild boar farms. There now appears to be a breeding population in excess of 300 individuals in 7 counties

throughout southern England (<u>http://</u><u>www.britishwildboar.org.uk/</u>).

Recent taxonomic research suggests that the Peninsular Malaysian population of bearded pigs is genetically the same or very similar to that of Borneo, and that these animals should be subsumed into S. b. barbatus and that S. b. oi should be limited to animals from Sumatra (Lucchini et al. 2005). Distinct body shape differences were consistently observed between the captive herds of Peninsular Malaysian and Bornean animals in Singapore which concur with Mohr's observations of both forms (Mohr 1960). In addition, there seems to be consistently distinct reactions to anesthesia between the two forms, with Bornean animals being more problematic than those of Peninsular Malaysian origin (C. Furley, pers. obs.). If, as it appears, the Peninsular Malaysian animals are distinct from both the Sumatran and the Bornean populations, their situation may be even graver than is suggested here.

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## Diet studies of Bearded Pigs in Kayan Mentarang National Park, Borneo, Indonesia

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The WWF research station in Kayan Mentarang National Park has been working on diet studies for some of the larger mammals in the area since the beginning of 2003.

The purpose of these studies is to find out what these animals consume in the forests of Kayan Mentarang throughout the year, and how this relates to our phenology records. Detailed information on animal diets from other areas in Borneo is rather limited, and often focusses on the impact of Dipterocarp mast fruiting on Bearded Pig populations. In Kayan Mentarang however, Dipterocarpaceae are generally not as dominant as they are in the lowlands of Borneo. The ungulates will therefore often be feeding on other tree fruits, and the availability of these are also subject to fluctuations throughout the year. Bearded Pigs feed on a large variety of substances.

The diet studies are based on the analysis of stomach contents. The stomachs were obtained from animals that were hunted for food by people from Long Alango and Long Tebulo. The animals were hunted in the upper Enggeng area and the vicinity of these two villages. Under the participatory management system of Kayan Mentarang National Park, local communities are allowed to hunt, for personal consumption, as they have been doing here for many decades. The availability of stomachs for this study is therefore dependent on the (fluctuating) hunting activities, since no animals are killed for the purpose of obtaining study material.

The stomach contents were dried in the sun until they were completely dry. The components were then sorted and identified as precisely as possible. Finally each component was weighted with a precision balance. It should be noticed that these results are only preliminary as the studies are still continuing. The correlation between diet and forest phenology in particular needs to be refined. The present results are based on the analysis of 31 stomach contents of Bearded Pigs.

## **Bearded Pig** (*Sus barbatus*)

A very large part of the stomach contents of Bearded Pigs consisted of pulp from nuts, hard fruits fallen from trees. These nuts are usually chewed quite well by the pigs, though a portion of the pulp consisted of larger particles. The skins of these nuts are not digested and can be easily separated from the pulp.

The nuts eaten most often by the Bearded Pigs were found to be the fruits of *Lithocarpus* and *Quercus* trees. The nuts from *Canarium* and other Burseraceae trees were found to be often eaten as well. *Castanopsis* nuts were frequently eaten, but not in large amounts. This is of course during periods when many Fagaceae and Burseraceae fruits are available.

Bearded Pigs in this area show a strong preference for nuts. During periods when few Fagaceae fruits are available the pigs were found to look for other tree fruits. The nuts of *Arenga obtusifolia* are often eaten and serve as an important food source for pigs during periods when other nuts and fruits are scarce. This palm species is common in the area, but it grows mainly along the sides of rivers and streams. The nuts of the wild sago palm (*Eugeissona utilis*) are rarely eaten, probably because of the difficulty to crush their very hard rinds. Other nuts that were found to be frequently eaten include those of *Walsura pinnata* (Mel.)

Dipterocarp nuts were not so often found in the stomachs, but this is more a reflection of the low

availability of these fruits than of diet preferences.

Fleshy fruits were eaten in much smaller volumes. Frequently eaten fruits include various *Artocarpus* fruits and *Garcinia* fruits as well as the fruits from *Ficus* species. Wild bananas were eaten only occasionally.

Small amounts of leaves are eaten throughout the year. These are mainly leaves from herbs and grasses. A particular favourite kind of leaf is from *Selaginella plana* ferns, which was found in nearly all of the stomachs.

Small roots are sometimes eaten, but it is probably not a common component of the pig's diet. Parts of roots were found only in only a few of the stomachs and only in small amounts. Traces of Bearded Pigs digging the earth are a rather common sight in the forest here, in particular along riversides, but also in other sites. However, these pigs were probably not so much digging for roots but more often for earthworms.

The Bearded Pig's diet consists indeed of several faunal components.

Pieces of earthworms were found with several of the pigs. These were slightly chewed before being swallowed. Insects are frequently eaten by Bearded Pigs. Most of these insects were beetles, but centipedes, termites and other insects were also frequently taken. Pieces of insects were found in most of the stomachs. One pig was found to have scavenged on monkey carrion. Large pieces of skin and bone were found in the stomach. Another pig had swallowed a tail of a skink.

Many of the pigs have small residential worms in their stomachs as a kind of parasites. (These worms are usually still alive when opening the stomach). It was observed that not many of the residential worms survive during periods when many *Lithocarpus* nuts are eaten. The high levels of tannin probably cause the release of these worms.

Several pigs had inorganic material in their stomachs. These were pieces of clay, probably swallowed by coincidence while digging, but also small stones and gravel.

## **Juvenile Pigs**

Juvenile Bearded Pigs were found to feed mainly on grasses, mainly Graminae but also a few Cyperaceae. The stomach contents of these juveniles consisted mainly of parts and pulp of grasses and sedges, as well as grass seeds. A very small amount consisted of beetles. These were probably devoured by coincidence while the piglets were eating their grasses.



## **Pygmy Hogs in Southern Nepal (or news at last on the so-called 'Hormel Expedition')?**

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Information on the former distribution range of pygmy hogs (Sus salvanius) is scanty and imprecise. The species' is generally supposed to have occurred throughout the narrow alluvial tract known as the 'terai' and 'duars', which extends south of the Himalayan foothills from northeastern Uttar Pradesh in the west, through southern Nepal and northern West Bengal to northwestern Assam and adjacent parts of extreme south Bhutan. However, the species has never actually been confirmed from any of these areas apart from northern West Bengal, from where it was first described by Hodgson (1847), and northwestern Assam, where it was 'rediscovered' in 1971 (Anon, 1971; Tessier-Yandell, 1971) and from where all subsequent reports have originated (Oliver, 1978, 1980; Oliver & Deb Roy, 1993; Narayan and Oliver, in press).

Nonetheless, there are good reasons for supposing the animals were more widely distributed, and diverse efforts have been made to confirm its presumed former occurrence and/or locate any possibly surviving populations in other areas; e.g. in southern Nepal, north-east Uttar Pradesh and extreme north-west Bihar (Bell, 1986; Griffiths, 1978; Oliver, 1981, 1984, 1985; Rands et al., 1979); and in north-eastern Assam, south-east Bhutan and Arunachal Pradesh (Narayan and Oliver, in press; Oliver, 1981, 1984, 1985, 1989; Oliver et al., 1998, 2001; Pandya, 1990). Although ultimately unsuccessful, most of these efforts were either based on rumours of the species' occurrence or yielded recent contemporary accounts by local informants; especially tribal shikars identified locally as being most knowledgeable about wildlife in each area. Such informants not only often have special names for these animals, but are to provide convincing descriptions that include features (e.g. very short tails) that they are unlikely to be aware of if not through personal encounters. Moreover, the only known habitat of these animals - i.e. secondary succes-

sional, mixed tall grasslands – are characteristic of this whole region since these communities develop on new alluvium laid down by sub-Himalayan tributaries of the Ganga and Brahmaputra Rivers which mark the southern limits of these alluvial tracts.

In other words, there is no reason to suppose these animals did not occur in these areas, and there are various good reasons for assuming they did so, though solid evidence is still wanting. Unfortunately, however, any such evidence is less and less likely to be found given the drastic diminution, fragmentation and continual disturbance of these habitats; all of which factors have also resulted in the systematic extirpation of most recently known populations of these animals throughout their former range in north-western Assam. As a consequence, the probability of finding hitherto unconfirmed populations of these animals elsewhere is extremely low, though any recent historical data pertaining to their likely former occurrence in these areas has assumed greater significance apropos the possibility of future reintroduction projects in protected habitats within and outside north-eastern Assam.

In these circumstances it is somewhat disappointing to report the removal of a long-standing question mark pertaining to a 1964 expedition to Nepal, which had reputedly resulted in the capture of a live pygmy hog. If confirmed, this report was of obvious importance because it would constitute the only known confirmed record of this species in Nepal, and dramatically extend the western limits of its known former range. However, diverse efforts over the past twenty-five years to secure more information about this project proved fruitless until a chance meeting with Dr. Nate Flesness (Director, International Species Inventory System) during a European Association of Zoos and Aquaria (EAZA) conference in August 2005. During this meeting Dr. Flesness mentioned that a retired former colleague was interested in visiting the Pygmy Hog Research and Breeding Centre in Assam as he had taken part in an expedition to Nepal in the early 1960's to try to catch some animals for a proposed captive breeding and research project in the USA!

Enter Joe Mayo, a close friend and associate of (the late) Dr. Ullyses Seal (doyen and former Chair of the Conservation Breeding Specialist Group), who I had the pleasure of accompanying to Assam earlier this year, along with his two sons, Drs. Joseph and Chester Mayo. During this trip I finally heard the story of the 1964 expedition, which was organized by the University of Minnesota with funding support from the Hill Foundation. The Hormel Institute (which manufactures, and owns the world copyright, on the well-known processed meat 'SPAM') leant its name to the expedition through the close personal friendship of senior members of the Hormel and Mayo families, the latter also achieving similar prominence thanks mainly to the equally well known 'Mayo Clinic'. In the early 1950's, Joe's father, Charles W. Mayo, had also been appointed the first US Ambassador to Nepal, where he forged a personal friendship with the King of Nepal. The King subsequently visited the Mayo Family house in Rochester and, when consulted about the proposed expedition, commended a fellow American, Peter Burn, to accompany Joe as a local guide.

The primary purpose of the expedition, which lasted 5 months (i.e. from early January to early June 1964), was to obtain a founder breeding stock of pygmy hogs for captive breeding and biomedical research. If the expedition was successful, it was proposed to export these animals to Boston Zoo, and that any captive-bred progeny from these animals would be transferred to the University of Minnesota for propagation and medical research. News of the arrival of this expedition led to the early acquisition of a small wild-caught piglet (Plate 1), reputed to be a 'sano banel' (the local name for the pygmy hog), and accepted as such in good faith. This animal was purchased in the town of Simri in central south Nepal, and carried with the expedition for the next 12 weeks, before being left on temporary deposit at the National Zoo in New Delhi, where it died two weeks later. Meanwhile, the expedition proceeded on towards Dharan Bazar in extreme south-east Nepal, during which visits were made to grasslands and forest edge habitats forest edge and interviews conducted with local informants in the areas. However, no convincing reports or other evidence of this species existence was obtained. In late March, Joe also met with the Dalai Lama, who expressed considerable interest in the quest and subsequently gifted another live wild pig, this time a sub-adult, to the expedition (Plates 2 & 3). However, this animal, being obviously much too large to be a pygmy hog, was correctly identified as a wild boar (i.e. S. scrofa cristatus) and released with the Dalai Lama's blessing.

Unfortunately, the original piglet (Plate 1) was also an immature *S. scrofa*, not a 'sano-banel', as



Plate 1. Joe Mayo's *S. scrofa* piglet, suspected to be *S. salvanius*.



Plate 2: Body of the Dalai Lama's pig, southern Nepal, March 1964



Plates 3: Head of the Dalai Lama's pig, southern Nepal, March 1964. (photos 2 and 3 courtesy: Joseph Mayo)

is (now) obvious from body proportions, position of the orbit, length of its tail (though barely visible in Plate 1) and other diagnostic features; though the expedition leaders did not have the benefit of any prior personal experience with this species.

At the end of the expedition, Joe collected the preserved skin of this animal from the National Zoo (where the skull had unfortunately been dissolved in quick lime during a well-intended effort to clean and preserve it), which was destined for at the University of Minnesota. In the event, however, Joe stopped over in Frankfurt to meet with Dr. Bernhard Grzimek (former Director of Frankfurt Zoo), who informed him about the work of the local Hoescht Institute, which was also trying to develop mini-pigs for medical research. After visiting the Hoescht Institute, it was decided to deposit the skin there, rather than carry it back to the University of Minnesota. Presumably it's still there.

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## Differentiating between Sus scrofa and Sus verrucosus

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## Introduction

The two pig species on Java (Indonesia) Sus scrofa and S. verrucosus, are externally similar, and it will often be difficult to determine the species when an animal is seen running anyway in the distance. When seen from nearby, the male S. verrucosus is easily distinguished from any others by the presence of warts. These are, however, absent in the female. Compared to S. scrofa, S. verrucosus gives the impression of having a very large, heavy head, at least in adult males (Groves 1981). Males of S. verrucosus are also much larger than females (ca. 90 kg for males as opposed to 45 kg for females). Such pronounced sexual dimorphism is not found in scrofa, where the males weigh about the same as the verrucosus males, but the females are much heavier.

Below I describe various variables that visibly differ between the two pig species of Java, Indonesia, All information has been taken from the literature,

#### Colour

Pelage colouration varies greatly in both species. Generally *verrucosus* appears somewhat reddish, but some individuals look quite black from a distance. The hair on the crown and the mane on the back of the neck are usually a lighter hue, often reddish-orange and occasionally approaching blond. In *verrucosus* of all sexes and ages the hair on the belly is predominantly white or yellowish, contrasting with the darker pelage on the upper part of the body. *S. scrofa* on Java are most often black or grizzled, but reddish-brown ones are sometimes encountered. The mane is usually black and belly hairs are also dark, not contrasting with the pelage above (Blouch 1983).

The individual hairs in *S. scrofa* are of a single type: black with a band or (when worn) tip of yellowish. In *S. verrucosus* there are two hair types intermixed: shorter red or yellow hairs with black tips, and longer black ones (Groves 1981).

The colouration of piglets in the two Javan pig species varies as well. *S. scrofa* piglets are longitudinally striped, black-brown and whitish to fawn; the striping is very conspicuous. In *verrucosus*, on the other hand, the striping of piglets is very faint and will very often be impossible to detect in the field.

#### Tracks

According to Sody (1936) slight differences may exist between the shape of the hoofs of *scrofa* and *verrucosus*, with the latter having more pointed toes, but this needs to be confirmed. Making plaster casts of known tracks of the two species will help in finding out whether the tracks of the two can be reliably distinguished.

### Teeth

The shape of the lower canines in male pigs is an excellent indicator of their specific identity. If a cross section is take near the base, in *S. scrofa* the inferior surface (see Fig. 1) is the narrowest of the three, while in *S. verrucosus* it is as broad as the enamel-less posterior surface (Groves 1981). If the width of inferior surface is expressed as a percentage of the posterior surface, then for *scrofa* this ranges between 61.5 and 109.1 %, and for *verrucosus* it ranges between 113.3 and 161.5 % (Groves 1981).

It should be noted that all these measurements were taken on adult specimens: when it first erupts the canine in *S. scrofa* has a *verrucosus*--like shape.

The canines in females are also distinctive. In *S. scrofa* they are fairly large: the greatest diameter of the upper canine varies between 16.8 and 18.2 mm, of the lower between 14.0 and 17.0 mm, overlapping the male range. In *S. verrucosus* the canines of females are much smaller, the upper

measuring 9.3–11. 5 mm, the lower 7.3–10.0 mm (Groves 1981).

## Skull

The following skull characteristics can be used to distinguish between *scrofa* and *verrucosus* (after Groves 1981).

1. The shape of the preorbital fossa (Fig. 2) is highly characteristic: It is relatively shallow and flat in *S. scrofa*, with sloping borders; in *S. verrucosus* it is very deep and sharply overhung by a thickened shelf of bone postero-superiorly, similarly bordered behind and bordered below by a sharp horizontal crest which runs forward from the zygomatic root and gradually fades anteriorly.

The malar region (=anterior-most end of the zygomatic arch) (Fig. 2) is again highly characteristic. In *S. verrucosus* the malars are inflated and stand out sharply behind the sides of the rostrum; in *S. scrofa* they are not inflated and slope in at an angle to the rostrum. These differences, while more marked in males, are appreciable in females also, and can indeed be detected in infant skulls.



Figure 1. Mandibular canines of males, to show the difference between the *scrofa* group and the *verrucosus* group. Above *Sus verrucosus*. Below: *S. scrofa* (after Groves 1981)



Figure 2. Skulls of *S. scrofa vittatus* (top) and *S. verru-cosus* (bottom).

3. The depth of the zygomatic arch (Fig. 2) below the orbit in *S. scrofa* reaches a maximum of 34 mm in adult males, 32 mm in females; in *S. verrucosus* it has a minimum depth of 40 mm in males, 35 mm in females.

4. The anterior rostrum (Fig. 2) is extremely elongated in *S. verrucosus*. A consequence of this is the greater posterior placement of the infraorbital foramen (Fig. 3): above  $M^1$  in *S. verrucosus*, but above  $P^4$  in *S. scrofa*.

5. The diastema in *S. scrofa* is often absent, and if it exists at all it is rarely above 6 mm long, whereas in *S. verrucosus* it measures 7–13 mm.

Suripto (1987 in Suripto 2002) described another character which can be used to differentiate between both adult and juvenile specimens of *scrofa* and *verrucosus*. The ratio between the width across the mandibular swelling and the width across the points where the nasals, frontals, and maxilla meet is between 1.8 and 2.3 in *S. scrofa* and between 2.5 and 3.3 in *S. verrucosus*.

Sus scrofa vittatus (right) and S. verrucosus (bottom)



## Urea as source of non-protein nitrogen to collared peccary

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### Abstract

Several attempts to produce collared peccary (Tayassu tajacu) in captivity, to provide meat and pelts to the national and international markets, have failed to date because of low economic return, mainly due the use of high priced commercial pig diets. Indeed this species has a digestive physiology more similar to that of ruminants than to that of non-ruminant. Since urea is used on ruminant nutrition in order to decrease production costs, a trial was conducted with six adult collared peccaries to determine the effects of increasing levels of urea as source of non-protein nitrogen. Throughout an acclimatization period the urea level was gradually increased from zero to 20 g of urea per kg of crushed maize grain and salt plus mineral and vitamin premix. Each urea level was fed during seven consecutive days until reach 20g/kg. The animals were weighed and blood samples were collected after the experimental periods of diet urea levels of 0, 10 and 20-g/kg. Serum urea nitrogen concentration increased as the intake of urea in the diet resulted increased (F =4.88, P = 0.02) and a trend of increase on animal performance. These data denote the use of urea by peccaries' fore-stomach micro biota, since no urease is produced by animal tissue, and an advantage to animals. Probably, the microbial action increased the protein supply with this experimental diet containing low level of protein, which resulted in a trend of body weight gain observed in this study. The ability of the collared peccary to utilize urea as source of non-protein nitrogen could decrease production costs in regions where the most commonly used plant protein feeds, such

as soybean meal, are high priced and scarce, and turn on this activity profitable.

Keywords: *Tayassu tajacu*, nutrition, production, captivity.

### Introduction

The collared peccary (Tayassu tajacu) is a favored hunted species in most of its distribution range and represents an important source of income and protein for rural inhabitants of Neotropical countries (Bodmer et al., 1994). While commercial hunting is forbidden in Brazil, wildlife farming is legal and even encouraged by Environmental Governmental the Brazilian Agency (IBAMA) due to the growing demand for native meat in the country's biggest cities. However many attempts to produce this species have commercial failure to date because many breeders lack knowledge of the behavioral and physiological characteristics of the species and also do not employ good management practices, that are crucial with this type of development, especially to decrease production expenses (Nogueira-Filho and Nogueira, 2004).

The collared peccary has a fore-stomach with active fermentation (Langer, 1979; Carl and Brown, 1983; Cavalcante-Filho et al., 1998). And despite the ability of peccaries to digest low quality roughage (Gallagher et al., 1984; Comizzoli et al., 1997; Nogueira-Filho, 2005), many collared peccary farmers use commercial pig diets which substantially increase everyday expenses (Nogueira-Filho and Nogueira, 2004). Additionally, the daily nitrogen requirement of this species is far lowest than the pig ones, only around 0.8 g of N per kg

Urea	Ingredients
level	
0 g/kg	Experimental diet <sup>1</sup>
10 g/kg	Experimental diet plus 10.0 g/kg of urea
20 g/kg	Experimental diet plus 20.0 g/kg of urea

Vitamin-mineral premix

Table1. Ingredients used in the collared peccaries experimental diets.

<sup>1</sup> Experimental diet comprised by crushed maize plus 20 g/kg of NaCl plus 1 g/kg of mineral premix and 1 g/kg of vitamin premix. The mineral premix had the following composition: iron, 180 g; cuprous, 20 g; cobalt, 4 g; manganese 80 g; zinc 140 g; iodine, 4 g. While the Vitamin Premix had the following composition: vitamin A, 1,200,000 I.U.; vitamin D<sub>3</sub>, 1,500,000 I.U.; vitamin E, 1,500,000 I.U.; vitamin B<sub>1</sub>, 2 g; vitamin B<sub>2</sub>, 4 g; vitamin B<sub>6</sub>, 4 g; vitamin B<sub>12</sub>, 20,000 mg; calcium pantotenate, 15 g; biotin, 0.10 g; vitamin K<sub>3</sub>, 3 g; folic acid, 0.6 g; nicotinic acid, 20 g; Zn bacitricin, 20 g; metionine, 100 g; L-lisine, 300 g; coline clorine, 100 g, BHT, 10 g; selenium 0.10 g.

of metabolic weight (Carl and Brown, 1985). Langer (1979) proposed that the microbial protein synthesized in the fore-stomach of the collared peccaries could furnish a portion of this requirement. Thereafter, Carl and Brown (1983) found a substantial protozoan population in the peccary's fore-stomach.

No studies have already been done to reveal the importance of microbial protein synthesis within the fore-stomach of the collared peccary. Carl and Brown (1985), however, studying the protein requirements of this species, suggested that the high digestibility of crude protein and the low protein requirements supports the evidence that the collared peccary has a digestive physiology closer to the one of ruminants rather than the one of non-ruminants.

In ruminants the source of nitrogen (N) used by microorganisms for protein synthesis consists of both dietary protein and non-protein N (NPN). This happens because the rumen's bacteria can break down the urea, a source of NPN (Maynard and Lossli, 1969). The urea hydrolyses releases ammonia, which is used for microbial protein synthesis. After that, ruminal microorganisms are harvested by he host and together with the dietary protein that escapes degradation in the rumen, supplies the small intestine with protein for digestion and absorption (Owens and Zinn, 1988). Consequently, ruminants can subsist and produce their own protein without a source of dietary protein. Therefore, the aim of this study was to exam-

of metabolic weight (Carl and Brown, 1985). ine the urea as a source of non-protein nitrogen to Langer (1979) proposed that the microbial protein collared peccary.

## Methods

Captive born and reared collared peccaries were kept in-groups of 14 and 12 in two outdoor enclosures measuring 18 x 20-m each one at the Estação Experimental do Almada of the Departamento de Ciências Agrárias e Ambientais of the Universidade Estadual de Santa Cruz. Animals were fed *ad libitum* a experimental diet composed by crushed maize (582g/kg), wheat meal (400g/kg) and mineral salts (18 g/kg), with 96.3 g digestible protein/kg and 14.1 MJ/kg of digestible energy, and had *ad libitum* access to water.

Six adult male collared peccaries were selected and housed individually in pens with 16 m<sup>2</sup> (2.0 m x 8.0 m). After a 20-day acclimatization period the original diet was changed to one composed by crushed maize grain and 20-g/kg of sodium chloride (NaCl) plus mineral and vitamin premix. Following 15 days the urea level was gradually increased, from zero to 20 g of urea per kg of crushed maize grain and salt plus mineral and vitamin premix (Table 1). Each urea level was fed by all six animals through seven consecutive days.

The water was available *ad libitum*, and in order to avoid animal intoxication, the experimental diets were offered in two meals at 0800 and 1600 and the daily diet consumed was restricted to 25 g per kg of animal live weight, and only 25 g per kg of animal live weight when we reach the level of



Figure 1.The effect on live body weight and serum urea nitrogen of peccaries receiving increasing levels of urea.

## 20 g per kg of urea.

We weighed the animals and collected blood samples in order to evaluate the effects of the addition of urea in the peccary's diet, through the effects on serum urea nitrogen concentration. We collected about 10 ml of blood samples by anterior vena cava puncture in plain vacuteiner tubes on Days 15, 43 and 71, when the animals were receiving 0, 10-g/kg and 20-g/kg of diet urea levels, respectively. Additionally, through the animal weigh gain and feed consumption we determined the feed conversion ratio (FCR): the weight of the feed fed to the animal divided by the weight of animal gain.

The blood samples were centrifuged for 15-20 min at 3000 rpm. The serum was stored at  $-20^{\circ}$ C until required for analysis. This samples were analyzed at the Biomedical Laboratory of the Universidade Estadual de Santa Cruz, on a semi-automated clinical chemistry analyzer -50 Probe UV-visible Spectrophotometer (VARIAN) - using control samples and standards to ensure precision and accuracy on serum urea analyzes. Samples of maize and urea were analyzed for drymatter (AOAC-code 934.01) and total nitrogen

(AOAC-code 976.06) (AOAC, 1990). Gross energy of maize was determined in a Parr adiabatic bomb calorimeter.

Data for peccary performance – weight gain and feed conversion rate – and serum parameters were subjected to ANOVA procedures appropriate for a randomized design using the GLM procedures of SAS and the means were compared using the Tuckey test (SAS 2002). Furthermore, the animals were continually monitored in order to register any behavior change or signal of animal intoxication in reason of the urea use.

## Results

The average daily feed intake was 51.97-g/kg metabolic weight (MBW), 52.71 g/kg MBW and 38.78 g/kg MBW on the urea levels of 0-g/kg, 10-g/kg and 20-g/kg, respectively. Additionally, the maize had 13.76-g N/kg while the urea had 440.0-g N/kg. Those figures outcome an average daily consumes of 0.71, 0.93 and 0.92 g N/ kg MBW on the levels of 0, 10 and 20-g/kg of urea, respectively.

The maize had 20.1 MJ/kg of gross energy on dry matter basis and, according to Nogueira-Filho et al. (2005), the total tract apparent digestibility of

	Urea level (g/kg)		
Variable	0	10	20
Average live weight (kg)	$18.5^{a}(3.1)$	$19.5^{a}(3.8)$	$20.9^{a}(3.4)$
Body weight change (g/day)	-	68.8 <sup>a</sup> (56. 7)	92.2 <sup>a</sup> (39.9)
Feed intake (g/day)	462.5 <sup>a</sup> (77.0)	488.3 <sup>a</sup> (94.9)	418.33 <sup>a</sup> (67.2)
Feed conversion ratio	-	23.97 <sup>a</sup> (28.33)	5.41 <sup>a</sup> (2.8)
Serum urea nitrogen (mg/dl)	8.4 <sup>a</sup> (3.3)	$11.5^{ab}$ (1.2)	13.4 <sup>b</sup> (3.3)
Serum creatinine (mg/dl)	$1.5^{a}(0.5)$	$1.13^{a}(0.3)$	$1.40^{a}(0.1)$
Serum urea nitrogen:	6.4 <sup>a</sup> (3.4)	11.1 <sup>a</sup> (4.2)	9.6 <sup>a</sup> (2.1)
creatinine ratio			

Table 2. Average performance of peccaries receiving increasing levels of urea (SEM<sup>1</sup>).

<sup>ab</sup> Averages in the same row followed by different letters differed at p < 0.05.

 $^{1}$  SEM = Standard error of mean.

crushed maize is 0.83. These data, with the diet urea by peccaries' fore-stomach microbial, since consume ones, resulted on an average daily consumption of 799.42, 868.10 and 799.42 kJ/kg MBW of digestible energy on the levels of 0, 10 and 20-g/kg of urea, respectively.

There was a trend on body weight increase with the introduction of urea in diets but this one was not significant (F = 0.7478, P = 0.50) and a non significant decrease on feed conversion rate (F =2.52, P = 0.1436) (Table 1). There were, however, differences on serum urea nitrogen levels according the urea level fed by the animals (F = 4.88, P = 0.02) (Figure 1). In spite of that there were no signal of animal intoxication or behavioral changes in reason of urea consume.

## Discussion

The average daily consumption of digestible energy was above the maintenance requirements for adult non-reproductive collared peccaries 620.73 kJ/kg MBW (Galagher et al., 1984) - at all urea levels fed by the animals. On the other hand, without urea the average daily consumption of N was slightly below the daily nitrogen requirement of this species [0.8 g N/kg MBW] determined by Carl and Brown (1985). After the introduction of urea in the diet, however, this requirement was attained and there was a trend on body weight increase, a decrease on conversion rate, and a significant increase on serum urea nitrogen level peccaries at lower prices; this can contribute to the (Table 1). Those data denote the effective use of development of collared peccary production in

no urease is produced by animal tissue (Owens and Zinn, 1988). Probably, the microbial action increased the protein supply with this experimental diet containing low level of protein, which resulted in a trend on the body weight gain observed in this study (Figure 1).

The animals, however, must pass through an adaptation period with a gradual increase in the urea levels to avoid the danger of intoxication produced by the increase on serum nitrogen urea levels (Maynard and Lossli, 1969), as observed in this study (Table 1). Nevertheless, the values for serum urea nitrogen in this study were within the range of previous published values for collared peccaries receiving natural or artificial diets (Zervanos and Hadley, 1973; Lochmiller and Grant, 1984; Lochmiller et al., 1985).

Additionally, the ability of the collared peccary to utilize urea as source of non-protein nitrogen, as showed in this study, confirms the hypothesis that the collared peccary has a digestive physiology similar to ruminant animals.

Finally its resemblance to ruminants and the ability of the collared peccary to utilize urea as source of non-protein nitrogen, as showed in the present study, could reduce production costs. This physiological characteristic could allow feed collared regions where the plant protein sources, such as Langer, P. 1979. Adaptational significance of the soy meal may be scarce and/or costly, and where forestomach of the collared peccary, Dicotyles tathe commercial captive breeding of peccaries is jacu (L. 1758) (Mammalia: Artiodactyla). Mamgrowing in interest (Nogueira-Filho et al., 2004). At these places the urea could be an alternative of non-protein nitrogen source since it is economical to use urea as a protein supplement when plant protein feeds are high priced (Owens and Zinn, 1988).

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# Lessons learned through the INCO PECARI Project: "Development of different production systems for the sustainable exploitation of the Collared Peccary (*Tayassu tajacu*) in Latin America". (2001-2005).

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## Introduction

The collared peccary (Tayassu tajacu) (CP) is one of the most commonly hunted species in Latin America, particularly in forested areas such as the Amazon basin where pasture for domestic animals is scarce and local economies of rural people heavily rely on hunting for protein and income. It is also one of the favorite meats in urban markets of the Amazon Basin (Bodmer and Pezo 1999), and a preferred wildlife product throughout Brazil. In large cities of Latin America such as São Paulo, peccary meat can be sold at high prices (US\$ 10 per kilogram) (Nogueira-Filho & Nogueira, 2004). Peccary pelts are also very valuable in some countries: Those are kept as byproducts from commercial CP hunting for meat production. As a result, Peru exports 40.000 CP pelts every year, to provide the international pelt industry with one of the most resistant and flexible existing leathers, used in Europe and the US for the manufacture of luxury goods such as gloves or shoes. This trade provides Peru, the only country allowed to export CP leather, with a yearly income of 1.400.000 US\$ in foreign currency.

As a result of this economic value and popularity, many countries have started to show interest in the captive breeding of the CP for the commercial production of meat and hides and quite a few (such as Brazil, Peru, Colombia, Mexico, Trinidad & Tobago or French Guyana) have started research on this species during the last decade.

In view of this interest, the INCO PECARI project was conceived with the goal to fill the gaps on the biological and technical knowledge of that species, in order to contribute to the development of different systems of CP production in Latin America. To achieve this goal, funds from the European Commission (650.000 €) through the INCO DEV 5<sup>th</sup> Framework Programme, were awarded to the Department of Tropical Veterinary Medicine and Production (EMVT) from CIRAD, to coordinate a multi-disciplinary project featuring European and Latin American partners.

## **Project presentation**

The project focused on the sustainable production of this species through a multi-disciplinary, holistic approach addressing different topics such as its reproduction, nutrition, behaviour or health in captivity, the ecology and the management of free ranging herds in private properties or the economic viability of CP production in different locations. The final goal was to determine the range of possibilities for producing this species from a technical, ecological and socio-economic perspective by approaching different production systems such as small scale intensive farming more adapted to rural dwellers in forested areas or large commercial production more suitable to large private properties.

Coordinated by the EMVT Department from CIRAD, The scientific consortium encompassed 5 different countries and 8 scientific institutions including the Autonomous University of Barcelona (Spain), University of Kent (UK), Natural History Museum of Paris (France), Universidad Nacional de San Marcos-IVITA (Peru), Universidade Estadual de Santa Cruz (Brazil), Universidade Federal do Para (Brazil) and Embrapa Pantanal (Brazil).

The whole project was divided in 3 main parts, related to intensive captive breeding (Task I), ecology and extensive farming (Task II) and socio-economic viability (Task III), respectively.

Task I was designed to contribute to the development of intensive breeding initiatives of small scale farmers, and ultimately improve the viability of their enterprises in tropical forested areas of Peru and Brazil. The scientific and technical objectives were:

- to understand the reproductive physiology and to improve the reproductive efficiency of captive CP
- to test and develop efficient diets from locally available feed resources for CP in captivity
- to assess and to improve the health status of CP
- to analyse and to manage the aggression and stress in captive CP

Expected outputs of this task were a more efficient reproductive management, the conception of more efficient and low-cost diets, a better knowledge of the health status of CP in captivity and its threats and an improved welfare and control of stress in CP captive herds.

Experimental captive breeding station facilities from the Brazilian (UFPA in Belem, Brazil) and Peruvian Amazon (Iquitos, Department of Loreto) and from Northeastern Brazil (UESC, Ilhéus, Bahia) were made available for that purpose.

Task II addressed the innovative topic of experimenting CP ranching systems with the goal to provide incentives for conserving natural areas in private lands. It was thought that providing an extra income through a new economic alternative could alleviate struggling extensive productions of beef in the Pantanal or cocoa plantations of the Northeastern coast of Brazil. Primary scientific and technical objectives of this task were:

- To study the ecology of CP populations in those areas
- To experiment innovative systems for harvesting natural populations of CP in private states under study as it has been done for other peccary species (Andrade Figueira, 2003).

Expected outputs were a better knowledge of the keystone and limiting resources for the CP productivity of wild CP populations and the establishment of innovative exploitation systems of CP

populations in quasi natural conditions

Task III had the ambitious goal to analyze the economic viability of the different CP exploitation systems. This work had to provide the CP industry with critical guidelines for a sound long term development. Expected outputs were a comparative assessment of the different CP breeding systems in terms of production and economy and recommendations on the viability of CP breeding systems and the development of the CP industry.

## **Results and discussion**

After 4 years (2001-2004), a substantial amount of work and information on the ecology and biology of that species and its applications to captive breeding have been gathered by the project.

In terms of intensive breeding, the exploitation of the CP through small scale farming is probably the most widespread production system. The CP appears as a species with good potential for the commercial exploitation of meat and hides. The INCO PECARI Project has contributed to improve the information concerning the knowledge of the female CP reproductive tract from the anatomical and physiological perspective, and its reproductive cycle which is now well understood (Mayor *et al.*, 2004; Mayor et al., 2006c).

General features of the oestrous cycle and anatomy of the CP have been studied and described, allowing the possibility to implement management actions in the reproductive herd in order to increase productivity (Mayor et al, 2006b)The project contributed to the development of diagnostic methods for the detection of different reproductive events in the CP female (Mayor et al., 2005; Mayor et al., 2006b). The efficiency of a non invasive ELISA test for determination of progesterone in faeces has been finally confirmed as a useful tool for determination of the reproductive status of females and will be published soon. The analysis of vaginal smears, external genital features and estrogen and progesterone values in blood suggest that females in captivity show a polyestrous reproductive pattern with no seasonal effect in the Amazon region (Mayor et al, 2006b,d); those are easy tools that can be implemented to monitor female receptivity. Ultrasonography provides an efficient tool for pregnancy determination with a 100% of accuracy at early periods of gestation (Mayor *et al.*, 2005). The existence of a fertile oestrous cycle in the early postpartum period has been confirmed by several methods (invasive and non invasive) and by production data (Mayor et al., 2006d), representing an additional physiological characteristic of the species to increase production. All this information will be very useful to esablish more efficient reproductive management of CP breeding herds in captivity.

Another advantageous aspect underlined by the project, is the capacity of *Tayassu tajacu* to digest coarse fibre into protein (Nogueira-Filho, 2005). This characteristic allows the utilization of agricultural by-products for feeding that species. This aspect represents an interesting economic advantage since agricultural by-products can be used in the preparation of CP diets, reducing feeding expenses, the larger part-by far- of production costs (Nogueira Filho, 2006).

From the veterinary perspective, the CP appears as a species with a high resistance to stress and an excellent capacity to adapt to captive conditions. In breeding farms monitored by the project in the Amazon Basin, different hematological and biochemical parameters were determined (Wilson, 2005; Schettini, 2005). The species showed high resistance to the most common infectious diseases and parasitic infestations. Mortality in monitored farms has been low with the exception of an important neonate mortality rate (Mayor *et al.* 2006a). The possible links of this pattern with maternal behavioural disorders or infectious causes deserves further investigation (Mayor *et al.* 2006b).

Another interesting health finding has been that leptospirosis seems to be a common disease in CP farms in the Peruvian Amazon (Mendoza *et al.*, 2006). *Leptospira* spp. is a spirochete responsible for several human cases–sometimes fatal – of severe disease in the Peruvian tropical forest. Although this situations is not specific for CP and also occurs in other domestic animals bred in the tropics (Bovquist, 2005), hygiene precautions are necessary for people in close contact with CP and

their products, such as hunters, traders and animal keepers in order to prevent transmission of spirochetes to humans and other domestic animals (Mendoza *et al.*, 2006). Further research is necessary to assess the epidemiological role of captive and wild CP in the maintenance and dissemination diseases of public health concern.

Finally, the behaviour of captive CP in Amazonian farms monitored by the project was exceptionally calm for a wildlife species in captivity even in the case of animals captured in the forest. Stress problems were not reported and animals in the farms could be manipulated for minor procedures (blood and vaginal sampling) without any chemical restraint. In monitored groups, there appeared to be a certain hierarchy among reproductive females; however further studies are necessary to establish links between age or parental relations and female hierarchy. This is a key issue for the development of CP production that could not be completed in this project and deserves further investigation.

Task II focused on the study of free-ranging herds of CP and their ecology in view of an eventual exploitation of the species in private properties. The ecology of natural populations of CP has been extensively studied by the project by the team of Prof. Richard Bodmer (University of Kent, UK) in the Pantanal and by the team of Sergio Nogueira (University of Santa Cruz, Ilhéus, Brazil) in the cocoa plantations of Bahia. Ecological studies in the Pantanal examined how keystone and limiting resources influence the population dynamics, habitat use, and feeding ecology of CP that can now be compared to other wild pig species in a variety of locations (Keuroghlian & Desbiez, 2005). The preliminary results suggest that densities of CP in the Pantanal are around 5,5 individuals/Km2 although seasonal and regional variations exist according to landscape and vegetation structure. Macroanalysis of the feces has shown that CP show seasonal variations in their diet, palm fruits being the main item in periods of high fruit availability and vegetation being the main item consumed in periods of fruit scarcity. An interactive key using DELTA software is being constructed to conduct a detailed analysis at the species level of plants and fruits consumed. A total of 100 plants are being described as well as 25 fruit seeds. In view of a possible commercial exploitation, it was concluded that CP in the Pantanal does not seem like a viable option for ecological reasons. In that sense the feral pig, being an introduced species with very high acceptance among the Pantanal inhabitants and with a higher prolificity, appears as a much better candidate for commercial exploitation. All this data will be the subject of a forthcoming PhD thesis to be defended this year at the University of Kent (UK).

In Bahia, ecological studies were also undertaken in old cocoa plantations. Densities of CP oscillated between 5,5 and 6,5 individuals per Km2. These densities would allow the exploitation of free ranging CP in Bahia. Nevertheless, for technical and economical reasons semi-intensive farming systems appear like a more viable option for extension programmes than the exploitation of freeranging populations.

Concerning the technical exploitation of CP populations in semi-natural conditions, the project has met more mitigated success. In terms of experimenting ranching methods, capture and management of CP in the Pantanal by group trapping traps was technically possible, but capture effort turned out to be extremely high for CP. With the same capture effort using corral pens 10 CP, 30 feral pigs and 67 white lipped peccaries were trapped, suggesting that sympatric wild pig species showed a better response to capture and management through traps by pushing out CP from trapping sites. Moreover, capture mortality in CP was higher than in the other two species, particularly when using chemical restraint or when the animals were lassoed on horse.

The use of radio collars to monitor CP movements allowed to estimate home range of two CP herd at 1, 47 Km<sup>2</sup> (minimum convex polygon) during the dry season. Nevertheless, the use of 570gr. collars in CP induced mortality in most of the animals monitored (60%, n=3). Alternative methods such as radio ear tags fell regularly and were not successful for monitoring the animals. In conclusion, managing wild CP herds for exploitation in the Pantanal was more difficult than expected and did

the species level of plants and fruits consumed. A not appear as a very promising economic activity. total of 100 plants are being described as well as The feral pig, easier to capture and manage, 25 fruit seeds. In view of a possible commercial seems a better alternative for commercial ranchexploitation, it was concluded that CP in the Paning.

> However, as another alternative to small scale farming, the project described a possibility of exploiting large herds of CP in large enclosures, when those are issued from the same original herd (Nogueira et al., 2004). This characteristic offers good prospects for the management of large herds of CP if enough space is available, and opens up an alternative for the production of CP at a larger scale in semi intensive production systems (Nogueira Filho, et al. 2004), as it has been experimented for the white-lipped peccary (Andrade Figueira et al., 2003). Nevertheless, further research is necessary to confirm the viability of this system. In that sense, the social structure and hierarchy among reproductive females within these artificially created CP herds, is a key issue that deserves further investigation.

> In economic terms, a proper analysis of the activity could only be carried out in Bahia plantations using simulation data relative to the development of semi intensive CP production schemes. These simulations demonstrate that commercial exploitation of CP through semi-intensive production systems can be cost-effective after the 3<sup>rd</sup> year of production. The acquisition of breeding stock and the building of the facilities represented more than 50% of investment costs, while feeding represented at least 77% of the variable costs (Oliveiras Santos, 2004).

## Conclusions

After 4 years of research around that species, we can conclude that the INCO PECARI project has improved the perspectives of development of intensive production systems. The captive breeding of CP in small scale conditions is technically viable and the species has a great potential for production of meat and hides. Substantial progress has been made in the knowledge of the reproductive biology of the species and its applications for a more efficient management of the herd in terms of reproductive production (Mayor, 2004). To confirm the social and economical viability of



Figure 1: Comparative pictures of pelts obtained through subsistence hunting (left and middle) and through farming (right).Note the difference in quality after the wet-blue treatment. (Photos: F. Jori)

this activity, it is now is necessary to develop pilot production systems is less developed and there extension projects in areas with good potential for are fewer conclusive experiences. Nevertheless, marketing and commercialization of CP meat and CP bred in captivity has a high reproductive turnhides, in order to confirm social viability and costefficiency. CP production in Peru could enable producers to obtain better quality hides to be sold to the pelt industry as "green leather", thus increasing the variety and size of leather products in the market. Indeed, more than 50% of the pelts currently marketed in Peru are hunting byproducts seriously damaged by moist, bullets, tick bites or scars. In that sense, pelts issued from farming have a much better quality (Figure 1) and the pelt industry is willing to pay up to ten times the current price for high quality pelts that can be used to produce larger and better quality leather manufactured items. This could encourage the commercialization and trade of high quality and environmentally friendly CP leather items among the European leather industry in the long term and could certainly represent an added value for potential CP farmers in Peru.

For meat marketing, areas close to cities where game is sold at higher prices and wildlife is scarce, have a higher probability of success than remote forested areas where hunting, if legal, will always be more cost effective than farming.

Compared to the development of small scale intensive farming, the exploitation of large scale CP over which allows the development of familiar units of several dozens of individuals after several years of breeding. Cost efficiency of this possibility should be explored in more depth in the following years, and particularly the possibility to increase the number of breeding females in the same reproductive group or herd.

Unfortunately, the project failed in providing information on the economic viability of CP production in other locations than Bahia. This goal was probably premature since despite the fact that research has been undertaken in many countries, CP farming remains experimental and is not widespread. The research team in Bahia managed to demonstrate that CP farming can be a profitable initiative there. Nevertheless, economic viability is different depending on the location of the farms. Therefore, this kind of analysis should be undertaken in every location or country with local data.

In any case, a substantial amount of information which should be of interest to zoos, CP breeders, conservation organizations, rural development organizations and the pelt industry, and scientific and teaching institutions has been produced. The INCO PECARI project also allowed to create a



Figure 2: Peccary in captivity in the UFPA breeding station in Belem, Brazil. (Photo:F.Jori)

positive synergy within a very active network of scientists interested in the development of CP production in Latin America that should carry on working together beyond the scope of this project.

Moreover, the project allowed to compile two PhD thesis, (one of which will be completed during 2006 in the UK), 6 MSc thesis, the publication of 10 papers accepted in international peer reviewed journals, the presentation of more than 40 communications in international congresses and has trained more than 45 persons in different countries. In addition, several papers are in preparation and will be probably produced out of the project in the next few years. In that sense, the project has provided a good scientific background that will hopefully contribute to the development of CP production in Latin America in the coming years. Equally, many questions have arised which remain without response and which will hopefully provide the basis for future research initiatives around the production of that species in the coming years.

## Acknowledgements

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## **Project Description**

## Developing management capabilities for wild pigs damage control in agroecosystems in and around Protected areas of India.

Task: Ecology and Management of wild pigs in and around Ranthambore Tiger Reserve. Name of the Investigator(s): Dr. N.P.S. Chauhan. Email: npsc@wii.gov.in Name of Researchers: Mr. Kuldeep Singh Barwal & Avdhoot Dilip Velenkar.

## **Background:**

The Project aims at developing management capabilities for wild pigs (Sus scrofa) damage control in agro-ecosystems in and around protected areas of India. A four years study on ecology and management of wild pigs is proposed. The study will be conducted in and around the Ranthambore Tiger Reserve in Rajasthan. Wild pigs have always been associated with man, and successfully utilise the human altered landscape. Wild pigs cause extensive damage to agricultural crops and utilise the agroecosystem for food resource and shelter. They also cause damage to ground vegetation, orchards, forest plantations. As a result, there has been increasing trend in human-wild pigs conflicts in and around protected areas and human settlements throughout the country. Consequently, the conservation efforts for the species are badly affected everywhere. Despite of this fact, management of this species hitherto has not been attempted in India because the

information available on ecology and behaviour is inadequate for management of this species.

Although the research conducted so far in India includes a few ecological parameters, these studies are not management oriented. No work has been done on home range, activity pattern, feeding ecology of wild boar, and developing capture techniques for pigs in India.

Therefore to mitigate the problem cost-effectively in specific situations, it is necessary to have the knowledge of the ecology and behaviour of wild pigs within protected areas and outside village interface man-altered fragmented areas. Study of spatial and temporal distribution, diurnal activity, population status, socio-biology, habitat use, ranging patterns, seasonal changes in the dietary intake and feeding habits, nature and extent of agricultural crop damage, socio-economic aspects, reproductive biology and health parameters of wild pigs will be done.





The project study: ecological and management considerations will provide a basis for developing an action plan to mitigate the problem effectively and on a long-term basis. Experimental trials to develop cost-effective wild pigs-specific barrier(s) and mass capture techniques will be conducted. Possibility of the use of fertility control methods or culling or shooting need to be evaluated as damage control strategy. Once the expertise is developed, it would be essential to disseminate the knowledge for mitigation of crop depredation to wildlife managers and scientists dealing such problems in different states.

## **Study Area:**

The Ranthambore Tiger Reserve which is situated in the Sawai Madhopur district of eastern Rajasthan. The total area of the Reserve is 1334.6 sq. km. and falls into the park area and its buffer, revenue land, reserve forest, village land, degraded wasteland and private land. Of the total area, 26% of forests are in the Aravali and Vindhyan formation ranges. The main forest types are of Anogeissus pendula, scrub and miscellaneous forests. In the peripheries, 432 sq. km. area is under agricultural crops and 55 sq. km. is lying fallow. As per the 1981 census, the total population is 100,000 people living in 60 villages around the Ranthambore National Park. They are dependent on the park's resources mainly for small timber, firewood and charcoal requirements and grazing their cattle. Fodder is extracted from the buffer zone.

Ranthambore is famous for its tigers and other predators: leopards, hyena, jackal, jungle cat and caracal. Deer and antelopes are samber, spotted deer and chinkara and nilgai. Wild pigs are seen in large numbers in the park and outside in agricultural areas and human settlements. Besides, it has variety of other fauna.

Ranthambore National Park, Sawai Madhopur, Rajasthan.

#### **Project Objectives:**

1. To prepare habitat maps of Ranthambore National Park in relation to wild pig occurrence, and quantify vegetation composition and structure within each habitat.

2. Study the spatial and temporal distribution of wild pigs in context of habitat attributes.

3. Population status and socio-biology: social structure and age and sex classes.

4. To develop capture techniques most suitable for wild pigs, having wider management application.

5. Quantify habitat use and ranging patterns of wild pigs using telemetry. Study the diurnal activity on seasonal basis.

6. Assess the seasonal changes in the dietary intake and feeding habits of wild pigs.

7. Reproductive biology: Breeding season, success and behaviour.

8. To study health parameters of pigs: Clinical

physiological parameters, parasitic and infectious from season to season. Observations on reproduc-(bacterial and viral) diseases.

9. To assess the man-wild pigs conflicts: nature and extent of problems. Agricultural crop damage pattern and crop preference for various growth stages with seasonal differences. Qualitative and quantitative assessment of crop damage by wild pigs in different seasons.

10. To evaluate the use and efficacy of power fence in controlling crop damage caused by wild boar.

11. Suggest cost-effective methods to control wild pigs and mitigate agricultural crop damage. To develop predictive models and formulate recommendations for mitigation of wild pigs-man conflicts.

12. Through the project, the expertise will be developed at this Institution and knowledge of mitigation of crop depredation will be disseminated to wildlife managers and scientists dealing such problems in other states.

## Work progress

For vegetation mapping, 40 transects, 1 km length each, in different habitat types within the park have been laid. There are 20 transects in Sawai Madhopur range, 11 transects in Khandar range and 9 in Kundera range. All these transects have been walked three times, once during rainy season (August and September 2005), the second time during winter (November and December 2005) and third time dur-

ing summer (March-April 2006). Information of tree, shrub and herb species and cover, direct and indirect evidences of wild pigs, biotic pressure is being collected.

Based on direct and indirect sightings, the spatial and temporal distribution of wild pigs in being done. Information on socio-biology i.e. group size, structure and age and sex classes is being collected. The group size varies from solitary animal up to 48 individuals, and it varies

tive activity, breeding season, success and behaviour are also being made.

We have already procured radio-collars. The capturing and radio-collaring of wild pigs, and the study on habitat use, ranging patterns, diurnal activity, and health parameters will be started soon.

To study the seasonal changes in the dietary intake and feeding habits of wild pigs, direct observations are being made, and faecal matter samples are being collected. So far, 155 samples have been collected and air dried.

Village survey is ongoing to assess the man-wild pig conflict. Information on agricultural crop damage pattern and crop preference is being collected on seasonal differences in specially designed questionnaire format. Out of 90 villages situated in the periphery of the park, 20 villages with severe crop damage problem have been surveyed. Some of the worst affected villages with wild pig problem are Indala, Khatuli, Padara, Mordungri, Jaitpur, Mai, Kushalpura, Chhan, Rawal, Baso, Shyampura and Bhadlav.

For construction of power fence to check movement of wild pigs, village sites have been selected. In Baso village, marking of the fence line has been completed, and now ground leveling work is being done.





**Brief conservation news (1) - Young hippo orphaned in Mombassa, Kenya, adopts a 100 year old tortoise** 



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## Brief conservation news (2) - The polar bear and hippopotamus are for the first time listed as species threatened with extinction by the world's biodiversity agency.

By Richard Black, Environment Correspondent, BBC News website

They are included in the Red List of Threatened Species published by the World Conservation Union (IUCN) which names more than 16,000 at-risk species. Many sharks, and freshwater fish in Europe and Africa, are newly included. The IUCN says loss of biodiversity is increasing despite a global convention committing governments to stem it. "The 2006 Red List shows a clear trend; biodiversity loss is increasing, not slowing down," said IUCN director-general Achim Steiner. "The implications of this trend for the productivity and resilience of ecosystems and the lives and livelihoods of billions of people who depend on them are far-reaching." Overall, 16,119 species are included in this year's Red List, the most detailed and authoritative regular survey of the health of the plant, fungi and animal kingdoms. This represents more than a third of the total number of species surveyed; the list includes one in three amphibians, a quarter of coniferous trees, and one in four mammals. "The more species we assess, the more threatened species we find," commented Jean-Christophe Vie, deputy coordinator of IUCN's species programme. "And because it is such a massive effort to assess a species, to gather all the data, get it all peer-reviewed and so on, 16,000 is a massive underestimate of the true problem," he told the BBC News website.

#### Climate and hunting

Polar bears are particularly affected by loss of Arctic ice, which the IUCN attributes to climatic change. They need ice floes in order to hunt seals and other prey; without it, their food supply will decline. There is also evidence that the snow caves where they raise their young are melting earlier in the year.

Polar bears are listed as Vulnerable to Extinction based on forecasts that their population will decline by 50% to 100% over the next 50 to 100 years. In the tropics, the common hippopotamus has entered the Red List for the first time because the population in the Democratic Republic of Congo has declined spectacularly - by about 95% in a decade. The country's turbulent political situation has allowed unregulated hunting for meat and for the ivory in their teeth. "Regional conflicts and political instability in some African countries have created hardship for many of the region's inhabitants, and the impact on wildlife has been equally devastating," said IUCN chief scientist Jeffrey McNeely. The common hippo's decline in DRC has led to a Vulnerable listing even though other African populations including the largest, in Zambia, have held up well. The much less well known pygmy hippo has suffered from illegal logging and poor protection in several West African nations, leading to an upgrade in its status from Vulnerable to Endangered.

#### Marine misery

For the first time, this year's Red List includes a comprehensive region-by-region assessment on some groups of marine animals. It shows that sharks and rays - members of the elasmobranch group of fish - are disappearing at an unprecedented rate across the globe. About 20% of the 547 species surveyed merit inclusion on the Red List. Some of these are fish which were once common on dinner plates in the UK and surrounding countries. The angel shark has been declared Extinct in the North Sea and Critically Endangered globally, while the common skate's status has also been upgraded to Critically Endangered. The IUCN says that with fisheries extending into ever deeper zones of the ocean which are largely unregulated, populations of many species are set to decline sharply. "The desperate situation of many sharks and rays is just the tip of the iceberg," said Craig Hilton-Taylor of the IUCN Red List Unit. "It is critical that urgent action to greatly improve management practices and implement conservation measures, such as agreed non-fishing areas, enforced mesh-size regulations and international catch limits is taken before it is too late." In the Mediterranean, freshwater fish are faring even worse than their sea-going counterparts. Fifty-six percent of the 252 species endemic to the Mediterranean are threatened with extinction, the IUCN says.

#### Limited success

It is not all doom and gloom. The first optimistic note is that the overall number of species in this Red List is not significantly higher than in the last edition published in November 2004, which numbered 15,589 species on the brink. And the number of species believed to have gone extinct over the last 500 years has not changed, a reflection of the fact that conservation efforts tend to intensify as final oblivion approaches. The IUCN notes some marked conservation successes among the much more frequent stories of a slide towards oblivion. The number of white-tailed eagles has soared in many European nations, and the bird's status has been downgraded from Near Threatened to Least Concern. A recent decision by the Indian government to phase out a veterinary drug which was poisoning the common vulture, causing numbers to fall by 97%, is also cited as a simple measure which can bring great success. But the overall message is that biodiversity continues to decline, despite the UN Biodiversity Convention which commits governments to halt the trend by 2010. Jean-Christophe Vie believes there is a vast gap between what governments have promised and the action they are taking. "Everything we find shows that it doesn't happen," he said, "and there is very little chance to achieve this goal unless there is a drastic change and governments decide to tackle the roots of species extinction."

## Job announcement - White-lipped peccary ecologist position/Posicion para un especialista en pecari de labios blancos (*Tayassu pecari*)

World Wildlife Fund seeks a researcher to help direct a multi-year, field-based study of the ecology of white-lipped peccaries, as part of a larger project on selected area-sensitive mammal and bird species of the Amazon basin. Ultimately, the goal is to use data collected on ecology and habitat use of these species to address reserve design questions. Applicant will be based at a field research station in the Peruvian Amazon, that has electricity and wireless internet connection but is a 6-hr boat ride to the nearest town. You will direct a small field staff of local and student field assistants in locating, capturing, radio-tagging, and monitoring habitat use. The project has an ultralight for VHF telemetry locations and we are experimenting with GPS collars RFID tags, and new VHF technology. We have also habituated a group of the peccaries (100+ individuals) and are collecting detailed observations through direct observations.

As the project focuses on spatial use issues we are looking for someone with strong quantative skills and experience with spatial analyses. Command of Spanish is required; an advanced degree, GIS skills are preferred. You will be expected to assume a lead role in data analysis, manuscript preparation, and publication. Salary - \$15,000 to \$24,000 depending on experience, plus per diem at field station and travel to and from Peru at least once a year (in addition to travel to site first time). Contract will initially be for 12 months but is open-ended (the project currently has 2 years of funding), beginning in May, 2005 or as soon thereafter as possible.

Interested candidates should send a curriculum vitae, a brief summary of research experience and interests, and names of at least two references (with their email addresses) to George Powell at: george.powell@wwfus.org.

La World Wildlife Fund esta buscando a un investigador(a) para la dirección de un estudio sobre Pecari de labios blancos (Tayassu pecari). Este estudio es parte integral de un Proyecto cuyo objetivo principal la estimación del tamaño adecuado y la configuración espacial de áreas protegidas y manejadas necesarias para conservar mamiferos y aves sensibles a la perdida del habitat.

El investigador(a) tendra su base en una Estacion científica en el Amazonas peruano (Madre de Dios) que cuenta con electricidad e internet, sin embargo se encuentra a 6 horas en bote hasta la poblacion mas cercana. Se espera que el candidato elegido dirija un equipo de personal de campo y estudiantes en la captura, localizacion y marcado de individuos asi como del monitoreo de su uso del habitat. Se cuenta con un avion ultraligero para telemetria y estamos experimentando con collares GPS, RFID tags, y tecnologia nueva de VHF. Tambien tenemos habituado a un grupo de peccaries (+100 ind.) y estamos colectando observaciones detalladas mediante observacion directa.

Debido a los intereses del proyecto, se busca a alguien con conocimiento y experiencia en analisis espacial. Dominio del español es requerido: posgrado y conocimiento de GIS son preferibles pero no imprescindibles. Se espera que este investigador asuma la responsabilidad del analisis de datos, la preparacion de escritos y publicaciones. El salario puede ir de \$15,000 a \$24,000 Dlls. (dependiendo de la experiencia), mas la estancia en la Estacion Científica, pasajes de avion desde y hacia Peru por lo menos una vez al año (mas el viaje hacia la zona por primera vez). El contrato sera incialmente por 12 meses pero no es definitivo, (el Proyecto tiene al momento dos años de soporte financiero), y puede comenzar en Mayo de 2005 o tan pronto como sea posible.

Los candidatos interesados pueden enviar un Curriculum vitae, un pequeño resumen sobre su experiencia e intereses, y los nombres de al menos dos referencias (con direccion de correo electronico) dirigido a George Powell al correo electronico: george.powell@wwfus.org



## New Literature on Suiformes



## **Ecology and conservation studies**

**1.** Melis, C., P. A. Szafrańska, et al. (2006). "Biogeographical variation in the population density of wild boar (*Sus scrofa*) in western Eurasia." Journal of Biogeography **33**(5): 803-811

Abstract. Aim. We reviewed 54 studies reporting population densities of wild boar (Sus scrofa) in western Eurasia in order to investigate the roles of vegetation productivity [fraction of photosynthetically active radiation (FPAR) index], winter harshness (mean January temperature) and presence/ absence of wolves (*Canis lupus*) in shaping the biogeographical variation in population density of wild boar. Location. We collected published data on the autumn-winter population density of wild boar (number of individuals km-2) in 54 locations in western Eurasia, from 1966 to 2003. Methods. The mean January temperature. obtained from the World Climate data base (http:// www.worldclimate.com), was taken as a measure of winter severity. We used monthly  $4 \times 4$  km MODIS FPAR data sets covering January 2000 to June 2004 to calculate the vegetation productivity index. In addition, we collected literature data about the presence or absence of wolves from the study areas. Results. In the geographical span of 37–60° N, the population densities of wild boar declined by three orders of magnitude, from 10 to 0.01 individuals km-2. The best multiple regression model (selected with the Akaike information criterion corrected for small samples) showed that mean January temperature and the vegetation productivity index were the most important factors explaining the biogeographical variation in population densities of wild boar. The impact of temperature was stronger than that of productivity. The presence of wolves had a weak limiting effect on population densities of wild boar at the biogeographical scale. Main conclusion. We propose that winter harshness imposes density-independent mortality on wild boar populations at higher latitudes. Competition for food in less productive regions may cause stronger density dependence in birth and death rates of wild boar populations. We expect that wild boar will respond to global warming by both an increase in local population densities and an expansion of their geographical range north and north-eastwards.

**2.** Semiadi, G. and E. Meijaard (2006). "Declining populations of the Javan warty pig Sus verrucosus." <u>Oryx</u> **40**(1): 50-56.

Abstract: We conducted an interview-based survey for the Javan warty pig *Sus verrucosus*, endemic to the islands of Java and Bawean in Indonesia. The species occurs in 10 isolated areas, although some additional, probably very small populations, may remain. Compared to a survey conducted in 1982, 17 of the 32 (53%) populations are extinct or have dropped to levels so low that local hunters have failed to encounter the species in recent years. This indicates a rapid population decline. We hypothesize that this loss is primarily caused by a decline in suitable habitat, especially stands of teak *Tectona grandis* forest or similar forest plantations, and by high hunting pressure. Competition from and hybridization with the Eurasian wild boar *Sus scrofa* may be further threats to *S. verrucosus*. Rapid action is needed to prevent extinction in the wild. We recommend effective protection of selected *S. verrucosus* populations, lobbying of the Government to give protected status to *S. verrucosus*, conducting ecological research and investigating crop damage issues, and establishment of conservation breeding programmes.

**3.** Beck, H. (2006). "A review of peccary-palm interactions and their ecological ramifications across the Neotropics." Journal of Mammalogy **87**(3): 519-530

Abstract: Palms (Arecaceae) are a dominant element within the neotropical plant community and be-

cause they substantially contribute to the overall and year-round fruit availability they are considered a key resource for frugivores, particularly for peccaries. Similarly, peccaries (Tayassuidae) are a dominant element within the neotropical mammal community. Their evolution of a strong mastication apparatus, unique interlocking canines, patterns of movement, and foraging ecology are viewed as adaptations to exploit hard seeds, particulary palm seeds. But how strong are the interactions between peccaries and palms, and what are the ecological ramifications? This review synthesizes over 76 papers, published between 1917 and 2004, which revealed that peccaries consumed fruits from 46 palm species, 73% of whose seeds were destroyed after ingestion. Furthermore, peccaries disperse palm seeds; eat flowers, seedlings, and roots; and trample seedlings. Thus, peccaries affect the spatiotemporal distribution and demography of palms. Local extinction of peccaries resulted in dramatic changes in the forest ecology. New conservation strategies are required to protect peccaries and prevent negative cascading effects.

**3.** Hadjisterkotis, E. and P. M. Heise-Pavlov (2006). "The failure of the introduction of wild boar Sus scrofa in the island of Cyprus: a case study." <u>European Journal of Wildlife Research</u> **52**(3): 213-215

Abstract: Wild boar (*Sus scrofa* L.) were introduced in the island of Cyprus in 1990, when five animals were imported from Greece for game farming. In 1994, wild boars were illegally released in Lemesos (Limassol) Forest and in 1996 in the Troodos National Forest Park. Soon the population increased and dispersed throughout the park. In 1997, the government of Cyprus decided to eradicate wild boar because of the danger of transmitting diseases to livestock and to prevent possible environmental destruction. To control the wild boar, hunting was permitted and game wardens were instructed to eliminate the free-ranging animals. In 2004, no animals were observed in localities where they had been seen before. Surveys in September 2004 (Troodos National Park) and January/February 2005 (Troodos Forest, Pafos Forest, and Lemesos Forest) revealed no signs of recent wild boar presence. The reasons for the possible failure of wild boar to establish in Cyprus are discussed.

**4.** Santos, P., P. Fernandez-Llario, et al. (2006). "Habitat and reproductive phenology of wild boar (Sus scrofa) in the western Iberian Peninsula." <u>European Journal of Wildlife Research</u> **52**(3): 207-212

Abstract: We examined the reproductive phenology of wild boar populations in four regions of the western Iberian Peninsula during the 1999/2000 hunting season (October-February). To estimate conception dates and birth distribution frequencies, we used foetal weights. Regions differed significantly, and we detected a relationship between region and birth distribution frequencies. Throughout the year, food availability had a major influence on the distribution of farrowing. Although a short period of high food availability leads to highly synchronous births, even in relatively harsh environmental conditions, adult females that exploit low-quality food items appear to be able to give birth at any time of the year.

## Taxonomic, morphological, biogeographic, and evolutionary studies

**1.** Liu, L. P., D. S. Kostopoulos, et al. (2005). "Suidae (Mammalia, Artiodactyla) from the late Miocene of Akkasdagi, Turkey." <u>Geodiversitas</u> **27**(4): 715-733

Abstract: The suid remains from Akkasdagi, late Miocene of Central Anatolia (Turkey), represent the widespread, long-ranging, and polymorphic species Microstonyx major (Gervais, 1848). The rich material represents at least 10 individuals, two of which are juveniles, and comprises both postcranial and craniodental material, including one nearly complete skull. The Akkasadagi population is characterised by medium size, strong elongation of the skull, and moderate reduction of premolar size. These characteristics are shared with other populations of late middle Turolian age (MN 12). The elongation of the skull appears elsewhere to be associated with the and end of the species' ecological range.

2. Robins, J. H., H. A. Ross, et al. (2006). "Taxonomy - Sus bucculentus revisited." Nature 440 (7086)

## **Veterinary studies**

**1.** Berger, E. M., K. Leus, et al. (2006). "Faecal steroid metabolites for non-invasive assessment of reproduction in common warthogs (*Phacochoerus africanus*), red river hogs (*Potamochoerus porcus*) and babirusa (*Babyrousa babyrussa*)." <u>Animal Reproduction Science</u> **91**(1-2): 155-171

Abstract: The objectives of this study were to analyse faecal steroid metabolites in African and South East Asian pig species kept in European zoos. Species studied were the warthog (Phacochoerits africanus), the red river hog (Potamochoerus porcus) and the babirusa (Babyrousa babyrussa). Faecal samples were collected 1-3 times per week from non-pregnant and pregnant captive female warthogs (n = 9), red river hogs (n = 7) and babirusas (n = 5). Enzyme-immunoassays for faecal progesterone, androgen, and oestrogen metabolites, were tested for their ability to determine follicular and luteal phases. In all three species, oestrous cycles could be monitored with 20 alpha-OH- and 20-oxopregnane assays. In contrast, oestrogens and androgens were not useful in characterising follicular activity during the oestrous cycle in any species. Faecal 20 alpha-OH- and 20-oxo-pregnane values were significantly correlated. Faecal pregnane concentrations revealed species-specific differences. Luteal phase values of 20 alpha-OH-pregnanes were considerably higher than 20-oxo-pregnanes; 20a-OHpregnanes were in the range of 3-10 mu g/g in warthogs and red river hogs, whereas concentrations were 30-200 mu g/g faeces in the babirusa. Regular oestrus cycles had a length of about 35 days in all three species studied. Results indicated a seasonal influence on the occurrence of reproductive cycles in the warthog with anoestrous periods in the European summer. The red river hog was found to be a seasonal and poly oestrous breeder; oestrus cycles started by January and continued until summer. In contrast, the babirusa showed non-seasonal ovarian cyclicity. In pregnant red river hogs, progesterone metabolites were comparable to luteal phase values of the oestrous cycle during the first 3 months of gestation, but did further increase during the last month of pregnancy. Oestrogens and 17-oxoandrostanes were significantly elevated during the second half of gestation. In summary, the reproductive biology of three exotic pig species was studied using non-invasive faecal steroid analysis and these methods were used for comparative investigations of oestrous cycles, pregnancy and seasonality. (c) 2005 Elsevier B.V. All rights reserved.

**2.** Foata, J., D. Mouillot, et al. (2006). "Influence of season and host age on wild boar parasites in Corsica using indicator species analysis." Journal of Helminthology **80**(1): 41-45

Abstract: The indicator value (Ind Val) method which combines measures of fidelity and specificity has been used in a study on wild boar parasites in Corsica during 2001-2003. Because of its resilience to changes in abundance, IndVal is a particularly effective tool for ecological bioindication. The Ind Val method showed how season can influence the occurrence of parasite species in the wild boar, and also identified parasites as bioindicators relative to host age. The randomization test identified five parasite species having a significant indicator value for the season (the ticks, *Hyalomma aegyptium* and *Rhipicephalus sanguineus*, the louse, *Haematopinus suis* and the nematodes *Globocephalus urosubulatus* and *Ascaris suum* and two indicator species of an age class (the nematodes *G. urosubulatus* and *Metastrongylus* sp.). Data on species composition and infection levels would help improve the monitoring and management of parasitism in Suidae populations.

**3.** Mayor, P., M. Fenech, et al. (2006). "Ovarian features of the wild collared peccary (Tayassu tajacu) from the northeastern Peruvian Amazon." <u>General & Comparative Endocrinology</u> **147**(3): 268-275

Abstract: In this study, the ovaries of 27 wild collared peccaries (*Tayassu tajacu*) from the Amazonian region of northeastern Peru were examined macroscopically and microscopically, and expression of major steroidogenic enzymes was detected by immunohistochemistry. Our observations suggest a mean ovulation rate of  $2.3 \pm 0.6$  follicles and a low rate of reproductive wastage ( $0.4 \pm 0.6$  oocytes or embryos per pregnancy). The collared peccary seems to exhibit follicular waves involving the syn-

chronous growth of a cohort of follicles, several of which seem to attain selection. The presence of antral follicles in pregnant females suggests that follicular turnover continues during pregnancy. In cyclic animals, corpora lutea were characterised by the presence of distinct large and small luteal cell populations. The luteal volume in pregnant females was larger than that recorded for non-pregnant females. Through immunohistochemistry, it was observed that luteal cells from active corpora lutea exhibit intensive 3 beta-HSD expression in advanced stages of pregnancy. This suggests that the corpora lutea seems to remain steroidogenically active throughout pregnancy and likely contribute to progesterone production during pregnancy.

**4.** Santos, T. C., V. Dantzer, et al. (2006). "Macroscopic and microscopic aspects of collared peccary and white-lipped peccary placenta." <u>Placenta</u> **27**(2-3): 244-257

Abstract: This study examines middle and late gestational placentae from 13 Tayassu tajacu (collared peccary) and 3 Tayassu pecari (white-lipped peccary), which are Artiodactyla belonging to the Family Tayassuidae. The chorionic sac of Tayassu species is diffuse and chorioallantoic. These epitheliochorial placentae show no trophoblast invasion into the uterine epithelium and there is interdigitation between fetal and maternal microvilli. Two distinct regions of the fetomaternal interface can be identified: the interareolar and the areolar regions. The uterine epithelium has eosinophilic cytoplasm with dispersed, basophilic and electron-dense granules. Trophoblast cells are irregularly cuboidal on top of the fetal ridges and columnar on troughs, where cells have cytoplasmic vesicles and large basal vacuoles, surrounded by whorls of smooth membranes. Capillaries indent the trophoblast cells forming a placental barrier 3 mu m or less thick. The columnar uterine glandular epithelium has a subpopulation of granules staining with Perl's Prussian blue reaction, suggesting iron secretion. In areolar areas, the trophoblast cells show apical microvilli, a basophilic cytoplasm with electron-dense intracellular vacuoles and cisternae. The placenta can therefore be classified as non-deciduate. The ultrastructural aspects of this study reveal features that have not previously been described and extend our knowledge of functions relating to materno-fetal transport in these species. (c) 2005 Elsevier Ltd. All rights reserved.

**5.** Schwarm, A., S. Ortmann, et al. (2006). "Digestion studies in captive Hippopotamidae: a group of large ungulates with an unusually low metabolic rate." Journal of Animal Physiology & Animal Nutrition **90**(7-8): 300-308

Abstract: We performed intake and digestibility studies in four common (*Hippopotamus amphibius*) and four pygmy (*Hexaprotodon liberiensis*) hippos from two zoological institutions, using acid detergent lignin as an internal marker for the quantification of faecal output. In the case of one pygmy hippo, where total faecal collection was also possible, there was no distinct difference between the two methods of faecal output quantification. Two animals from each species were tested on a conventional zoo diet of hay and concentrates (diet HC) and on hay only (diet H). The other two animals received fresh grass at two different levels of intake (diets G1 and G2). Dry matter (DM) intake was higher on HC than on H or G diets, and averaged 37 +/- 11 for common and 35 +/- 14 g/kg(0.75) for pygmy hippos. There were no species differences in the average digestibility (aD) coefficients. Non-dietary faecal nitrogen averaged 65 +/- 4% of total faecal nitrogen, aD of crude protein (CP) averaged 67 +/- 9% and true protein digestibility 89 +/- 3%. Average digestibility of DM and crude fibre averaged 54 +/-11% and 45 +/- 17%, respectively. In comparison with ruminants, hippos generally achieve lower aD for DM, organic matter and fibre parameters, but equal or higher aD CP coefficients. This is most likely due to the absence of significant fermentative activity in the hindgut and the corresponding low metabolic faecal nitrogen losses. Digestible energy intake was higher on HC than on H or G diets and averaged 0.30 +/- 0.11 MJ/kg(0.75) metabolic body mass. This value is extremely low for ungulates, supporting earlier suspicions that hippos have particularly low metabolic rates, and explains the proneness of this species to obesity in captivity when fed energy-dense pelleted feeds.

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## The newsletter of the IUCN/SSC Pigs, Peccaries

### and Hippos Specialist Group (previously Asian Wild Pig News)

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Editorial board: William L.R. Oliver Rona A. Dennis Dr. Colin P. Groves Dr. Rebecca Lewison The IUCN/SSC Pigs, Peccaries and Hippos Specialist Group PPHSG is one 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.

It consists of a group of technical experts focusing on the conservation and management of wild pigs, peccaries and hippos.

The broad aim of the PPHSG 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.

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