

# Suiform Soundings

Volume 7, no.  
1. July 2007

ISSN: 1446-991X

- Decline in the hippopotamus population of Virunga National Park
- A short history of claims of sympatric wild hog species in Indochina
- Actividades del sub-grupo peccaries
- Observations of social structure changes in a collared peccary herd
- Status and conservation of *Babyrousa babyrussa* in the Togeian Islands, based on direct observations and questionnaire surveys (intermittently, 1990 – 2001)
- Communal hunting of wild boars (*Sus scrofa*) as a common practice in West Sumatra, Indonesia
- Abundancia y patrones diarios de actividad del Jabalí (*Tayassu pecari*) en la región este del Parque Nacional Mirador-Río Azul, Petén, Guatemala
- First photo register of white-lipped peccary, *Tayassu pecari*, in Grande Sertão Veredas National Park, Minas Gerais state, Brasil.
- Análise espacial de um remanescente da Floresta com Araucária baseada nas métricas da paisagem e nos requisitos ecológicos de ungulados silvestres, Paraná, Brasil.

## 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

**IUCN**  
The World Conservation Union

 **SSC**  
Species Survival Commission

---

Photo front page: Kae Kawanishi came across this photo of a strange looking pig amongst the collection of camera-trap photos from their Taman Negara Tiger Project, and was wondering if it might be *Sus barbatus*, a bearded pig, as opposed to *S. Scrofa*. Any opinions?

---

## TABLE OF CONTENTS

EDITORIAL *by Erik Meijaard and Anne-Marie Stewart* **2**

Decline in the hippopotamus population of Virunga National Park *by Robert Muir* **3**

A letter from the Afro-tropical coordinator *by Chris Gordon* **5**

A short history of claims of sympatric wild hog species in Indochina *by Gary Galbreath* **6**

Actividades del sub-grupo pecaries *by Mariana Altrichter* **8**

## PAPERS AND COMMUNICATIONS

Observations of social structure changes in a collared peccary herd *by Selene S. C. Nogueira, Tais M. A. Pereira, Ana Paula Serra Lopes & Sérgio L. G. Nogueira-Filho* **9**

Status and conservation of *Babryrousa babyrussa* in the Togean Islands, based on direct observations and questionnaire surveys (intermittently, 1990 – 2001) *by Shaifudin Akbar, Mochamad Indrawan, M. P. Yasin, James Burton & Jandri Ivan* **16**

Communal hunting of wild boars (*Sus scrofa*) as a common practice in West Sumatra, Indonesia *by Rizaldi, Kunio Watanabe, & Amsir Bakar* **25**

Abundancia y patrones diarios de actividad del Jabalí (*Tayassu pecari*) en la región este del Parque Nacional Mirador-Río Azul, Petén, Guatemala *by José Moreira, Roan McNab, Rony García, Francisco Córdova, Tomás Dubón, Marcial Córdova y José Soto* **31**

First photo register of white-lipped peccary, *Tayassu pecari*, in Grande Sertão Veredas National Park, Minas Gerais state, Brasil. / Primeiro registro fotográfico de queixada, *Tayassu pecari*, no Parque Nacional Grande Sertão Veredas, Minas Gerais, Brasil *by Joaquim A. Silva, Edsel A. Moraes Jr. & Marcelo J.R. de Oliveira.* **33**

Análise espacial de um remanescente da Floresta com Araucária baseada nas métricas da paisagem e nos requisitos ecológicos de ungulados silvestres, Paraná, Brasil. / Spatial analysis of forest remainder with Araucaria based on the landscape metric and on the ecological requirements of wild ungulates, Parana, Brazil *by Gisley Paula Vidolin, Daniela Biond, Adilson Wandembruck* **34**

NEWS IN BRIEF (1-3) **37**

NEW LITERATURE ON SUIFORMES **40**

---

## Editorial: Farewell to my favourite newsletter

**All great things must come to an end. After 7 years of publishing the newsletter of the IUCN/SSC Pigs, Peccaries, and Hippos Specialist Group, I have decided to move on and focus on other conservation work. It was not an easy decision, as I have greatly enjoyed my work with the PPHSG.**

I started as the coordinator of a small research group dealing with Bornean Bearded Pigs (*Sus barbatus*), for which I published a regular information bulletin. That bulletin quickly became formalized in a newsletter, with the simple name Asian Wild Pig News. Not much later William Oliver, the PPHSG chairman, asked me whether I would be interested in developing a newsletter that would deal with all PPHSG species, and within 2 years we had created Suiform Soundings, the official PPHSG newsletter.

The online, pdf format of the newsletter proved popular, and I took pride in monitoring its increasing popularity by checking the number of downloads from our website. From an initial average of <2.5 downloads/day, we went up to >5.5 downloads/day in 2007, with some 300 people downloading the latest issue when these were released. Clearly no Science or Nature, but it means that the newsletter was reaching some 2,000 people every year, if we include the regular subscribers. For a relatively obscure topic such as pig, hippo and peccary conservation, that is not bad.

Looking back I think I had hoped for more. I wanted to create a newsletter that would really drive the PPHSG's strategies and activities, and become the central communication tool for the group. For a group that has limited funds for meetings, an effective communication strategy is very important to ensure that all group members really feel part of a group. Effective participation in a group helps in the development of common strategies and also funding mechanisms for conservation. I could have done better there. But in the end it all became too time consuming, even though I obtained much needed support from Mariana Altrichter and Edsel Amorim Moraes Junior, who vastly increased the output from Latin America. Every 6 months I was struggling to prepare the next issue, sacrificing my holidays

in the process, and when my professional work load significantly increased when I took on a new job while retaining the old one, I simply ran out of steam.

My decision to move on was not taken lightly, and I do worry that I am letting down my colleagues who continue this important conservation work. Some of that worry is taken away because I know that my successor will do a very good job at further developing the newsletter. With this, I would like to introduce Anne-Marie Stewart, the new editor-in-chief who has kindly agreed to take over from me. I have just worked with Anne-Marie for a year in Borneo, and fully trust her to do an excellent job at keeping the newsletter going and improving it. Anne-Marie's long-term experience in African conservation might also help in attracting more interest for hippos and hogs from researchers working on that continent. Together with Chris Gordon who has accepted the interim position as Africa coordinator, this should considerably strengthen our African conservation work.

I would like to thank everyone who has helped me with the newsletter over the last few years, especially Kristin Leus, Colin Groves, Rona Dennis, William Oliver, Rebecca Lewison, Jean-Pierre d'Huart, Mariane Altrichter, and Edsel Moraes Junior. I really hope that there will be a Suiform Soundings for many years to come, and that the PPHSG will continue to develop its important conservation work. Good luck and all the best.

*Erik Meijaard*



---

## ... And greetings from the new editor.

Welcome to this, the 13th issue of Suiform Soundings and the first of 2007. It is also my first issue as the new editor, and I look forward to many more successful offerings. I have taken over from the previous editor, Dr. Erik Meijaard, with whom I worked in Indonesian Borneo, and I'm sure you'll all agree that his are rather difficult shoes to fill!

I am new to the world of pigs, peccaries and hippos and am learning all the time about the conservation issues pertaining to the various species. This newsletter has served in the past to keep you updated about recent developments in ecological studies and conservation of the PPHSG species, and I hope it will continue to do so. Erik expressed his desire to see this newsletter serve as a tool for communication between various members, and a possible fundraising channel. It was his aim that Suiform Soundings also help to channel research towards critical issues. I think this newsletter has proved successful in meeting many of these objectives.

But it has even more potential to serve as a platform from which researchers and managers who

deal with issues pertaining to PPHSG species can communicate, co-ordinate, and provide feedback on research and conservation efforts. As members of PPHSG, and readers of this newsletter, it depends largely on you in what direction you would like to see this newsletter heading. So please send me your opinions, feedback and suggestions. And keep the contributions coming!

This issue includes an article on the status and conservation of Babirusa in the Togean Islands, as well as a brief history of claims of sympatric wild hogs in Indochina. Our Latin American group has contributed a number of articles on peccary species, and we also have a paper advocating the hunting of wild boars in Sumatra. The newly-appointed interim Africa coordinator, Chris Gordon, outlines his plans in a letter to the group - please assist him by contributing any information you may have on the African suids.

And finally, a huge thank you to all of you that answered my pleas for contributions to this newsletter. Happy reading!

*Anne-Marie Stewart, Cape Town, South Africa*

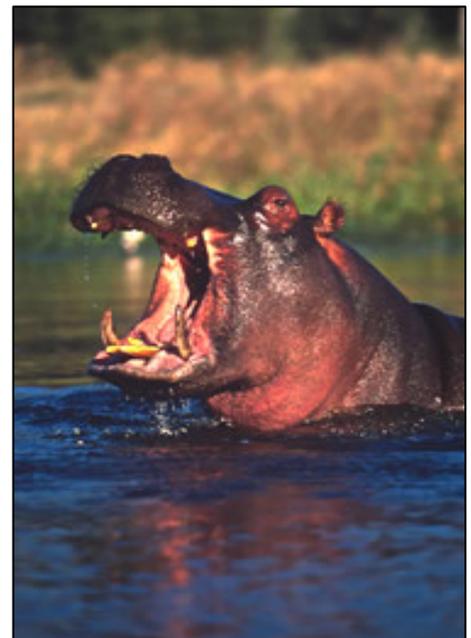
---

## Decline in the Hippopotamus Population of the Virunga National Park

**In the last issue of Suiform Soundings, Rebecca Lewison reported on the decimation of the hippo population in Virunga National Park, DRC. Large scale poaching driven by civil unrest has led to a drop in hippo numbers by more than 90% in this area, resulting in a serious threat to the continued existence of this population. In this issue, we include an extract from the online blog of Robert Muir, who highlights just how serious the situation is.**

*From Gorilla Journal 33, December 2006:*

A census carried out October 23rd, 2006 revealed that there are only 629 hippos left in the Virunga National Park, Democratic Republic of the Congo. In the late 1960s and early 1970s there were around 30,000 hippos living in the park. The aerial census carried out by the *Frankfurt Zoological Society* (FZS), with funding from the *US Fish and Wildlife Service*, showed that this population had declined by 98%. With the second round of presidential elections



---

in Congo less than one week away, the Mai-Mai and other non-integrated local militia groups were poaching at an unprecedented rate because they believed their days in the park were numbered. The Congolese army, who operate in the park without sufficient rations or salary, have also been accused of poaching the hippos, often in collusion with the militia troops. The problem had become so serious that the Ugandan military deployed troops along the River Ishasha, which separates Congo from Uganda, to help deter the Mai-Mai from killing the park's largest remaining group of hippos consisting of only 134 individuals. The Mai-Mai and other poachers have been targeting hippos and elephants for their ivory, which is collected regularly from the militia camps and is thought to leave Congo through Uganda and Sudan to be traded illegally on the international black market. The Mai-Mai have refused to engage in dialogue with the rangers and have recently begun launching attacks on their patrol posts. Despite the fact that over 100 rangers have been killed over the last few years trying to protect Virunga's wildlife populations, and that they have not received a proper salary for more than a decade, the rangers continue to show remarkable commitment, determination and fortitude. After years of hardship, some support from the European Union and other donors is enabling the Congolese rangers to take control of the situation, but this positive development may be too late for the hippos. Poaching has now become so prolific, and the threat to rangers so serious, that a combined operation between the park rangers and the UN peace keeping troops is needed. The Mai-Mai camps are well known to both the rangers and the UN, and an operation needs to be mounted quickly. But the UN is preoccupied with the lead up to the second round of elections and the militia forces have taken advantage of the situation. Over the last months the park has seen unprecedented levels of poaching, ambushes, violence, and violations of human rights.

**Update December 2nd:** The situation has gone from bad to worse, and despite significant risks, the ICCN are now sending their rangers to Vitshumbi to protect one of the last main hippo groups. The sudden increase in poaching comes as a direct result of UN and military troops leaving the park in support of operations against the dissident General Laurent Nkunda. The vacuum has been filled by a lunatic group of Mai-Mai rebel soldiers currently living in the park. Many of these soldiers have now moved out of the bush and into Vitshumbi, a fishing village on the edge of Lake Edward, where they are systematically destroying what remains of the hippo population.

**Update December 4th:** I have just flown over Vitshumbi where less than 2 months ago we had counted over 200 hippos. Today we saw just 13. This follows a massive slaughter over the past week by a group of Mai-Mai some 20 km east of Vitshumbi on the southern shores of Lake Edward. This same group of Mai-Mai attacked Lulimbi, a ranger station in the east of the park. Fortunately no one was killed, but they left a ranger badly injured and made off with 10 rifles and 4 walkie-talkies. The Virunga Park's best chance now lies in the hands of its elite ranger force, trained by FZS and deployed to help protect the last few hippos from extinction. The Congo rangers are massively underresourced and are outnumbered five-to-one by poachers armed with machine guns and rocket launchers. UNESCO and the EU are engaging at the highest political levels in Kinshasa, but support in terms of patrol equipment, rations and salary supplements is desperately needed on the ground if the rangers are to halt the precipitous decline in hippos and wildlife.

*Robert Muir (from his blog on [www.wildlifedirect.org/congo-rangers](http://www.wildlifedirect.org/congo-rangers) )*

How you can help: If you are interested in contributing directly to protect Virunga Hippos, visit [http://www.wildlifedirect.org/congo-rangers/?page\\_id=96](http://www.wildlifedirect.org/congo-rangers/?page_id=96). To support hippo conservation efforts across Africa, you can donate to the [International Hippo Foundation](#), contact [rlewis@sciences.sdsu.edu](mailto:rlewis@sciences.sdsu.edu) for more information.

---

“I have myself a poetical enthusiasm for pigs, and the paradise of my fancy is one where pigs have wings. But it is only men, especially wise men, who discuss whether pigs can fly; we have no particular proof that pigs ever discuss it.” *G.K. Chesterton (1874 – 1936)*

---

## A letter from our Afro-tropical co-ordinator

Dear Members,

I have recently taken over as the interim Afro-tropical regional co-ordinator for the PPHSG. Firstly, many thanks to Jean-Pierre d’Huart for all his hard work and enthusiasm over the years. The development and success of a group such as this one relies very much on the dedication and expertise that someone like Jean-Pierre offers.

Coming into this role leaves one thinking just where to begin! The most immediate thing that springs to mind is the Action Plan, which was written in 1993. So I felt that perhaps, we, as a group, could update it for 2008, to see what we have achieved in the last 15 years, what is still to do, what we have learnt and how best to coordinate all future efforts for the relevant regions / species. I can only speak for the Africa region, but in order to do this we will need to reassess the current status of the 5 African Suids. Once this has happened, we can liaise with Rebecca Lewison to look at the Hippopotamuses in the

Afro-tropical region to determine jointly how best to progress with the Action Plan for these seven species.

I plan to do this in two stages, firstly by updating the status of *Phacochoerus africanus* and *Phacochoerus aethiopicus*, and then addressing the other three Suids. I will, however, need some help from any researchers / specialists in the Afro-tropical region so as to collate everything that has happened in the past 15 years. In this issue, I plea for anyone who has worked with or even held an interest in the two warthog species to send any relevant information to me (distribution, population size, local extinctions, increased pressures in particular regions on these species etc etc.) I hope to collate this data in time for the next issue, whereby I shall turn my attention to the other species and then we can update the action plan. Thank you very much in advance to all those who are able to help in any way.

With best wishes, and in anticipation,

Chris Gordon

[chrisgordon@hotmail.com](mailto:chrisgordon@hotmail.com)



The common warthog, *Phacochoerus africanus*, photographed in the Eastern Cape area of South Africa.

*Photo courtesy of P. Schulz*

---

## A Short History of Claims of Sympatric Wild Hog Species in Indochina

Gary J. Galbreath, Ph.D.

Biological Sciences, Northwestern University, Evanston, IL USA, and Geology Department, Field Museum, Chicago, IL USA Email: gjg853@northwestern.edu

Despite the ongoing discussion (e.g.: Groves *et al.* 1997, Robins *et al.* 2006) concerning the possible reality of *Sus bucculentus* as a species occurring in the Annamite Mountains, it is perhaps not widely realized that there is a long and complex history of claims of sympatric species of wild hog in (former French) Indochina.

As long ago as 1908, an unnamed naturalist told de Monestrol (1952) that he had seen Cambodian peccaries. Indeed, the notion that peccaries existed in Indochina sympatric with the larger wild boar *Sus scrofa* may have been widespread among colonial hunters in the early 20<sup>th</sup> century. Tiran (1929) and Sauvaire (1930) wrote of them, the latter author stating that the peccaries lived in large bands up to a hundred strong. Sauvaire further stated that peccary/wild boar hybrids occurred, living separately from the peccary bands.

Millet (1930) noted a type of wild hog found in highland areas of what is now Vietnam that he suspected to be a domestic hog/wild boar hybrid form. This hog was stockier than the wild boar, with weaker canines and shorter and fewer bristles. Teston & Percheron (1931) mentioned wild hogs that tasted like domestic ones, and that were not the same as the wild boar. Plas (1932) mentioned a good-tasting type of wild hog resulting from wild boar/domestic hog hybridization. Cheminaud (1939) depicted a short-legged supposed wild/domestic hybrid. Chochod (1950) discussed wild “Moi hogs” that hunters claimed to be a race ultimately descended from domestic hogs.

More recently, sympatric wild hogs were reported from a site in northern Vietnam by local people (Meijaard *et al.* 2002). One was said to have a long face marked on the sides with white; the other, a shorter face and shorter legs. The putative shape of the latter’s footprint suggests a feral form. Meijaard *et al.* (2002) also reported (second-hand) that at a site in southern Vietnam, a hog with white on the sides of the face was said by local people to coexist with a generally darker, longer-snouted hog.

De Monestrol (1925, 1952) discussed the widespread occurrence of feral hogs in Indochina. This phenomenon is to be expected even today, given the freedom to roam that many rural domestic hogs enjoy. Many domestic hogs, particularly in highland areas, possess an appearance somewhat similar to that of *Sus scrofa* to begin with (Bauche 1902, D’Andre 1906, Millet 1930, De Monestrol 1952, personal observations). Male hogs are often either castrated early (Bauche 1902) or kept in close confinement, so first-generation feral animals in breeding condition will most often be female. Such females can be expected to mate at times with *Sus scrofa*, producing hybrid offspring in the wild.

In the northern Annamites today, one type of wild hog is said by local people to be lankier and longer-faced than another, darker form (Groves & Schaller 2000). The former has been thought to represent *Sus bucculentus* occurring within a small range. But as documented above, stories of an “extra” Indochinese wild hog are not confined to the northern Annamites. The most parsimonious hypothesis is that all accounts, over nearly a century, involve semi-feral, feral, and/or hybrid animals. In the northern Annamites, the lighter-colored, lankier, longer-faced form, mistaken for *Sus bucculentus*, is probably the relatively light-colored form of *Sus scrofa* found east of the Mekong. The darker, squatter, shorter-faced form probably consists of hogs wholly or partly descended from domestic stock. This conclusion concurs with analysis of mitochondrial DNA data (Robins *et al.* 2006) in casting doubt on the existence of *Sus bucculentus*.

### References:

- Bauche, J. 1902. Les porcins d’Indo-chine. *Bulletin Économique, Nouvelle Série* No. 12: 841-852.
- Cheminaud, G. 1939. *Mes Chasses au Laos. Tome I.* Payot, Paris.
- Chochod, L. 1950. *La Faune Indochinoise.* Payot,

- Paris.
- D'Andre. 1906. Note sur la race porcine de la région Moï. *Bulletin Économique, Nouvelle Série* No. 49: 217.
- De Monestrol, H. 1925. *Les Chasses et la Faune d'Indochine*. Imprimerie d'Extrême-Orient, Hanoi.
- De Monestrol, H. 1952. *Chasses et Faune d'Indochine*. A. Portail, Saigon.
- Groves, C. P. & G. B. Schaller. 2000. The phylogeny and biogeography of the newly discovered Annamite artiodactyls. In: *Antelopes, Deer, and Relatives* (Eds: E. S. Vrba & G. B. Schaller). Pp. 261-282. Yale Univ. Press, New Haven and London.
- Groves, C. P., G. B. Schaller, G. Amato & K. Khounboline. 1997. Rediscovery of the wild pig *Sus bucculentus*. *Nature* 386: 335.
- Meijaard, E., W. L. R. Oliver, B. Martin & V. N. Thanh. 2002. Records and reports of pigs in Vietnam. *Asian Wild Pig News* 2 (2): 40-42.
- Millet, F. 1930. *Les Grands Animaux Sauvages de l'Annam: Leurs Mœurs, leur Chasse, leur Tir*. Librairie Plon, Paris.
- Robins, J. H., H. A. Ross, M. S. Allen & E. Matisoo-Smith. 2006. *Sus bucculentus* revisited. *Nature* 440 (13 April 2006): E7. (doi: 10.1038/nature04770)
- Sauvaire, P. 1930. *Mon vieil Annam. Ses Bêtes*. Challamel, Paris.
- Tiran, G. 1929. *Big Game Hunting in French Indochina*. J. Aspar, Saigon.



This photo, published in several Philippine local newspapers depicts a group of Mindanao warty pigs (*S. philippensis mindanensis*) in a little zoo in Metro Manila. According to William Oliver, who sent in this contribution, the animals shown in this picture appear to be in full breeding condition, as evinced by the well-developed mane of the boar (left), which is (probably) shed during the non-breeding season, and obvious white 'highlights' in the crest of the sows (on right), which the zoo owner, Manny Tangco, claims are characteristic of females in breeding condition and not evident at other times of the year.

---

## Actividades del sub-grupo pecaríes

*Mariana Altrichter*

El sub-grupo pecaríes del grupo de especialistas de la UICN organizó un taller sobre conservación e investigación de pecaríes. El mismo se llevó a cabo durante el VII Congreso Internacional sobre Manejo de Fauna Silvestre en la Amazonía y América Latina. El congreso se realizó en Ilhéus (Bahía, Brasil) del 3 al 7 de septiembre de 2006. El taller duró cinco horas de intenso trabajo, y fue muy enriquecedor gracias al aporte de las personas que asistieron. Hubo aproximadamente 30 personas presentes, entre investigadores de varios países, estudiantes y otros interesados en pecaríes. A cargo de la organización del taller estuvieron: Richard Bodmer, Mariana Altrichter, Rafael Reyna, y Edsel Edsel Amorim Moraes.

La meta del taller fue fortalecer la comunidad de investigadores e interesados en pecaríes y avanzar hacia adelante en la conservación, manejo y conocimiento de estas especies, así como revisar las metas y actividades del sub-grupo pecaríes. Podemos decir con placer que la meta se cumplió satisfactoriamente.

Durante el taller hicimos actividades para 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 experiencias de campo con el fin de hacer las futuras investigaciones más eficientes.

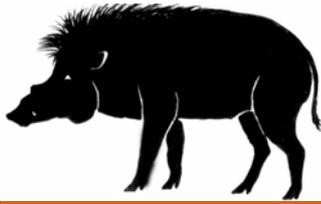
Primero hicimos presentaciones para informar a los participantes sobre las actividades y metas de los Programas Mayores de estudio y manejo de Pecaríes. Estos son programas de larga duración, multi-institucionales y multi-propósitos. Los programas que se presentaron fueron:

- Programa de establecimiento de prioridades para pecaríes labiados (presentado por Mariana Altrichter).
- Programa de certificación de pieles (Richard Bodmer).
- INCO, "Programme for international scientific cooperation" de la Unión Europea (Pedro Mayor, Yvonncik Le Pendu, y Alcester Mendes).

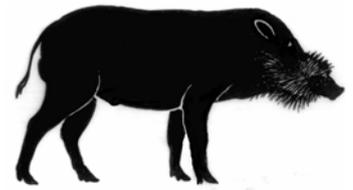
Rafael Reyna hizo una revisión de metodologías usadas en las investigaciones de campo de pecaríes. Previo al taller, Rafael se contactó con investigadores y recopiló información de los diversos métodos que se han aplicado en el estudio de pecaríes en campo. Gracias a la colaboración de los investigadores, se logró hacer una revisión muy completa y con recomendaciones útiles para futuros estudios. Los resultados de esta actividad se pueden ver en el número anterior del Suiform Soundings.

Mariana Altrichter hizo una presentación en la que se describió brevemente cada uno de los estudios y proyectos relacionados a la conservación de pecaríes que se están haciendo actualmente, y los que están empezando. Para armar esta presentación también se necesitó la colaboración de los investigadores previo al taller, por lo que es posible que no todos los estudios que se están desarrollando actualmente hayan sido presentados. Luego se hizo un resumen del número de investigaciones por tema y por país, y entre todos los presentes se armó una lista de temas importantes para investigar.

Posteriormente, Richard Bodmer hizo una revisión de las metas y actividades del sub-grupo pecaríes. Entre todos los presentes se discutieron las limitaciones y posibilidades del grupo y se decidieron algunas acciones para seguir fortaleciendo el mismo. Entre otras, se propuso que se diseñara una estructura organizativa con comités, representantes de especies y representantes de países. En estos momentos, Mariana Altrichter está contactando a los investigadores de pecaríes para dar seguimiento a esta propuesta. Muchos investigadores ya han respondido y en el próximo número del Suiform Soundings esperamos publicar la estructura organizativa del sub-grupo pecaríes.



# Papers and communications



## Observations of Social Structure Changes in a Collared Peccary Herd

Selene S. C. Nogueira<sup>\*</sup>, Tais M. A. Pereira, Ana Paula Serra Lopes & Sérgio L. G. Nogueira-Filho  
Universidade Estadual de Santa Cruz – UESC, Ilhéus, Brazil

Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz – UESC, Rod. Ilhéus  
Itabuna, km 16, Ilhéus, BA, Brazil, 45650-000.

<sup>\*</sup> Corresponding author, E-mail: [selene@uesc.br](mailto:selene@uesc.br) Fax: + 557336805226 Phone: +557336805262

### Introduction

The collared peccary (*Pecari tajacu*) is one of three species of peccary (Artiodactyla, Tayassuidae) that inhabits the Neotropics (Eisenberg, 1989). In the Central and South American rain forests, this species lives in small herds consisting of 3 to 15 individuals (Castellanos, 1983, Fragoso, 1994, Robinson and Eisenberg, 1985). Their herd size and composition does not change during the year, except when herds are temporally fragmented due to a seasonal lack of food resources (Ellisor and Harwell, 1969, Bigler, 1974, Sowls, 1974, Byers and Bekoff, 1981). Furthermore, two or three herds could drift together when an abundant but highly localized food resource becomes available; at these times up to 50 collared peccaries can be seen together (Green et al., 1984, Robinson and Eisenberg, 1985, Fragoso, 1998, Altrichter, 2005). Thus, they are classified as a fission and fusion society, in contrast with the white-lipped peccary (*Tayassu pecari*), a species closely related to Tayassuidae species that lives in extremely cohesive units (Sowls, 1997; Fragoso, 1998).

Among social individuals, some kind of social structure is needed to maintain the group cohesiveness to avoid disruption and resolve conflicts when members dispute a limited resource (Wilson, 1975). In the literature, there is a controversy regarding the existence of social dominance among members of collared peccary

herds. Bissonette (1982) described a linear dominance hierarchy in wild peccary herds, with a dominant male always located at the top of hierarchy. On the other hand, Byers and Bekoff (1981) did not recognize social dominance among wild peccary herds. Sowls (1984) criticized both studies because the authors did not identify all herd individuals; consequently, they could not draw unquestionable conclusions about peccary societies.

Through analysis of social interactions of marked animals under captivity, Sowls (1997) described social dominance hierarchy among individuals of collared peccary herds. The author concluded that no definite answer can be offered on which kinds of social dominance occur among collared peccary. The same was inferred by Nogueira-Filho et al. (1999), who could not rank herd individuals in any kind of hierarchical order, although several behavioral patterns related to dominance/subordination were observed among individuals of a collared peccary captive herd. Otherwise, Dubost (2001) found “a clear dominance hierarchy” within a captive collared peccary herd, with two distinct monosexual hierarchical orders. Additionally, the Packard et al. (1991) observation suggests some kind of social structure among collared peccaries. The authors observed that the mating system of captive collared peccaries appears to be flexible, possibly switching between polygyny and promiscuity depending on the ability of a male to maintain exclusive breeding status.

---

The analysis of collared peccaries' social relationships and proximity are important in order to understand how to manage these animals under captivity and provide diagnosis of social incompatibilities among individuals assembled arbitrarily in collared peccary farms. In this context, the aim of this study was to analyze the consequences of herd changes in peccary social interactions in order to clarify some aspects of their social structure after individual removal.

## Methods

### *Animals and housing*

We observed 12 adult collared peccaries (4 males and 8 females), born and reared under captivity. The age classes were rough estimates based on tooth wear described by Sowls (1984); the males' age varied from four to six years old while females' ages ranged from six to eight years old.

We obtained the animals from the Mossoró Experimental station in Rio Grande do Norte, Brazil, and they were living together about two years before this study started in an 1800 m<sup>2</sup> paddock at the Almada Experimental Station of the Universidade Estadual de Santa Cruz in Ilhéus, Bahia, Brazil. The area where they lived was surrounded by a 1.5-m high net wire fence and had a dirt substrate with low vegetation, one 12m<sup>2</sup> shelter, one water tank (0.6-m x 0.3-m) and four feeders (1.0-m x 0.3-m). In order to identify the animals, we used colored plastic ear tags cut in different shapes. The animals were fed *ad libitum* an experimental diet composed of maize, wheat meal and mineral salts (12% of crude protein and 3.2 kcal/g of gross energy), ensuring the nutritional requirements of collared peccaries were met (Galagher et al., 1984). They also had *ad libitum* access to water.

### *Observation sessions*

The observation sessions occurred between June-July, 2002 from 0830 h up to 1030 h on non-consecutive days. We observed the herd for 44 hours; 22 hours before female (A) removal (Period I) and after female (A) removal (Period II). We observed all occurrences (Altmann, 1974) of squabbling and tooth clacking interac-

tions, both agonistic acts related with dominant-subordinate relationships. The squabbling was originally described by Sowls (1997), and occurred when two animals faced each other, raised their snouts, opened their mouths, and emitted a growl in a sparring position. Tooth chattering by both animals accompanied the action, and is described by Byers and Bekoff (1981) as the sound beginning with a low-pitched, growling vocalization and giving way to an explosive series of "pops" or "clacks".

We also recorded friendly interactions: mutual rubbing, olfactory investigation, contact and related acts, interactions originally described by Byers and Bekoff (1981). Mutual rubbing occurred when two animals, oriented head-to-tail with their sides touching simultaneously, rubbed the sides of their heads up and down over the other's rump in the region of the dorsal gland. Both animals started and stopped at about the same time. Unreciprocated mutual rubbing occurred when one animal, in the typical mutual rub posture with another, mutually rubbed while the other stood still. Nose to nose contact was a mutual act, in which both animals stretched their necks forward and brought their rhinal disks close together, sometimes lightly touching. Finally, we recorded all nose back acts: when one animal applied its nose to, or close to, the back of another one. Sniffing or movements of the rhinal disk were sometimes observed. Nogueira-Filho et al. (1999) classified such contact actions as friendly interactions since in their study such actions were only performed by acquainted individuals.

### *Data analysis*

We compared the occurrences of agonistic to friendly interactions between the two periods through a likelihood-ratio (*G*-test). This statistical analysis was carried out using SPSS software (Statistical Package for the Social Sciences, version 11.0, SPSS Inc., Chicago, IL, USA).

The dominant-subordinate relationships were analyzed using the approach originally described by Lehner (1996). We scored every individual either as a winner or a loser after each aggressive interaction. We considered as a loser the animal that

showed submissive displays or fled from the winner. Data on agonistic encounters was entered into a dyadic agonistic interaction matrix. In the columns were listed the winners while the losers were listed in rows. Animals were considered dominant over another when the number of victories won by this individual was greater than the number of defeats. Winners were scored as one while losers were scored as zero. Two individuals of equal rank received the intermediate score of 0.5. Following this procedure, we determined the Kendall (K) index of linearity following Appleby's (1983) procedure. This index ranges from 0 (non-linear hierarchy) to 1 (perfectly linear hierarchy).

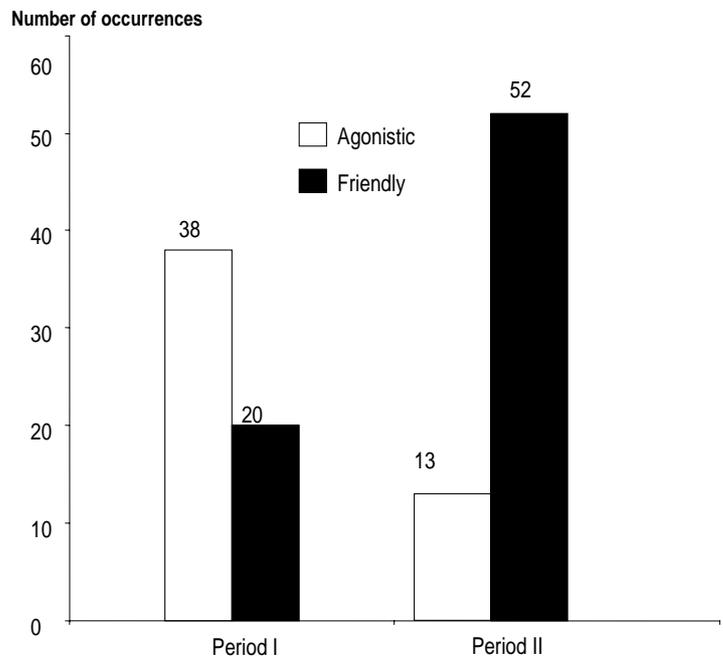
Dominant-subordinate relationships were analyzed among the whole herd (males and females together in the same hierarchy) and grouped by sex. Additionally, results of agonistic encounters were graphically expressed through diagrams. Finally, the animal spatial pattern data (scan sample) was analyzed using the single linkage methods in Minitab (version 14).

We analyzed the individual proximity patterns through the scan sample method, as proposed by Lehner (1996). We recorded the animals' locations within individual quadrants (100m<sup>2</sup>). We considered two or more animals to be together if one was no more than two body-lengths away from another. We located the position of all animals every 15 minutes and determine the relative distance between individuals.

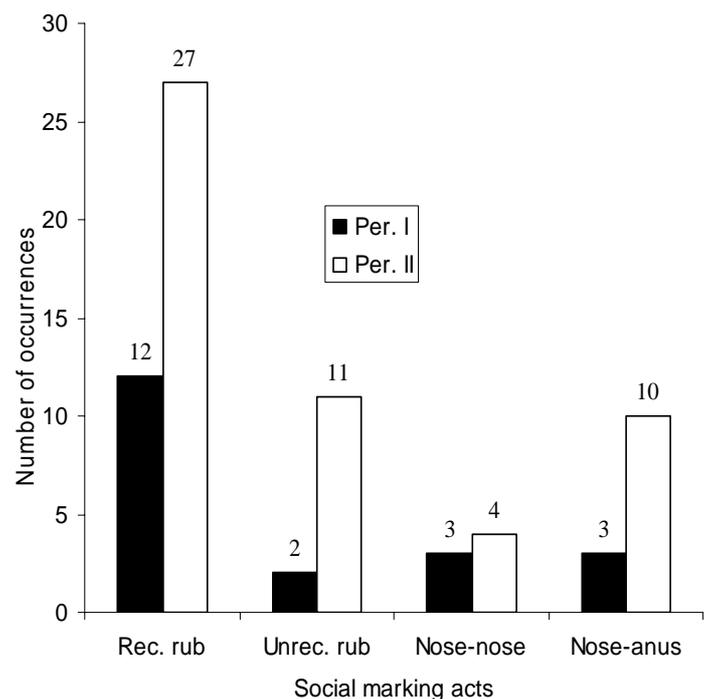
## Results

### *Agonistic and friendly interactions and analysis of social dominance hierarchy*

In the present study we observed a decrease on agonistic interactions among animals and an increase on friendly interactions from Period I to Period II ( $G$  (Willians) = 26.79;  $FD = 1$ ;  $P = 0.0001$ ) (Figure 1). We observed 72 mutual rub, inter-individual olfactory investigation and related friendly acts. The majority of these acts (52) were observed after female A was removed (Figure 2).



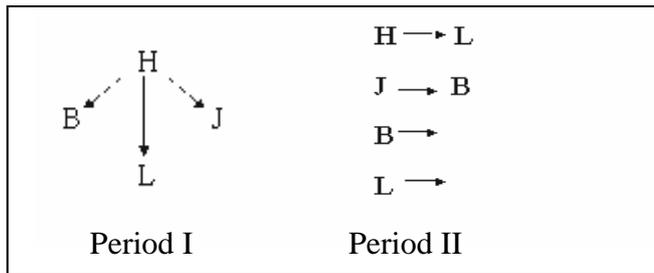
**Figure 1: Occurrences of agonistic and friendly interactions during the Periods I and II.**



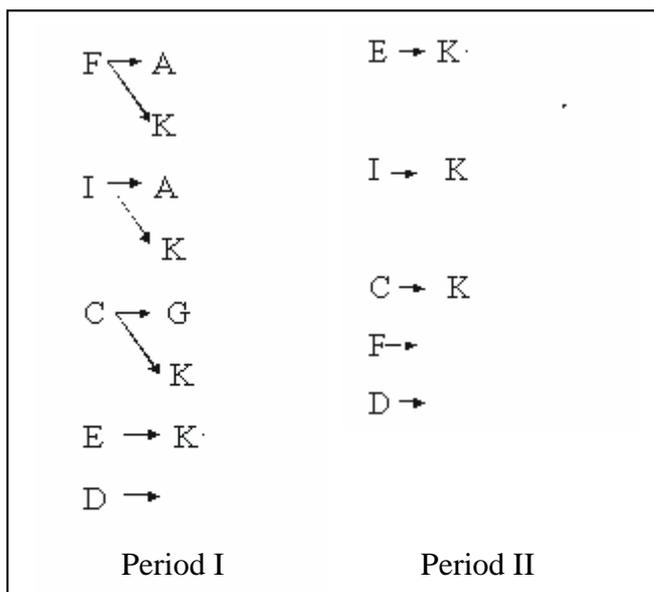
**Figure 2: Scent related acts during the Periods I and II.**

Using the Kendall indices, it was possible to conclude that collared peccaries did not exhibit a linear hierarchy either for the whole herd or for males and females separately.

Figures 3 through 5 graphically express the results of dominant-subordinate relationships among peccary herd individuals: within males, within females and within males and females. On the other hand, the shape of the diagram obtained through conflict analysis among males during Period I suggests the presence of a despotic hierarchy (Table 1 and Figure 3). This diagram shows male H as dominant with the remaining males in the same subordinate hierarchical position. In the subsequent period, however, the same kind of hierarchy was not evident (Figure 3).



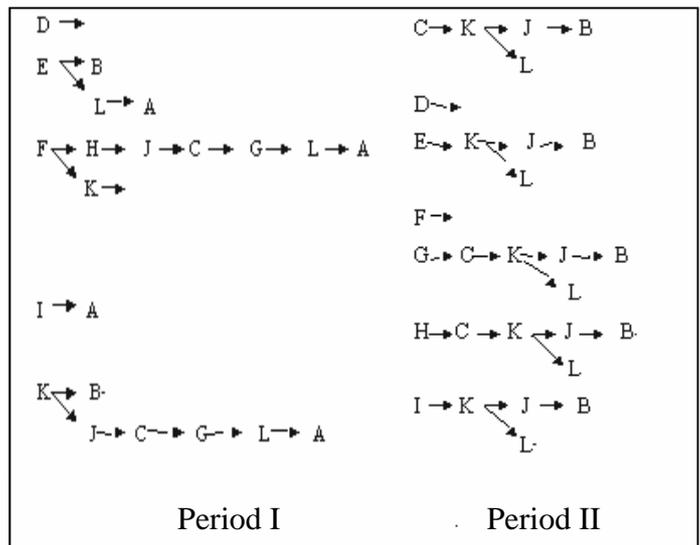
**Figure 3: Male dominant-subordinate relationships during the observational periods. The arrows indicate the dominance direction.**



**Figure 4: Female dominant-subordinate relationships during the observational periods. The arrows indicate the dominance direction.**

**Table 1: Kendall linearity indexes (K) according to the observational period**

Observational period	Males	Females	Whole herd
PI	0.6	0.36	0.3
PII	0.3	0.01	0.05



**Figure 5: Whole herd dominant-subordinate relationships during the observational periods. The arrows indicate the dominance direction.**

#### *The individual proximity pattern analysis*

Dendrograms (Figures 6a and 6b) show the segregation of the herd individuals during the two periods into a larger subgroup, and some individuals into couples or alone. During Period I, we observed one subgroup comprised of seven individuals (F, H, I, E, K, G and D), two couples (CB and JL) and an isolated individual (A) (Figure 6a). After the displacement of the female A during Period II, the dendrogram (Figure 6b) revealed one subgroup (DHI) and four couples (CB, KE, GF and JL).

#### **Discussion**

In order to determine the appropriate management practices to manage collared peccaries under captivity conditions and to obtain information to reduce fights in their herds we must better understand their social relationships.

Byers and Bekoff (1981) suggest that collared peccary gregariousness is selectively favored as an anti-predator adaptation. However, as observed in primate societies, social life in a group provides a variety of physical stresses including agonistic encounters, running from a rival or producing energetically costly displays (Beehner et al., 2005). For this reason, some societies organize themselves into dominance hierarchies with dominant individuals holding priority access to limited resources. Collared peccary herds are normally described as stable

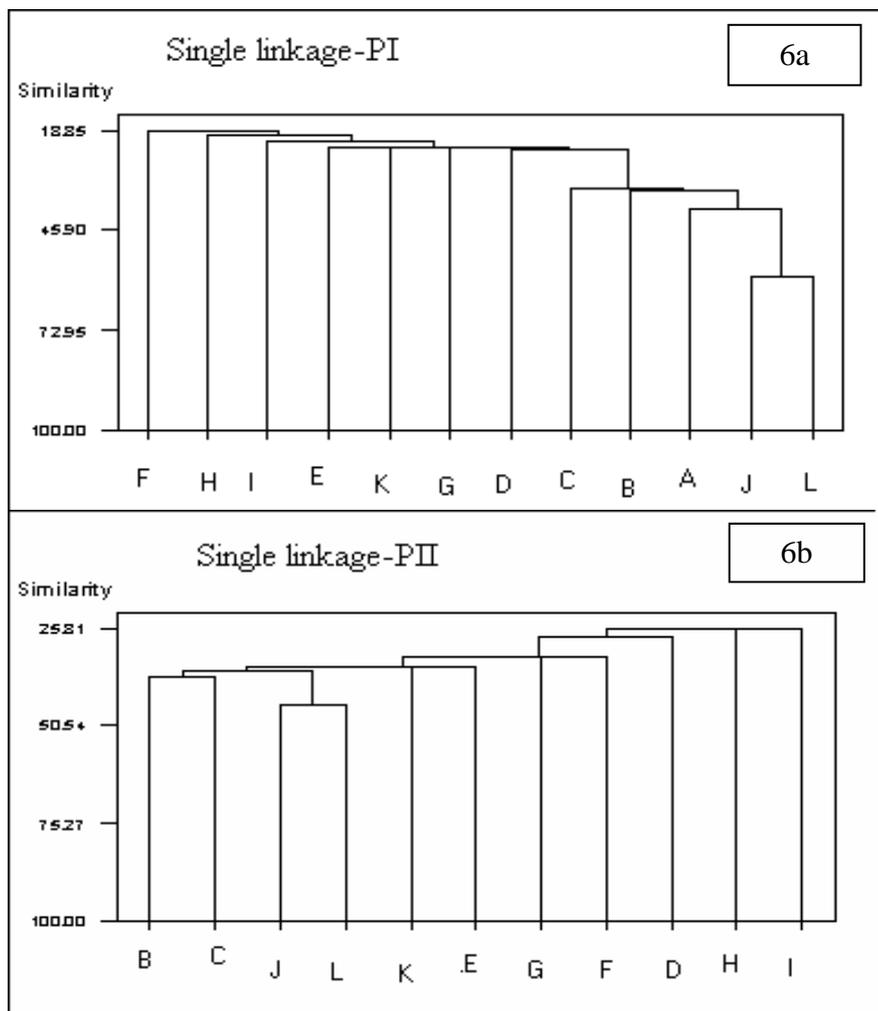
and cohesive (Byers and Bekoff, 1981; Sowls, 1997). However, Schweinsburg (1971) observed five individuals that abandoned their original home range and joined another herd. The newly arrived individuals were never fully integrated, remaining outside the core of their new herd. The same was proposed by Day (1985), who observed four outsider males trying to join a herd but continually being repulsed. Even individuals of the same herd that were temporarily isolated were never completely re-integrated (Byers and Bekoff, 1981).

This kind of social segregation was also observed under captivity conditions by Nogueira-Filho et al. (1999), who studied a herd comprised of individuals obtained from different colonies. Even after two years being housed in the same enclosure the authors observed friendly interactions according to the individual's origin. Indeed, deadly fights were recorded when unacquainted animals were placed together in captivity (Lochmiller and Grant, 1982, Sowls, 1997, Nogueira-Filho and Nogueira, 2004). Perhaps the same kind of social exclusion occurred in the present study, which could

explain why one individual was unable to access enough food to maintain its weight despite these resources being offered *ad libitum*.

Additionally, the low Kendall linearity indexes found in this study corroborate the results of Sowls (1997) and Nogueira-Filho et al. (1999) where they did not find linear hierarchy among all herd individuals. However, we obtained a star-shaped diagram of male dominant-subordinate relationships during Period I (Figure 3), as the females displayed only partially linear structures (Figure 4), while the whole herd dominant-subordinate relationships also showed partially linear structures (Figure 5). Dubost (2001) suggested that males and females are organized in two distinct hierarchies. On the other hand, our data suggested that the collared peccary herd has three interaction levels of social structure, one for each sex (male or female) and another one for the whole herd.

The star-shaped pattern suggests a despotic hierarchical social structure among peccary males. In such a social structure, one individual rules over all other members of the group, with no rank distinctions made among the subordinates (Wilson,



**Figure 6. The spatial proximity among animals during the Period I (a) and II (b).**

1975). In the present study only one male (H) – dominated all other males of the same social status. Dominant animals of some despotically organized societies, such as bumblebees and lizards, utilize their power to terminate fighting among subordinates; aggression sharply increases when the dominant individual is removed (Wilson, 1975). Nogueira-Filho et al. (1999) observed only one male marking along territory with its dorsal gland and actively terminating conflict between other herd members. Sometimes, however a female passively interfered in conflicts between two males simply by being between them.

We did not observe any active or passive interference acts among peccaries as noted by Nogueira-Filho et al. (1999). It is interesting, however, that during Period I, in the presence of Female A, we did not observe agonistic interactions between subordinate males J and B. However, after the Female A displacement, we observed that these males began to fight each, thereby ending the despotic male hierarchy (Figure 3). In Figure 6a the Female A position suggests that this animal is a link between the bulk of the herd and the dyad formed by males L and J. We conclude that her removal promoted a disruption of male social structure. These facts suggest that even though a collared peccary herd is organized in separate male and female hierarchies as proposed by Dubost (2001), nevertheless individuals from one sex could exert influence upon the social structure of the other.

Additionally, and differently from our expectations, the agonistic interactions decreased while the mutual rub, inter-individual olfactory investigation and related friendly acts increased due to a change in social structure (Figure 1). Among collared peccaries, the friendly contacts and olfactory investigations were used to maintain herd integrity or cohesion both in the wild and in captivity (Byers and Bekoff, 1981, Sowls, 1997 Nogueira-Filho et al., 1999; Dubost, 2001). The increase in social marking, olfactory investigation and related acts observed after herd change corroborates this hypothesis and suggests that these kinds of interactions play an important role in the coordination of peccary social structure as appeasement signals.

Sowls (1997) proposed that the scent from the dorsal gland of peccaries is important in individual recognition. The results obtained in the present study reinforce this proposition and indicate that the olfactory investigation related acts could help in collared peccary recognition. Additionally, we suggest that these friendly behavioral patterns could have evolved to promote the herd fusion after a fission process occurs in the wild (Castellanos, 1983, Robinson and Eisenberg, 1985, Frago, 1994).

Coalitions and alliances appeared and disappeared continually depending on herd changes, such as the displacement of a single individual (see Figures 6a and 6b). These results suggest a relatively high degree of flexibility in peccary herd social structure, the shape of which will depend on the specific moment of data collection. The despotic hierarchy observed in males during Period I and the absence of any kind of hierarchical structure in the subsequent period (Figure 3) illustrates this point. Furthermore, describing collared peccary social structure requires observation of not only the frequency of aggressive acts, as argued by Chalmers (1980), but also friendly, scent-related acts, as they were related to the formation and maintenance of coalitions and alliances in this study.

Therefore, collared peccary managers must take care when they need to isolate, for any reason, some individual from its herd, as this animal may play an important role in herd social stability. We acknowledge that the present social data of collared peccaries is very limited. However, the dynamics of social relationships amongst peccaries after a change in their herd helps to explain the existent controversy in the literature regarding social dominance hierarchy in collared peccary herds and their apparent stability.

## **Conclusion**

These results suggest a complex and flexible social structure in the collared peccary and offer important tools for managers to diagnose social incompatibilities among individuals assembled arbitrarily in herds and maintained under captivity conditions.

## Acknowledgements

To Joara M. Bergsleithner, Randall Moorman, and Michael Bassfort for their invaluable help in preparing this manuscript. To CNPq for the fellowship received by SSCN (Process Number 300843/1999-2). This work was funded by the EC through the INCO-Pecari project (INCO-DEV ICA4-2000-10393), and followed the "Guidelines for the use of animals in research," published in *Animal Behavior*, Vol 43, 1992.

## References

- Altmann J. 1974. Observational study of behavior: sampling methods. *Behaviour* 49: 227-265.
- Altrichter M. 2005. The sustainability of subsistence hunting of peccaries in the Argentine Chaco. *Biol Cons* 126: 351 – 362.
- Appleby M.C. 1983. The probability of linearity in hierarchies. *Animal Behav* 31: 600-608.
- Bigler W.J. 1974. Seasonal movements and activity patterns of the collared peccary. *J Mammal* 55: 851-855.
- Beehner J.C., Bergman T.J., Cheney DL, Seyfarth, RM., Whitten PL. 2005. The effect of new alpha males on female stress in free-ranging baboons. *Animal Behav* 69: 1211 - 1221.
- Bissonette J.A. 1982. Ecology and social behavior of the collared peccary in Big Bend National Park. *Scient. Mono. Series no. 16*, U.S. Nat. Park Serv., Washington, D.C. 85p.
- Byers J.A., Bekoff M. 1981. Social spacing and cooperative behavior of the Collared peccary, *Tayassu tajacu*. *J Mammal* 62: 767-785.
- Castellanos H.G. 1983. Aspectos de la organización social del Báquiro de Collar, *Tayassu tajacu* L. en el Estado Guarico- Venezuela. *Acta Biol Venez* 11: 127-143.
- Chalmers N. 1980. Social behavior in primates. London: E. Arnold 256 p.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora. 2003 CITES Available at: <http://www.cites.org>
- Day G. I. 1985. Javelina Research and Management in Arizona. Phoenix: Arizona Game and Wildlife Fish Dept.
- Dubost G. 2001. Comparison of the social behaviour of sympatric peccary species (genus *Tayassu*) correlation with their ecological characteristics. *Mammal Biol* 66: 65-83.
- Eisenberg J.F. 1989. *Mammals of the Neotropics: Panamá, Colômbia, Venezuela, Guyana, Suriname, French Guiana*. V.1. The northern Neotropics. University of Chicago. Chicago. 550p.
- Ellisor J.E, Harwell WF. 1969. Mobility and home range of collared peccary in southern Texas. *J. Wildl Manage*: 33: 425-427.
- Fragoso J.M.V. 1994. Large mammals and the community dynamics of an Amazon rain forest. PhD. (Dissertation) Gainesville: University of Florida.
- Fragoso J.M.V. 1998. Home range and movement patterns of white-lipped peccary (*Tayassu pecari*) herds in the northern Brazilian Amazon. *Biotropica* 30: 458-469.
- Galagher J.F, Varner L.W., Grant W.E. (1984). Nutrition of the collared peccary in South Texas. *J Wild Manage* 48: 749-761.
- Green G.E., Grant W.E., Davis E. 1984. Variability of observed group sizes within collared peccary herds *J Wildl Manage* 48: 244-48
- Lehner P.N. 1996. *Handbook of ethological methods*. 2nd edition, Cambridge University Press 662p.
- Lochmiller R., Grant W. 1982. Intraspecific aggression results in death of a collared peccary. *Zoo Biology* 1: 161-162.
- Nogueira-Filho S.L.G., Nogueira SSC, Takechi, S. 1999 A estrutura social de Pecaris (Mammalia, Tayassuidae) em cativeiro. *Rev Etologia*. 1: 89-98.
- Nogueira-Filho S.L.G., Nogueira SSC. 2004. Captive breeding programs as an alternative for wildlife conservation in Brazil. In K. Silvius, R. Bodmer and J. Fragoso Eds. *People in Nature: Wildlife Management and Conservation in Latin America*. New York: Columbia University Press p.171 -190
- Packard J.M., Babbitt KJ, Franchek KM, Pierce MP. 1991. Sexual competition in captive collared peccaries (*Tayassu tajacu*). *Appl Anim Behav Sci* 29: 319 – 326.
- Robinson J.G., Eisenberg J. 1985. Group size and foraging habits of the collared peccary (*Tayassu tajacu*). *J Mammal* 66: 153 – 155.
- Schweinsburg R. E. 1971 Home Range, movements, and herd integrity of the collared peccary.

J Wildl Manage 35: 455-460.

Sowls L.K. 1974. Social behaviour of the collared peccary *Dicotyles tajacu*, L. In V. Geist, F. Walther, editors. The Behaviour of Ungulates and Its Relation to Management. Morges, Switzerland: I.U.C.N. Pub. Series 24, 1. p 144-165

Sowls L.K. 1984. The peccaries. The University of Arizona Press 250 p.

Sowls L.K. 1997. Javelinas and other peccaries. Texas AandM University Press. p 325.

Wilson E.O. 1975. Sociobiology. Harvard University Press 720p.

---

## Status and conservation of *Babirusa babyrussa* in the Togeian Islands, based on direct observations and questionnaire surveys (intermittently, 1990 – 2001)

Shaifudin Akbar<sup>1</sup>, Mochamad Indrawan<sup>1,3</sup>, M . P. Yasin<sup>1</sup>, James Burton<sup>2</sup>, Jandri Ivan<sup>1</sup>

<sup>1</sup>YABSHI – Indonesian Foundation For the Advancement of Biological Sciences, Indonesia

<sup>2</sup>VBS, R(D)SVS, The University of Edinburgh, Edinburgh, Scotland, UK

<sup>3</sup> corresponding author, email [jamblang@cbn.net.id](mailto:jamblang@cbn.net.id)

**Key words:** Babirusa, Togeian, conservation

### Abstract

This study collated the available information based on the authors' own field observations and local interviews, to improve practical knowledge of the status and conservation of the Babirusa in the Togeian Islands. Direct sightings were opportunistically obtained by S. Akbar during macaque monitoring works between 1990 – 4, and added by M. Indrawan during a brief visit (1–28 August 1996). The questionnaire surveys were held from 17 February 2001 to 10 May 2001, on three main islands (Togeian, Batudaka, and Malenge).

In the Togeian Islands the Babirusa are distributed in Batudaka, Togeian, Talatakoh and Malenge. The results of the interview survey concerning the population trend over the last five years did not show a clear trend, which could be interpreted that between 1995 - 2000 no sharp decline had been detected. Most respondents estimate the Babirusa numbers across the island group at between 100 and 1000, though this needs to be carefully interpreted. It appears that the Babirusa are not necessarily restricted to primary forests and managed to use mosaics of forest and

plantations as well. Factors probably affecting the numbers and survival of Babirusa included hunting and predation by dogs, predation by snakes, and forest habitat clearance and disturbance

The Togeian Islands was accorded national park status in 2004, although without proper public consultation and participatory spatial planning, this may not necessarily be the solution. Furthermore, the Babirusa was, and still is, a subject of local conservation controversy and therefore research priorities should be spent on finding ways to minimize conflict between Babirusa conservation and local farming practices.

### Introduction

The Babirusa *Babirusa babyrussa* is a monotypic suid found only in Sulawesi and smaller islands to its east and southeast. The origins of the Babirusa have yet to be conclusively determined (Clayton 1996). A hypotheses later backed by diagnostic chromosome banding patterns has been put forward suggesting that Babirusa evolved since the Oligocene along a separate evolutionary line, although yet a later study also showed that there are closer similarities between the chromosomes of *Sus* and *Babirusa* than had been interpreted

---

from their banding patterns (Thenius 1970, Bosma 1980, Bosma and de Haan 1981, Bosma *et al.* 1991, reviewed by Macdonald 1998).

To date, three extant subspecies are recognized, namely *B.b. babyrussa*, *B.b. celebensis*, and *B.b. togeanensis*, distributed in Sula and Buru Islands, the Northern peninsula of Sulawesi and the Togean Islands respectively. Two subspecies recorded from southwest Sulawesi, namely *B.b. bolabatuensis* and *B.b. beruensis* are now thought to be extinct (Groves 1980, Macdonald 1997, Macdonald 2005).

Although there are a high proportion of regionally endemic birds on Sulawesi relative to the number of widespread species, the Togean Islands appear to have a number of species from Sulawesi too (Indrawan 2004). This is also the most likely route of arrival for terrestrial vertebrates, albeit more difficult. A Pleistocene land bridge (or biogeographical umbilici *sensu* Diamond and Gilpin 1983) connecting the Togean Islands with the eastern peninsula of Central Sulawesi has been postulated following analysis of geometric patterns (Indrawan *op. cit.*). It is therefore conceivable that the Togean form of Babirusa might have arrived and island-hopped through eastern Sulawesi; phylogenetic studies are urgently needed.

The Togean form of Babirusa was described by Sody in 1949 based on an adult male specimen collected from the Malenge Island, and its holotype is deposited at Museum Zoologicum Bogoriense (Sody 1949, Becking 1989). The collector, J.J. Menden, who is a commercial trader dealing with natural history specimens, sometimes sent hunters to make collections on his behalf, and it was uncertain if he personally participated in the collecting activities in the Togean Islands (Becking 1989, Ripley 1941, Voous 1952, S. Somadikarta *pers. comm.*).

As a little known species classified by IUCN (Pigs and Peccaries Specialist Group 1996) as Vulnerable (A1cd), field information of the Babirusa and its habitat is of primary importance. Although Babirusa in North Sulawesi have received detailed study (Clayton, 1996), elsewhere throughout its

range its natural history is poorly known. In the Togean Islands, a group of five Babirusa has been studied in Pangempa, a small islet (c.22.3 ha) off the Togeian I. proper, by Selmier (1983). A recent study was undertaken by Ito *et al.* (2005), who for a total of 80 days between 2000 and 2003 focused the form's conservation status on Malenge Island, one of the smallest islands off the main island (length and width were respectively 10 and 4 km).

This study aimed to collate the available information based on the authors own field observations and local interviews, to improve practical knowledge of the status and conservation of the Babirusa in the Togean Islands.

### Study Site and Methods

The Togean islands are located in the gulf of Tomini, and flanked by the northern, north central and eastern peninsulas of Sulawesi. The island group have 35 small islands, seven of which are relatively large (more than 1000 hectares), namely: Togeian, Batudaka, Talatakoh, Una-Una, Malenge, Walea Bahi and Walea Kodi. Independent botanical surveys by Dedi Supriadi (1996), Kade Sidiyasa (2000) and R.M. Hidayat (*in litt.*, 2001) revealed that the island group harbored wet forests of variable types, frequently differing from one island to another, and ranging from monsoon to evergreen. Up to 2001, patches found in reasonably good condition were noted on the islands of Malenge, Togeian, Batudaka and Walea Bahi. Economically valuable trees occurred in some of these patches. Summary description of lowland forests in the island group is provided elsewhere (Indrawan *et al.* 2006).

The mammalian species of the Togean Islands include 16 species of bats, and Sulawesi's endemic species or subspecies of non-volant mammals, including the Togean Macaque *Macaca tonkeana togeanus*, and the Togean form of Spectral Tarsier *Tarsius spectrum* (Owen *et al.* 1987, Froecllich *et al.* 1998, Shekelle 2003). The Bear phalanger *Phalanger ursinus togianus* Tate, 1945 occurred in the island group (Corbett and Hill 1992; this study). The distribution of the Sulawesi Warty Pig *Sus celebensis* is unclear. In Malenge it did not appear to occur (S. Akbar *pers. obs.*, Masaaki Ito *pers.*

comm.), though it was reported in the Batudaka I. Even when it was reported from some villages (Bomba, Kuling Kinari, Patoyan; Batudaka I.) the relative abundance of warty pig appeared to be lower than the Babirusa (M. Yasin, unpublished.)

Direct sightings were opportunistically made by S. Akbar during macaque monitoring works between 1990 – 4, and added by M. Indrawan during a later brief visit (1–28 August 1996). The questionnaire surveys were held on three main islands namely Togean, Batudaka and Malenge (17 February 2001 - 10 May 2001). Further anecdotal information was added from visits of M. Yasin in 2003-04. Respondents were asked a specific set of questions by a single recorder (Mr. Jandri Ivan), and the answers were noted on the pre-prepared survey form. Only farmers who had seen babirusa were interviewed. Twenty six farmers (from 8 villages on the 3 islands) were pre-selected, and responded to the interview. The Babirusa were known locally with various names e.g. “Favu”, “Tora”, “Beleng”, reflecting the variable ethnic

groups of the respondents. The respondents reported 39 sighting locations altogether (Appendix 1).

## Results

In the Togeian islands the babirusa were found on Batudaka, Togean, Talatakoh and Malenge Islands. Table 1 presents details of the direct sightings from 1990 to 1996, made sporadically over Malenge. In some cases when repeated observations were made over the same site (s) individual recognition of Babirusa was possible. For instance, ‘Parat’, one particularly large male (estimated to be at least 100 kg) with broken upper canine which was found in the same locality and showed aggressive (probably territorial) behaviour was observed three times in a particular valley on Malenge.

The questionnaire surveys showed that 40.7 % of respondents saw the babirusa within the last month (of the interviews taking place). 14.8%, 18.5%, and 3.1 % of the remaining respondents had seen Babirusa in the last two, three and four months, respectively. 3.7 % of respondents

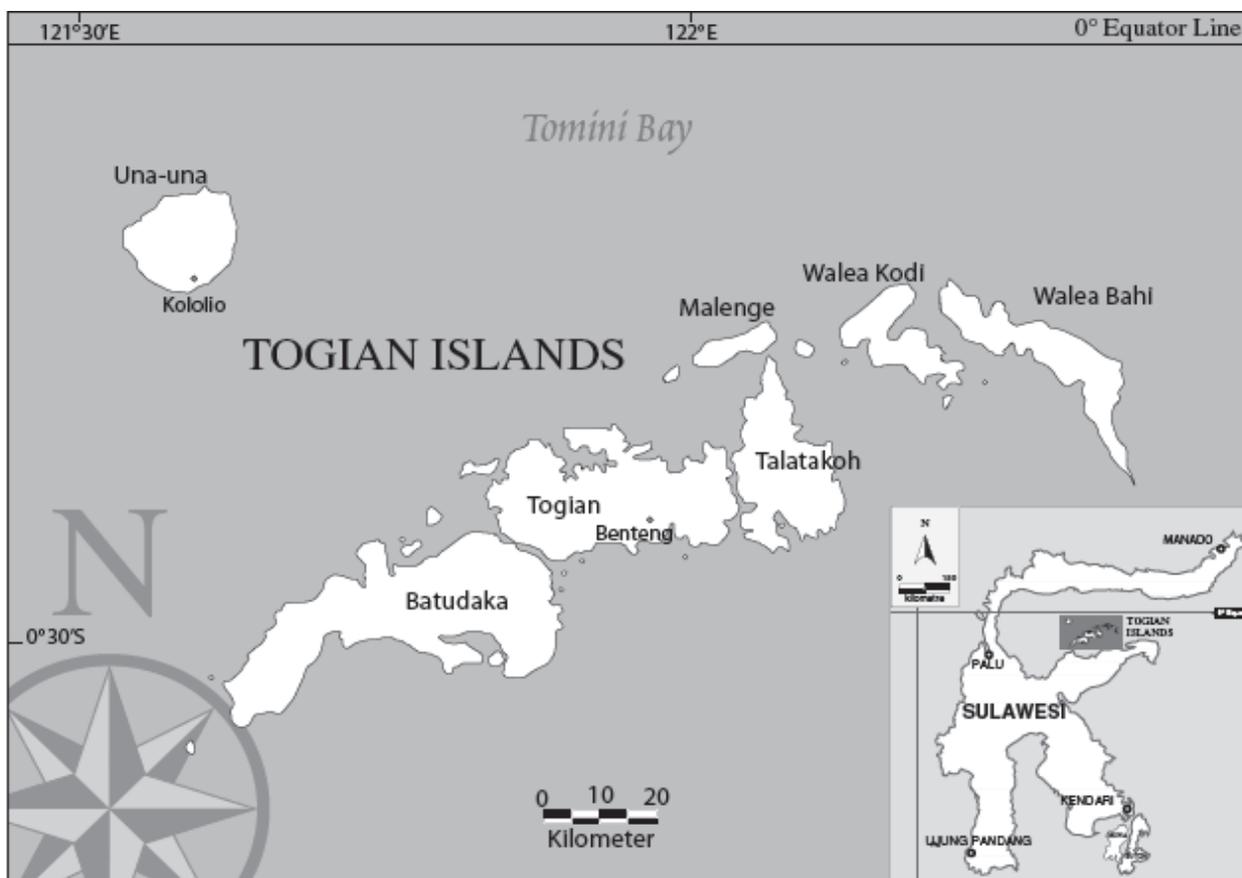


Figure 1: Map of the Togian Islands

claimed to have seen Babirusa only within the last two years.

37 % of the respondents mentioned that the Babirusa is a solitary animal, 29.6 % of those questioned reported that the Babirusa is gregarious, and usually composed of one adult pair with a litter of 2-3. 29.5 % respondents reported group size of more than 5 individuals, and these were typically composed of an adult male with multiple females and a litter.

Most respondents (68.2 %) encountered the Babirusa in the morning, between 0600 to 1000 a.m. The reported observations of Babirusa included various activities during that time, such as foraging, mating, wallowing, and resting. The types of habitats in which sightings were made were (in decreasing order of frequency): mixed gardens, regrowing scrub of former *ladang*, secondary vegetation in the forest, village edges, freshwater swamps, and beaches. The range of materials in which the Babirusa had been reported to feed on were rhizomes, fallen fruits (e.g. “pangi” *Pangium edule*, “rao” *Dracontomelon* sp, mango *Mangifera* sp, coconut, “kedondong”, “cempedak”, cacao, tamarinds, and jackfruits), annual herbs and vegetables.

Four respondents witnessed antagonistic interactions between adult Babirusa. The observations indicated that fighting is likely to occur either or both between individuals after the same food or adult males after the same females during the breeding season. The fighting events involved chasing, bumping the frontal heads, biting and standing on two legs. Two respondents reported Babirusa being attacked by pythons, and in both cases the attacked individual emitted an alarm call, which brought other Babirusa to emerge and attack the snake. In both observations, the rescuing Babirusa bit leaves between their teeth before proceeding to bite the snake. It is unknown why this activity is done, but it may act as protection from taste.

The respondents were also asked to evaluate Babirusa abundance and relative population trend during the last five years. Half the respon-

dents (51.8 %) believed the population of Babirusa is increasing. The suggested reasons, in order of decreasing frequency were: that systematic Babirusa culling had been stopped (some thirty years ago); that this suid reproduce at a high rate; and that Babirusa are generally not consumed due to religious prohibitions (but see the exception below in the discussion section). The remaining respondents (48.2 %) believed that Babirusa are declining due to (in decreasing order of frequency): uncontrolled hunting and dog predation, habitat reduction, and diseases.

Individual respondents estimated that the Babirusa population across the islands ranged between 100 and 1000, and the following breakdown was made:

- 20% respondents estimated the number to be less than 100 individuals
- 36% gave estimates of 100 to 500 individuals
- 12% gave estimates of 500 to 1000 individuals
- 32% estimated the number of Babirusa to be more than 1000 individuals

## Discussion

The population size estimated from local interviews, should be interpreted with caution. This can only be an estimate and not assumed to be absolute numbers. The local respondents might exaggerate the numbers, although the interviews were attempted judiciously. A recent estimate by M. Yasin (unpublished) suggested about 200 individuals might occur in Batudaka alone.

That the respondents reported that Babirusa reproduce at relatively high rates needs scientific evidence. On Sulawesi, Babirusa normally produce only a single individual per breeding cycle. There is no reason to assume that the biology of the Babirusa in the mainland and Togeian Islands are the same (or different), and this would be an interesting topic to research.

Since the observations were sporadic, and partially repeated over the same sites, or groups, or individuals, the direct observation survey did not allow for proper analyses of activity pattern of the Babirusa. However, in confirmation of Selmier's (1983) observations it was clear that the Babirusa

---

is active during both night and day as in the mainland Sulawesi (Clayton 1996; pers. comm.).

The observations in Malenge (Ito *et al.* 2005; this study) constituted an original series of observations for the island. Before, Babirusa were listed only for Batudaka, Togean and Talatakoh (Macdonald *et al.* 1993). Specific distribution localities are listed for the major Togean islands, which might serve as bases for future monitoring (Appendix 1). No records thus far have been made of three other major islands, namely Walea Bahi, Walea Kodi, and Una-una, though admittedly no concerted efforts have been made to search for Babirusa in these islands.

The small island distribution of the Babirusa might be reflective of its dispersal capacity including possible ocean swimming abilities. On three separate occasions the Babirusa were observed swimming at least 100 meters from the shores of Togean and Malenge islands, (4 interviewees; two each in the two islands). There are a number of other reports of Babirusa swimming. For example, in Lake Poso, Central Sulawesi, a single Babirusa was observed swimming 25 m from the shore (R. Melisch, 1994). At Paguyaman (North Sulawesi) Babirusa have been reported to dive under the surface to swim across 25 m wide Nantu river (Lynn Clayton, pers. comm.). However, this distribution on certain islands may also be affected by human movement of Babirusa, and habitat and pressures present on each island.

Direct observations and questionnaire surveys indicate that Babirusa were widely distributed over coastal areas, and not necessarily confined to inland areas. It appears that they are not restricted to primary forest and managed to use mosaics of forest and plantations. The habitat use of the Babirusa appears to be influenced by the patchy nature of the natural and planted vegetation on the Togean islands. Hunting and predation by dogs is also likely to have affected the distribution of Babirusa.

The results of the interview survey suggest that between 1995 - 2000 there has not been a sharp decline in the population size. This study listed

the following factors affecting the numbers and survival of Babirusa; hunting and predation by dogs, predation by snakes, and forest habitat clearance and disturbance by humans.

It is notable that the threatened Babirusa were, and still are, subject to local conservation controversies. The Babirusa was viewed by the farmers as a pest as it attacks crops such as corn and fruits. In the 1970s Babirusa hunting was approved and even encouraged by the Provincial Office of Dept. of Agriculture. Spears, snares, large trap holes, and poison were all used to cull Babirusa. Hunting was intensive to the extent that our own highly-experienced guide (a 53 year old farmer/ hunter) estimated that he alone has killed no less than thirty Babirusa in his life time. In the early 1980s the Provincial Office of DG of Nature Conservation, Dept. of Forestry, pleaded for Babirusa conservation and managed to reverse the trend toward Babirusa killing. However, the perception of Babirusa as pests still exists among farmers and occasional hunting is still practiced.

Hunting for food has been known only in non-Moslem tribes in a few villages such as those inhabited by Patoyan and Sangir people. The Babirusa is hunted using "dedeso" (ground snares), spears – which are often combined with hunting dogs employments. In certain villages (e.g. Patoyan), people are also known to hunt the Babirusa using 100 meter long "pukat" (nets), especially before festive seasons. During that time one week of operation could bag as many as 100 Babirusa, but the practice has been stopped since 1998, after a regional political unrest unsettled the festive seasons.

In mid April 1998 Malenge Island was ravaged by fire which consumed two thirds of the forest and mixed gardens. Forest fire was also reported in the previous year, following long droughts of 9 months from 1996 to 1997 (Ito *et al.* 2005). However, no large vertebrate mammal carcasses were found in the following surveys. Also, Babirusa were observed in several of these localities since (Amir Dodoa pers.comm.), which indicates the population survived. However, further habitat degradation threats remain, as efforts continue to log and convert the forest for agriculture (Indrawan 2000; pers. obs, 2000)

It is important to consider the remaining lowland forests of Indonesia. The lowland forests of Sulawesi have been determined to be practically extinct in 2000 with those in Sumatra and Kalimantan predicted to follow in the next 5 and 10 years respectively (Holmes, D.A. 2001. The predicted extinction of lowland forests in Indonesia. Unpublished manuscript.; Jepson *et al.* 2001). This emphasises the urgent need to effectively conserve the remaining forest habitats of the Togeian island group.

A marine reserve for the Togeian Islands was proposed as far back as 1982 (Anon. 1982a; Anon. 1982b). On 19 Oct. 2004, a national park covering about 336.773 ha of marine water, and 25.832 ha of land, was decreed for the Togeian Islands. However, despite the two-decade interval, no effective measure has occurred to encourage local communities to participate in the deliberations toward park establishment (Indrawan, pers. obs.). Public participation is needed to develop spatial planning in particular (Pramono and Hutabarat 1997). With high intensity use of the forest, it is likely that strict protection against utilization of marine and terrestrial resources might bring increased local stakeholder conflict. This is likely to be disadvantageous to conservation - protection objectives. The Babirusa, however, has been decreed as a protected species in Indonesia (Governmental Regulations No 9, 1999). Considering the local economy and economic situation, development of Babirusa and bird based ecotourism can be recommended among the priority ways to protect the islands' forests and biological diversity. Still, this might have to wait until the regions political situation is more settled.

An initial activity for conservation and research should be to focus on finding ways to minimize conflict between Babirusa conservation and local farming practices.

### Acknowledgements

This study is done under research tenure of YABSHI – Indonesian Foundation for the Advancement of Biological Sciences, and supported by grants from Keindanren Nature Conservation Fund (to YABSHI) and the

Earthwatch Institute (to Dr. Jatna supriatna). Indrawan's longer term studies have been supported by Nagao Natural Environment Funds (NEF). James Burton and M. P. Yasin's studies have been supported by the Veterinary Biomedical Sciences, Royal (Dick) School of Veterinary Studies, The University of Edinburgh, as well as the Stichting Dierentuin Helpen (Consortium of Dutch Zoos), and the Royal Zoological Society of the North of England. We thank Bapak Amir Dodoa, Burhan and Iling Taskir for providing first -class guidance in the field. Dr. Alastair Macdonald (U. Edinburgh ), and Dr. Lynn Clayton kindly provided constructive comments to the first draft, as well as pertinent literature references. Msrs. Guritno Djanubudiman, Christoverius Hutabarat and Khaerul Anwar (YABSHI) assisted in summarizing the statistics of the questionnaire data. Mr Deddy Supriadi, Dr. Kade Sidiyasa, and Mr. R.M. Hidayat shared their published and unpublished botanical data. Dr. Masaaki Ito shared his field data on Babirusa habitat.

### References

- Anon. 1982a. National Conservation Plan for Indonesia. Vol. V. Sulawesi. FAO, Bogor.
- Anon. 1982b. Marine conservation potentials of the Togeian Islands. Central Sulawesi Bogor, FAO.
- Becking, J.H. 1989. *Henri Jacob Victor Sody (1892-1959) his life and work. A biographical and bibliographical study.* E.J. Brill, Leiden: viii + 272 pp.
- Bosma, A.A., and de Haan, N.A. 1981. The karyotype of the babirusa *Babyrousa babyrussa* (Suidae). *Acta Zoologica et Pathologica Antwerpiesia* 76: 17 - 27
- Bosma, A.A., de Haan, N.A., and Macdonals, A.A. 1991. The current status cytogenetics of the Suidae: a review. *Bongo, Berlin* 18: 258 – 272
- Clayton, L.M. 1996. Conservation Biology of the Babirusa *Babyrousa babyrussa* in Sulawesi, Indonesia. DPhil thesis, University of Oxford. 222 pp.
- Corbett, G.B. and Hill, J.E. 1992. *The Mammals of the Indo-Malayan Region.* Oxford University Press, Oxford.

- Diamond, J.M. and Gilpin, M.E. (1983). Biogeographic umbilici and the origin of the Phillipine avifauna. *Oikos* 41: 307-321.
- Froechlich, J.W., Supriatna, J., Hart, V., Akbar, S., and Babo, R. 1998. The Balan of Balantak: a possible new species of macaque in Central Sulawesi. *Tropical Biodiversity* 5 (3): 167 – 184.
- Groves, C.P. 1980. Notes on the systematics of *Babyrousa* (Artiodactyla, Suidae). *Zoologische Mededelingen* 55: 24 – 96
- Indrawan, M. 2000. Bitter chocolate. *Far Eastern Economic Review* (24 December 2000): 88.
- Indrawan, M. 2004. Avifaunal distribution and endemism in the Togian Islands, Gulf of Tomini, Central Sulawesi. Doctoral Dissertation. University Indonesia. 1999 pp
- Indrawan, M., Somadikarta, S., Supriatna, J., Bruce, M.D., Sunarto, and Djanubudiman, G. 2006. The birds of the Togian islands, Central Sulawesi, Indonesia. *Forktail* 22 : 7–22
- Ito, M., Nakata, H., Jaga, I.M. Baliak, I.W. 2005. Status of Togian Babirusa (*Babyrousa babyrussa togeanensis*) in Malenge Island, Central Sulawesi. In: Sugiri, N, Mustari, A.H., Suwelo, I.S., and Djuwita, I. (eds.). 2005. Kumpulan makalah seminar sehari Peduli Anoa dan babirusa (Bogor, 20 Sept. 2005). IPB,, Departemen Kehutanan, LIPI dan Pusat Informasi Lingkungan Hidup Indonesia. Pp 71 - 77
- Jepson, P., Jarvie, J.J., MacKinnon, K., Monk K.A. 2001. The end for Indonesia's lowland forests?. *Science* Vol. 292 (5518), May 04.
- Macdonald, A. 1993. The Babirusa (*Babyrousa babyrussa*). In: Oliver, W.L.R. 1993. Pigs, Peccaries and Hippos: Status survey and conservation action plan. IUCN, Gland
- Macdonald, A.A. 1997. The babirusa (*Babyrousa babyrussa*). In: Monk, K.A., de Fretes, Y. and Reksodiharjo-Lilley, G. *The Ecology of Nusa Tenggara and Maluku*. The Ecology of Indonesia Series, volume V. Periplus: Singapore. pp 374-378.
- Macdonald, A.A. 1998. The ecology and conservation of babirusa (*Babyrousa babyrussa*) and other terrestrial mammals in Eastern Indonesia. In: Prawiradilaga, D.M., Amir, M. Sugardjito, J. 1998. Proceedings of the Second International Conference on Eastern Indonesian-Australian Vertebrate Fauna. Indonesian Institute of Sciences, Indonesian Wildlife Society, Fauna Flora Int'l – Indonesia Programme, DG of Tourism of the Republic of Indonesia
- Macdonald, A.A., Leus, K., Florence, A., Clare, J. & Patry, M. 1996. Notes on the behaviour of Sulawesi Warty pigs (*Sus celebensis*) in North Sulawesi, Indonesia. *Malaysian Nature Journal* 50, 47-53.
- Macdonald, A.A. 2005. The conservation of the Babirusa (*Babyrousa babyrussa*). In: Sugiri, N, Mustari, A.H., Suwelo, I.S., and Djuwita, I. (eds.). 2005. Institut Pertanian Bogor, Departemen Kehutanan, Pusat Penelitian Biologi LIPI dan Pusat Informasi Lingkungan Hidup Indonesia. pp 90 – 111.
- Melisch, R. 1994. Observations of swimming babirusa *Babyrousa babyrussa* in Lake Poso, Central Sulawesi, Indonesia. *Malayan Nature Journal* 47: 431 –432
- Owen, D., Bilton, D., Lonsdale, K., and Strathdee, S. (1987) Proyek Kelelawar: a study of bats and invertebrates in an archipelago's caves. Oxford University Expedition to the Togian Islands, Sulawesi Indonesia (unpublished).
- Patry, M., Leus, K. & Macdonald, A.A. 1995. Group structure and behaviour of babirusa (*Babyrousa babyrussa*) in northern Sulawesi. *Australian Journal of Zoology* 43, 643-655.
- Pigs & Peccaries Specialist Group 1996. *Babyrousa babyrussa*. In: IUCN 2006. 2006 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>.

- Pramono, A. H. and Hutabarat, C. (Editors). 1997. Proceeding of the seminar and workshop on integrated development of Togeian Islands. Consortium for Integrated Development of Togeian Islands, Government of Central Sulawesi Province, State Minister for Environment, and the Diectorate General for Forest Protection and Nature Conservation. (in Indonesian).
- Ripley, S.D. 1941. Notes on a collection of birds from northern Celebes. *Occ. Pap. Boston Soc. Nat. Hist.*, 8: 343-358.
- Selmier, V.J. 1983. Bestandsgrosse und verhalten des hirschebers (Babyrousa babyrussa) auf den Togian Inseln. *Bongo, Berlin* 7: 51- 64.
- Shekelle, M. 2003. Taxonomy and biogeography of Eastern tarsiers. Doctoral Thesis. Washington University, St Louis.
- Sidiyasa, K. 2000. Laporan survei vegetasi dan tumbuhan di Kepulauan Togeian, Sulawesi Tengah [ Survey report of vegetation and plants of the Togeian islands', Central Sulawesi. Report prepared for Tropenbos and the Gibbon Foundation.
- Sody, H.J.V. 1949. Notes on some primates, carnivora, and the babirusa from the Indo-Malayan and Indo-Australian regions (with descriptions of 10 new species and subspecies). *Treubia* 20: 121 – 190
- Supriadi, D. 1996. Habitat and foraging behaviour of the Togeian monkey (*Macaca togeanus*, Froeichlich & Supriatna , 1996) on the island of Malenge, Togeian Islands, C. Sulawesi, with references to different foraging behaviours between group-living and solitary adult males. Universitas Indonesia, Depok. (unpublished postgraduate thesis, in Indonesian).
- Tate, A. 1945. The marsupial genus *Phalanger*. *American Museum Novitates* 1283: 41 pp
- Thenius, E. 1970. Zur Evolution und Verbreitungsgeschicht der Suidae (Artiodactyla, Mamalia). *Zeitschrift fur Sugetierkunde* 35: 113 – 114 & 249.
- Voous, K.H. 1952. A new race of babler from the Togeian Islands, North Celebes. *Ardea*, 40: 74.

**Table 1. Babirusa observations in the island of Malenge (1990 – 1996).**

Date	Time	Group Size	Group composition		Location	Habitat Type	Notes
			Adult male	Others			
23 Oct 1990	1000	1	1	-	Malenge village	Coconut groove	Flushed from a path
9 Nov 1990	1130	3	?	?	Malenge Village	Primary forest	
23 Nov 1990	1045	1	1	-	Lembah	Secondary forest	'Parat', eating coconut fruits
6 Dec 1990	1205	3	?	?	Hion	Secondary forest	Eating unidentified fruit
26 June 1991	0940	1	1	-	Malenge Village	Coconut groove	
29 June 1991	1300	1	1	-	Malenge Village	Primary forest	

**Table 1 cont:**

Date	Time	Group Size	Group Composition		Location	Habitat Type	Notes
			Male	Other			
28 July 1991	2220	1	1	-	Lembah	Coconut groove	'Parat'
10 Aug 1991	2319	2	?	?	Lembah	Coconut groove	
19 Aug 1991	1100	1	1	-	Lembah	Coconut groove	eating fallen coconut fruits
21 May 1993	1310	1	?	?	Malenge Village	Coconut groove	
16 June 1993	2200	1	?	?	Lembah	Coconut groove	
3 July 1993	1050	1	1	-	Lembah	Coconut groove	? 'Parat'
24 Oct 1993	0815	4	?	?	Malangkat	Coconut groove (bordering on mangrove and freshwater spring)	
5 Nov 1993	1225	1	?	?	Unnamed locality in the eastern shore of Talatakoh Island	Disturbed primary forest	Signs only, Babriusa tracks on a mudpool wallow
8 Dec 1993	1405				Kadoda	Coconut groove	
16 Jan 1994	1045	1	1	-	Malangkat	Coconut groove (bordering on mangrove and freshwater spring)	
28 May 1994	1250	2	-	2	Uemata	Coconut groove	
6 July 1994	1420	1	1	-	Malangkat	Coconut groove (bordering on mangrove and freshwater spring)	
18 July 1996	Not noted	1	?	?	Bunawang	Mixed garden grooves	
2 Sept. 1996	0530	4	?	?	Uemata	Mixed garden grooves	
3 Sept. 1996	1700	4	?	?			
8 Sept. 1996		1	?	?	Kadoda	Mangrove	One adult, dead by the mangroves of Kadoda, causes unknown

---

## Appendix 1: names of specific locations in Togian, Talatakoh, and Batudaka on which Babirusa had been sighted by local villagers

### Togian Island:

Lembanato/Motobiai (Tambun, Balelang, Inolibango, Tampale, Urung batang, Tangkutikin); Benteng area (Uesok, Tibondul, Gunung kidi-kidi, Manaya, Langges, slopes of Gunung benteng, Balelang, Lelengkoro, Beko, Sambote, Dali, Bakar); Tumbulawa (Padok, Lombulumbu, Limpiato, Tongkarang, Melei, Solonsom, Konak, Topaya, Bololiban, Tinangonan)

### Talatakoh Island

Melam, Balotongko, Binuan, Polandoa, Towan

### Batudaka island

Lolumbu, Kandala, Dudurian, Copata, Lalantang, Tondo

---

## Communal hunting of wild boars (*Sus scrofa*) as a common practice in West Sumatra, Indonesia

Rizaldi<sup>1,2,\*</sup>, Kunio Watanabe<sup>1</sup>, and Amsir Bakar<sup>2</sup>

<sup>1</sup>Primate Research Institute, Kyoto University, Inuyama 484-8506, Japan

<sup>2</sup>Department of Biology, Faculty of Science, Andalas University, Padang 25163, Indonesia.

\* Corresponding author, email rizaldi@pri.kyoto-u.ac.jp

### Summary

Wild boars are ubiquitously distributed and have become serious pests in many locations within Sumatra. Hunting wild boars with trained dogs is a common and legal practice in West Sumatra. It is unknown when this tradition began, but it has continued over the generations and is practically organized. Data were collected during surveys of large mammals across three provinces on the Sumatran mainland, including West Sumatra, Riau and Jambi. We described hunting activities based on direct observation of several hunting events and from direct interviews with the hunters and host farmers. Hunting is mostly located around traditionally cultivated land, which is adjacent to the forest edges. Hunting with dogs is a method to control pests and prevent crop raiding and land damage caused by the boars, complementing snared trapping, poisoning, crop guarding and fencing. At present, many people participate in boar hunts for sport. Bush meat was not a reason for this hunting because people in the region mostly do not eat

pork, as a result of religious restriction. This hunting might not have a significant influence on the wild boar populations because the number of boars killed is very few. However, it could be effective in driving the pests temporarily away from cultivated land.

### Introduction

In 2003 we began a survey of large mammals in Sumatra and continued in a part of each year until 2006. The survey aimed to evaluate the current distribution and population status of several large mammal species, including wild boars. In 2006, the survey covered three provinces including West Sumatra, Riau and Jambi. A total of 550 locations were surveyed within the three provinces. Each location is separated from the others by between 10 and 15 km distances. From this survey we found that some species (e.g., tiger, leopard, elephant, deer and some primates) have been extirpated at some locations in Sumatra. In contrast, the distribution of wild boars tended to expand even though they are legally hunted and their forest habitat has been rapidly converted for human

---

purposes. One possible reason for this increase is the disappearance of natural predators over the last decades, such as the Sumatran tiger, leopard (Kinnaird *et al.*, 2003) and reticulated python (Auliya, 2003).

Communal hunting by hundreds of people with trained dogs is a common practice in West Sumatra (Munir *et al.* 1993). People consider wild boars as an extraordinary pest species because the economical losses from crop raiding and damage are considerably high. Formerly, the purpose of this hunting might have been to protect crops from damage caused by boars but now even more people are involved. They are not only host farmers but also come from different villages and different types of fieldwork. It is organized into regional and district levels, which involves hundreds and sometimes more than a thousand participants. This communal hunting is always located around cultivated land and adjacent forests. Although this hunting has been done over many generations, its effectiveness has never been evaluated. This study was conducted to describe how people in West Sumatra practice communal hunting on wild boars and generally assess how successful the hunts are. We also discuss boar hunting from the perspective of pest control and population management.

## Methods

### *Study Area*

West Sumatra is one of the eight provinces located in the mainland of Sumatra, Indonesia ( $0^{\circ}54'N\sim 3^{\circ}30'S$ ,  $98^{\circ}36'E\sim 101^{\circ}53'E$ ). The area is 36,218.38 km<sup>2</sup> (excluding offshore islands) with the human population from both rural and urban areas at 4.24 million in 2001. About 49.62% of labour is in the agricultural sector. Agriculture is still dominated by traditional croplands although in the few last decades modern plantations have expanded. Forest is still the main vegetation type covering the land (60.59%) but recently deforestation has rapidly increased and abandoned lands have also expanded. About 28.55% of the land is used for agriculture. The main crops are rice, corn, palm oil, rubber plants and

various vegetables. Cultivation is possible year round but some land can be planted only during the rainy season between November and March (Statistic Bureau of West Sumatra Province, 2002). Cultivated land located adjacent to forest edges frequently suffers from crop raiding and damage by wild boars, monkeys, elephants, deer and other animals.

### *Data Collection*

We collected data on wild boar hunting during surveys of the distribution of large mammals on the Sumatran mainland (West Sumatra, Riau and Jambi provinces) in March 2003, February-March 2004, April-May 2005 and April-September 2006. Data were collected via direct interviews with hunters (N=400) and host farmers (N=152) in areas where boar hunting took place. A host farmer is a farmer who cultivates the land around a hunting location. To describe hunting activity, we directly observed 17 hunting events at 10 locations during the survey periods. We started observation from the morning until they finished hunting in the afternoon. The number of hunters joining each hunting event was obtained through the group leader of the hunters. The total area covered for each hunting event was obtained by using GPS coordinates and plotted onto a map.

## Results

Wild boars were widely distributed over 97.27% (535/550) of the locations surveyed in West Sumatra, Riau and Jambi provinces. People complained of wild boars as a pest species at 71.1% (185/260) of the locations we surveyed in West Sumatra. Wild boars frequently raided crops and caused damage to various cultivated plants such as vegetables, paddies, corns, cassava roots and beans, amongst others. In some areas where crop raiding and damage frequently occurred, local farmers were reluctant to cultivate their lands and had to compensate with other forms of works.

Wild boars were hunted in 46.7% (100/214) of the locations we surveyed in West Sumatra. Hunting locations were mostly distributed through the middle part of the province, around the land of the Minangkabau ethnic group (Fig. 1). Hunting has always been conducted near cultivated lands

adjacent to forests or abandoned lands. The location of the hunting is usually decided by a group leader, from a list of several locations, but sometimes may also depend upon requests from local farmers. However, only several scattered areas have been listed as alternative locations. This means that boars may sometimes only be hunted in one of two adjacent areas. Hunting boars can be done occasionally and/or regularly depending on the group size of the hunters. When a farmer finds a wild boar near his farmland, he will call other villagers and then a small sporadic hunting party from 10 to 15 people will be organized. Occasionally, such a small group is formed in the morning between 06:00 and 09:00.

Regular hunts are organized hierarchically from a regional to a district level. Regional group levels consist of several villages that hunt once a week, and then join other regional groups to form a district group every six months. Regular hunts are conducted all day, lasting from 08:00 to 15:00. Hunting at the regional level might involve between 150 and 500 hunters while district levels involve between 500 and 1200. Group members consist not only of farmers but also people from different fields. The groups are loosely organized and the members are not obligated to participate in all events. We interviewed 400 hunters and found that motivations for hunting were mostly hobby & sport (54%), controlling pests (41%) and the rest (5%) were hunters with special interests such as looking for specific plants or meeting friends. Hunting for bush meat was not a reason since most people in West Sumatra do not eat pork because of their religious beliefs.

Each hunter is accompanied by one or two trained domestic dogs and traditional weapons such as machetes, spears and/or local-made firearms. However, since the 1970s, the central government of Indonesia has prohibited people from keeping firearms. Hunters with their dogs gather at the starting point of a tracking route located near cultivated land and forest edges. Several host villagers who know their area better than other hunters are pointed as seekers. Seekers can be divided into three small groups of between 5 and 10 individuals. Seekers begin tracking by releasing and di-

recting their dogs to trail wild boars through bushes, mixed forest or secondary forest. Other hunters follow seekers from main tracks near cultivated land and forest edges. Fresh wild boar tracks leave a good scent for the dogs to follow. When dogs find a wild boar, they bark continuously and at that moment the other hunters release their dogs to begin the collective chase.



Five dogs can kill one wild boar, but sometimes people help with weapons. There are no selective target animals with hunters killing all age and sex classes of boars. Dogs will eat almost the entire carcass, and compete fiercely amongst themselves. Hunters do not seek out or chase boars deep into the forest. The total area covered for each hunt varies depending on the size of the group of hunters and the accessibility of landscapes.

The average number of participants for each hunting event was 349.17 (N=36) and average size of area covered was 740.28 ha (N=36). The number of boar killed per hunting event varied from 0 to 10 individuals (mean±SD: 3.05±2.44, N=36). Usually, the number of killed boars was higher than average when the dogs successfully found a sow with piglets. There was no significant correlation between the number of boars killed and the number of participating hunters in each event (Pearson Correlation = 0.084, N=36, P>0.05). There was also no significant correlation between the number of boars killed and the area covered by hunters during each event. (Pearson Correlation= 0.148, N=36, P>0.05).

The interviews with 152 host farmers who cultivated land near hunting locations revealed that 60% of the host farmers could not recognize any change in boar population as a result of the hunting. The other 37% have said that the boar population had decreased. However the remaining 3% argued that boar populations might have increased following hunts. They reasoned that the increases occur when boars from neighboring habitats come to their cropland after being hunted. However, many of them (63%) believed that hunting benefited them as a means of pest control. Only 17% believed that hunting was not useful in helping them control pest animals. The remaining 20% of respondents could not recognize any effects of hunting on pest control. When the question was posed as to what benefit the host farmers gained from the hunting, 45% believed that pests were evicted from their land and 36% responded that they benefited from the killing of pests. Some of the respondents (14%) had no answer regarding how they benefited, while 5% thought that they indirectly benefited as their village was visited by many people, which might help them expose local resources.

## Discussion

Hunting wild boars with trained dogs is a common practice in West Sumatra. Opportunistic hunting involving small groups of host farmers in their own villages might be the origin of boar hunting in West Sumatra. Formerly, hunting was only meant to kill pest animals but it has since developed a recreational aspect - they enjoy hunting as a hobby and for sport. The number of participant has increased and now in-



**Figure 1: Study site in West Sumatra, showing the distribution of hunting and non-hunting locations**

volves not only host farmers but people from different fields as well. Hunting has become somewhat conventionally organized in West Sumatra. Hunting wild boars with dogs was also found in various other provinces in Sumatra but has some differences in practice. In some areas in Riau and Jambi provinces, for example, hunts were not necessarily conducted near farmland but more exclusively in the forest and with different hunting techniques. Farmers were not the basis of these hunter groups. Usually, hunters sell the meat at the market or to non-Muslim communities nearby.

Hunting with dogs in West Sumatra might not be effective in controlling wild boar populations because the number of successful kills is considerably lower than their potential population growth. Wild

boar males are sexually mature by 5 to 7 months and females by 4 to 6 months (Brooks & Ahmad 1990). Up to 12 piglets are born after a gestation of 101-130 days, and the minimum birth interval is about 230 days (Diong 1973). This means that a single breeding female could potentially compensate for a hunt. However, the population density of target animals within a hunting area should primarily affect successful kills (Caley & Ottley 1995). It remains unclear whether low population density or poor hunting methods caused the low successful kill rate, since boar population density was unknown in this study. However, inappropriate strategies and lack of effort may result in a small number of boars killed during each event. While hunting, group hunters did not completely encircle the hunting area or corner target animals. The hunters usually concentrated their efforts on one side of cultivated lands, with much space on the forested side still remaining. This would have enabled the target animals to escape to the forest interior. In addition, the area covered during one day of hunting was smaller than the home-range size of wild boars. This resulted in less effective searching because target animals could hide or move easily within their home range. In this study, one-day hunting events covered from 6.0 to 10 km<sup>2</sup> while home range size for wild boars is reported to be larger. A study by Caley (1997) reported that the mean aggregate home-range

size was 33.5 km<sup>2</sup> for males and 24.1 km<sup>2</sup> for females and that the boars were rather sedentary with no tendency to disperse great distances from their initial home ranges. Saunders and Kay (1996) reported that the home range size of male boars was 35.0 km<sup>2</sup> and that of females was 11.1 km<sup>2</sup>. Another study by Dexter (1999) reported home-range size for male boars was 7.9-11.6 km<sup>2</sup> and that for females was 4.3-8.0 km<sup>2</sup>. These results are relatively similar to the area covered while hunting in this study. Another possible reason for the low successful kill rate is that the long history of periodical hunting at the same location could also influence target animals to develop anti-predator behaviors such as escaping or hiding strategies. Mob hunting is always noisy with barking dogs, so wild boars may move away the moment they hear the dogs, well before they are found.

In interviews with the host farmers, most could not identify any change in population even though the boars are periodically hunted. However, some farmers said that boar populations might gradually decrease in hunting areas. Does this hunting benefit the host farmer even though successful kill rates were likely low? Many farmers believed that hunting evicted wild boars temporarily from their cultivated lands. They noticed that wild boars did not come to their farmland within some days following a hunt. If this is the case, periodic hunting may be necessary. Con-



**Figure 2: Hunters gather with their dogs where cultivated lands meet the forest edge.**

trarily, McIlroy and Saillard (1989) reported that hunting with dogs does not cause the pigs to disperse from the area. Hunting with dogs is generally not as effective in reducing pig numbers as poisoning with walfarin (Mcilroy & Saillard 1989). Another study by Caley & Ottley (1995) con-

cluded that hunting with dogs is an effective way to remove residual pigs after other forms of control have reduced densities.

Wild boar hunting was conducted in some areas but not in other adjacent areas. This may benefit the host farmers but is a disadvantage for those farmers in the non-hunted adjacent areas. These farmers have to find other methods to kill boars, such as poisoning or trapping. Otherwise, local farmers have to guard their cropland during the night, especially cropland adjacent to the forest edges. Since hunts may not be effective in helping all farmers, we suggest that hunters should realize the potential for hunting to control the pest population. Locations and frequency of hunting should in turn be arranged systematically to avoid neglecting adjacent areas. Moreover, efforts should be made to minimize the effects of hunting on non-target animals, such as deer, mouse deer, primates and birds, which have been accidentally killed or frightened. Finally, a detailed study is necessary to convince hunters of the benefits to host farmers and to illustrate the advantages gained by the latter via hunting.

### Acknowledgements

We greatly thank Santi Nurulkamilah, Mr. Ardison, Putra Datuak and Muhammad Sadly for their help during the field surveys. We also thank Mr. Amiruddin, Mr. Zul Effendy and Yoni Effendy for their invaluable information and Andrew MacIntosh for kindly helping with English editing. This study was in part financially supported by Pro-Natura Fund–Japan 2005.

### References

Auliya M. 2003. A reticulated python (*Python reticulatus*) preys on an adult Sulawesi pig (*Sus celebensis*). Asian Wild Boar News 3 (1): 11-12.

Brooks, J. E., and Ahmad, E. 1990. The status of the Eurasian wild boar in Pakistan. USDA Report, Denver Wildlife Research Center. Denver.

Caley, P. 1997. Movement, activity pattern and habitat use of feral pigs (*Sus scrofa*) in tropical habitat. Wildlife Research 24(1), 77-87.

Caley, P. and Ottley, B. 1995. The effectiveness on hunting dogs for removing feral pigs (*Sus scrofa*). Wildlife Research 22(2), 147-154.

Dexter, N. 1999. The influence of pasture distribution, temperature and sex on home range size of feral pigs in a semi-arid environment. Wildlife Research 26(6), 755-762.

Diong, C.H. 1973. Studies of the Malayan wild pig in Perak and Johore. Malay. Nat. J. 26(2), 120-151.

Kinnaird, M.F., Sanderson, E.W., O'Brien, T.G. and Wibisono, H.T. and Woolmer, G. 2003. Deforestation trends in a tropical landscape and implications for endangered large mammals. Conservation Biology 17(1), 245-257.

McIlroy, J.C. and Saillard, R.J. 1989. The effect of hunting with dogs on the numbers and movements of feral pigs, *Sus scrofa*, and the subsequent success of poisoning exercises in Namadgi National Park, Act.

Munir, D., Utama, E., Rasyid, H.F., Usman, I., Alimin, S. and Paragoan, W. (1993). Minang Kabau. Yayasan Gebu Minang. Jakarta

Saunders, G. & Kay, B. 1996. Movement and home ranges of feral pigs (*Sus scrofa*) in Kosciusko national Park, New South Wales. Wildlife Research 23(6), 711-719.

Statistic Bureau of West Sumatra Province. 2002. West Sumatra in Figures. Published by BPS-Statistics of West Sumatra Province collaboration with the Regional Development Planning Board of West Sumatra. Padang.

**“I am fond of pigs. Dogs look up to us. Cats look down on us. Pigs treat us as equals. “**

**- Winston Churchill**

---

# Abundancia y patrones diarios de actividad del Jabalí (*Tayassu pecari*) en la región este del Parque Nacional Mirador-Río Azul, Petén, Guatemala

José Moreira<sup>1\*</sup>, Roan McNab<sup>1</sup>, Rony García<sup>1</sup>, Francisco Córdova<sup>1</sup>, Tomás Dubón<sup>1</sup>, Marcial Córdova<sup>1</sup> y José Soto<sup>2</sup>.

<sup>1</sup>Wildlife Conservation Society (WCS-Guatemala).

Avenida 15 de marzo, Flores, Peten, Guatemala.

<sup>2</sup> Department of Wildlife Ecology and Conservation, 366 Newins-Ziegler Hall, University of Florida, Gainesville, Florida, 32611-0430, USA.

\* Corresponding author, E- mail [josemo01@yahoo.com](mailto:josemo01@yahoo.com) [josemo01@gmail.com](mailto:josemo01@gmail.com)

## Introducción

La familia Tayassuidae está representada por tres especies que habitan América (Sowls, 1984). Para Guatemala se reportan dos especies, el jabalí (*Tayassu pecari*) y el coche de monte (*Pecari tajacu*) (Taibel 1977). El jabalí es el único mamífero mayor social del Neotropico que se desplaza en manadas de 20 a más de 300 individuos. Ecológicamente funge como importante dispersor y depredador de semillas. Aparentemente, esta especie es altamente susceptible a enfermedades infecciosas transmitidas por animales domésticos, a la fragmentación de su hábitat, y a la presencia humana, ya que es una fuente importante de proteína para las comunidades rurales (Sowls 1984; Morales 1993; Rolling 1995; Bodmer *et al.* 1997; Fragoso 1997; Baur 1999; Reyna 2002; Altrichter y Boaglio 2004; Beck 2004). Sin embargo en nuestro país existe un vacío de información sobre la ecología, biología e historia natural de esta especie. En el vértice noreste de la Reserva de la Biosfera Maya, en la frontera con México y Belice, se localiza el Parque Nacional Mirador-Río Azul (PNMRA), donde las poblaciones de jabalí se encuentran menos afectadas por las actividades humanas que en cualquier otra parte del país (García y Radachowsky, 2004). La Reserva tiene una extensión de 11,7429 ha. Anualmente, la temperatura varía de 22° C a 34° C, la precipitación varía entre los 1,200 mm en la época seca a 1,500 mm en la época lluviosa. La altitud se en-

cuentra entre los 100 a 200 msnm. Existen dos épocas marcadas; la época seca abarca los meses de febrero a mayo y la época lluviosa los meses de junio a enero. Durante la época seca, el agua superficial es limitada, encontrándose solamente en “aguadas” y pozas de ríos. Los objetivos del estudio fueron estimar la abundancia relativa y describir los patrones diarios de actividad del jabalí.

## Métodos

Las trampas-cámara Camtrakker (Camtrak South, 1050 Industrial Drive, Watkinville, GA 30677, USA) fueron colocadas del 22 de abril al 25 de mayo del 2006 en 11 cuerpos de agua. Se obtuvieron 27 fotografías de jabalí con un esfuerzo de 382 trampas noche. Se estimó una abundancia relativa (número de fotografías de jabalí/noches trampa-cámara) (Maffei *et al.* 2002) de 0.07, la cual es más alta que la reportada durante la Evaluación Ecológica Rápida (García y Radachowsky, 2004). Esto demuestra una relativa estabilidad de la población de jabalí dentro del parque. Las trampas-cámara revelan que los patrones diarios de actividad del jabalí son principalmente diurnos. La mayor actividad se dio entre las 8:00hr y 12:00hr del medio día. Por medio de las fechas y horas de capturas fotográficas se estima que en el área de estudio habitan como mínimo dos manadas. Los resultados muestran que posiblemente los jabalís buscan los cuerpos de agua durante el período de mayor temperatura. Este comportamiento podría ayudarlos a disminuir la temperatura corporal y como mecanismo de control de ectoparásitos (Estrada 2005). Las fotografías de individuos de

una manada (Cielo Rojo) muestran problemas de la piel para esta especie (Fig. 1 ). La fotografía se envió al estudiante de Doctorado de la Universidad de Florida Rafael Reyna y al Dr. Andrew Taber para que la revisaran y poder determinar la posible enfermedad. Según un veterinario de fauna silvestre (Manuel Weber) es difícil decir si es sarna o Aujeszky. La enfermedad parece que pudo ser transmitida por animales domésticos. En una comunidad cercana a la Reserva de la Biosfera de Calakmul, México y al PNMRA, durante este año, una epidemia de Aujeszky afectó a puercos domésticos del área (Reyna y Angeles, com. pers. 2006). Esta comunidad podría ser el foco de infección para las manadas de jabalí que se encuentran en esta parte de la Selva Maya. Los jabalís se desplazan en manadas de hasta cien individuos, el número necesario para mantener una epidemia en un ciclo de reinfección (Fragoso 1997). Las manadas de jabalí tienen áreas de vida no exclusivas, y los grupos tienden a juntarse ocasionalmente (Fragoso 1994). Esta ecología permitiría la diseminación de la enfermedad entre manadas y entre una población (Fragoso 1997). Futuros estudios deben estar enfocados en tomar muestras de tejidos y sangre para determinar las enfermedades que padece la especie y los posibles vectores. Acciones como estas favorecerán la conservación del jabalí en Guatemala.



**Figura 1.** Fotografía de jabalí (*Tayassu pecari*) con problemas en la piel. Aguada Cielo Rojo, Parque Nacional Mirador Río Azul.

## Referencias

- Altrichter, M. y G. Boaglio. 2004. Distribution and relative abundance of peccaries in the Argentine Chaco: associations with human factors. *Biological Conservation* 116: 217–225
- Baur, E. 1999. Estudio de la Cacería de Subsistencia en la Concesión Forestal de Carmelita, San Andrés Peten. Informe Final no publicado, Propeten / Conservation International, Flores, Peten. 65 pp.
- Beck, H. 2004. Seed Predation and Dispersal by Peccaries throughout the Neotropics and its Consequences: a Review and Synthesis. Department of Biology, University of Miami, Coral Gables, FL 33124, USA. 6: 77-115.
- Bodmer, R.E., R. Aquino, P. Puertas, C. Reyes, T. Fang y N. Gottdenker. 1997. Manejo y Uso Sustentable de Pecaríes en la Amazonía Peruana. Ocasional Paper of the UICN Species Survival Comisión No. 18. UICN-Sur, Quito, Ecuador y Secretaría CITES, Ginebra, Suiza. iv+102 pp.
- Estrada, N. 2005. Selección de hábitat y actividad diaria del chancho cariblanco (*Tayassu pecari*) en el Parque Nacional Corcovado: uso de trampas-cámara. Tesis de Maestría. Universidad de Costa Rica. xiii+50 pp.
- Fragoso, J. 1994. Large mammal and the community dynamic of an Amazonian rain forest. Tesis de doctorado. Universidad de Florida. 223 pp.
- Fragoso, J. 1997. Desapariciones locales del baquiro labiado (*Tayassu pecari*) en la Amazonía: migración, sobre-cosecha o epidemia? En: Fang, T., R. Bodmer, R. Aquino y M. Valqui (Eds.). 1997. Manejo de fauna silvestre en la Amazonía. UNAP, University of Florida UNDP/GEF e Instituto de Ecología. La Paz, Bolivia. 309-312 pp.
- García, R. y J. Radachowsky. 2004. Evaluación ecológica rápida del Parque Nacional Mirador Río Azul, Peten, Guatemala. 95 pp.
- Maffei, L., E. Cuellar y A. Noss. 2002. Uso de trampas-cámara para la evaluación de mamíferos en el ecotono Chaco-Chiquitanía. *Rev. Bol. Ecol.* (11): 55 – 65.

Morales, J. 1993. Caracterización Etnozoológica de la Actividad de Cacería de la Comunidad de Uaxactún, Flores, El Petén. Tesis de Licenciatura. Universidad de San Carlos de Guatemala. 114 pp.

Roling, G. 1995. Programa Piloto de Manejo de Vida Silvestre de ARCAS/UICN/CONAP/USAC- Escuela de Biología en Uaxactún, Petén, Guatemala. 49 pp.

Reyna, R. 2002. Hunting effects on the ungulate

species in Calakmul forest, México. Tesis de Maestría. Universidad de Florida. x+81 pp.

Sowls, L. 1984. The peccaries. University of Arizona. Press, Tucson. 251 pp.

Taibel, A. 1977. Mammiferi del Guatemala, con speciale riguardo alla regione del Petén, raccolti dal Maggio al Settembre 1932. Atti Societa Italiana di Scienze Naturali, Museo Civico di Storia Naturale di Milano 118(3-4): 379-401.

---

## **First photo register of white-lipped peccary, *Tayassu pecari*, in Grande Sertão Veredas National Park, Minas Gerais state, Brasil.**

### **Primeiro registro fotográfico de queixada, *Tayassu pecari*, no Parque Nacional Grande Sertão Veredas, Minas Gerais, Brasil.**

*Joaquim A. Silva, Edsel A. Moraes Jr. & Marcelo J.R. de Oliveira.*

The Grande Sertão Veredas National Park (GSVNP) is situated between the boroughs of Chapada Gaúcha, Formoso and Arinos in north-western Minas Gerais. The Park was created on the 12<sup>th</sup> of April 1989, under decree 97,658. With an area of 230,714.4 ha, it is the largest Park of the Brazilian Cerrado. This conservation area is situated in the basin of River Preto, and includes the source of this river, as well as the sources of the streams Mato Grosso and Boi, tributaries of the river Carinhanha, the natural limit of the Park with the state of Bahia (within the watershed of River São Francisco). According to PLANOROESTE II, the average annual temperature in the Park's region is between 21° C and 23° C and total annual precipitation is between 1050 and 1200mm. The topography is almost entirely flat with few hills and the soil is mostly sandy. The park contains four types of Cerrado (savanna-like vegetation): "cerrado" (sensu strictu), "campo cerrado" (herbaceous savanna), "campo sujo" (savanna-woodland), "campo limpo" (over-cleaned savanna) and gallery forest. "Carrasco" vegetation also occurs in the Park - transition vegetation between Cerrado

and Caatinga (thorn vegetation), characterised by dense thorny scrub vegetation.

"Veredas" vegetation, riparian palm community, dominated by the buriti palm, *Mauritia vinifera*, which occurs in marshy ground with an expansive carpet of grasses, is also common in the Park.

During the workshop "Lowland Tapir (*Tapirus terrestris*) and White-Lipped Peccary (*Tayassu pecari*) Range-Wide Geographical Status Analysis and Conservation Priority Setting", hosted by Wildlife Conservation Society, in Bolivia in April 2005, GSVNP was indicated as an important area for the conservation of *T. pecari* in South America (Edsel A. Moraes Jr. com. pess.).

In January 2006 14 cameras-traps were placed in GSVNP trails and roads 1 km apart from each other, in order to estimate large and medium sized mammal abundance and density. As a result of the first month of data collection we obtained the first photographic-record of *T. pecari* in the Park (Fig. 1). Previously the species have only been registered through tracks and interviews.

This is only the beginning of long term monitoring project of large mammals in GSVNP, that will follow with the capture and monitoring of these ani-

mals through radio-tracking. In this way, the *T. pecari* photographic-record indicates that White-lipped peccary groups are probably “returning” to the Park, probably because of the reduction in the number of families living inside the park (some families have been removed to a rural settlement), the fire prevention program, the increase in control activities and hunting repression. These actions may have created ideal conditions for an increase in the *T. pecari* popu-

lation and for its maintenance in the area, demonstrating GSVNP’s importance to the species conservation in the Brazilian Cerrado.

#### Acknowledgements

We thank João Ferreira da Silva, IBAMA, Peter G. Crawshaw Jr. and Jim Sanderson. The work was supported by Idea Wild, Fundação O Boticário and Conservação Internacional do Brasil.



**Figure 1. White-Lipped Peccary (*Tayassu pecari*) register in The Grande Sertão Veredas National Park.**

---

## **Análise espacial de um remanescente da Floresta com Araucária baseada nas métricas da paisagem e nos requisitos ecológicos de ungulados silvestres, Paraná, Brasil.**

*Gisley Paula Vidolin\**, *Daniela Biondi\*\**, *Adilson Wandembruck\*\*\**

\* *Biól., Doutoranda, Curso de Pós-Graduação em Engenharia Florestal, UFPR, paula@biositu.com.br*

\*\* *Eng Florestal, Dra. Prof do Curso de Engenharia Florestal da UFPR, dbiondi@ufpr.br*

\*\*\* *Eng Florestal, M.Sc., Bio situ Projetos e Estudos Ambientais Ltda, adilson@biositu.com.br*

Este trabalho trata-se na realidade de uma readequação metodológica do projeto intitulado “Influências da estrutura da paisagem nos aspectos ecológicos de *Tapirus terrestris* (anta) e *Tayassu pecari* (queixada) em áreas de Floresta com Araucária, Paraná, Brasil”, apresentado no Suiform Soundings, volume 5, no. 2 de dezembro de 2005. Tal readequação deu-se em virtude dos resultados

provenientes da captura dos animais e monitoramento dos mesmos, via rádio-telemetria, não terem sido alcançados de forma satisfatória (captura de apenas um grupo de queixadas). Sendo assim, a metodologia complementar adotada irá servir de estratégia para o estudo, de forma a garantir a obtenção de informações de mesma natureza e importância em um curto período de tempo. Esta metodologia consiste na amostragem

de amostragem levou em consideração a representatividade e comparabilidade das amostras. Para a representatividade amostral, considerou-se as parcelas que regularmente são distribuídas em toda a área de estudo e inclusas em todos os tipos de hábitat disponíveis. Quanto à homogeneidade, considerou-se que as escalas espacial e temporal de amostragem entre parcelas teriam que ser semelhantes, para que as amostras pudessem ser comparadas entre si.

Foi elaborado um mapa de uso e cobertura do solo, mediante fotointerpretação não supervisionada da carta imagem satelital da área, utilizando-se o programa ArcGis versão 9.0. A partir desta análise foram identificadas as classes principais de uso e cobertura do solo (tipos de habitats). Para a amostragem dos diferentes tipos de habitats aplicou-se uma grade de parcelas de 1 ha (unidades amostrais) sobre os mapas de tipos de habitat, totalizando 3.187 parcelas amostrais. A quantidade de parcelas a serem amostradas em cada habitat foi determinada mediante o Cálculo do Tamanho de uma Amostra Aleatória Simples, considerando-se um erro amostral tolerável de 5%, com 95% de confiança e 90% de exatidão esperada. O cálculo indicou a necessidade de amostrar 517 parcelas, sendo, 121 no habitat “floresta com predomínio de pinheiro”; 115 no habitat “floresta com predomínio de folhosas”; 99 no habitat “reflorestamento com exóticas”; 76 parcelas no habitat “floresta ciliar”; 61 no habitat “várzea”; 27 no habitat “influência antrópica”; e 17 no habitat “vegetação secundária”. Cada parcela recebeu uma numeração. Previamente, à cada fase de campo, é realizado um sorteio para definição de qual parcela será amostrada. Em campo, as parcelas são localizadas mediante suas coordenadas geográficas centrais e a partir daí, são delimitadas com o uso de trena de 50 m e GPS. Não há repetição de parcelas amostradas.

O registro da anta (*Tapirus terrestris*) e do queixada (*Tayassu pecari*) nestas áreas está sendo realizado pela constatação da presença de

indivíduos, considerando-se vestígios como pegadas, material escatológico, carreiros e outros sinais que atestem a presença dos animais. Com esses dados serão calculadas a intensidade de uso (baseada na porcentagem de coleta dos sinais de utilização) e seletividade de habitats pelas espécies estudadas (baseada na porcentagem de indícios das espécies em cada tipo de habitat em relação à disponibilidade desse habitat). Esta análise, juntamente com as de caracterização da estrutura da vegetação, oferta de alimentos, hidrografia e grau de conservação dos habitats, fornecerão informações sobre os aspectos funcionais da paisagem, ou seja, sobre as respostas biológicas das espécies às condições de cada habitat. Concomitantemente, os aspectos estruturais da paisagem estão sendo analisados mediante o uso de métricas da paisagem, que permitem identificar o padrão espacial dos diferentes tipos de habitats. Para a obtenção desse tipo de informação foi utilizado o *software* Fragstats 3.3, métricas para as classes de uso e cobertura do solo e paisagem. Foram calculadas as métricas de área, de área central, de borda, de forma, de proximidade e de intercalação.

Para a classificação da importância ecológica de cada tipo de habitat, os elementos estruturais e funcionais serão integrados por análises multivariadas, notadamente de componentes principais, que visam avaliar a significância dos dados, bem como obter informações sobre os aspectos de principal influência para os animais. Além da área controle, os dados (especialmente os de aspectos funcionais da paisagem) serão extrapolados para as áreas limítrofes de mesmas características ambientais, identificando-se com isso biótopos-chaves e, portanto, prioritários para a conservação das espécies em macro-escala da paisagem.

---

## Spatial analysis of forest remainder with *Araucaria* based on the landscape metric and on the ecological requirements of wild ungulates, Parana, Brazil.

Gisley Paula Vidolin\*, Daniela Biondi\*\*, Adilson Wandembruck\*\*\*

\* Biologist, Student of Doctorship, Post-Graduation Course in Forest Engineering, UFPR, paula@biositu.com.br

\*\* Forest Engineer, Doctor. Professor of Forest Engineering Course of UFPR, dbiondi@ufpr.br

\*\*\* Forest Engineer, M.Sc., *Bio situ* Projects and Environmental Studies Ltda, adilson@biositu.com.br

This paper consists of a methodological re-adaptation of the project "Influence of the landscape structure on ecological aspects of *Tapirus terrestris* (tapir) and *Tayassu pecari* (white-lipped peccary) in areas of Forest with *Araucaria*, Parana, Brazil", presented in *Suiform Soundings*, volume 5, No. 2, December 2005. Such re-adaptation happened due to unsatisfactory results stemming from the animals' capture and their monitoring by means of radio-telemetry (capture of only a group of wild boars). As a result, this complementary methodology that we have adopted will serve to ensure the attainment of the same type and importance of information in a short period of time. This methodology involved the sampling of different kinds of habitats that made up the landscape of the study area and checking for its use by the wild boar and tapir, taking into consideration the representivity and compatibility of the samples. For sampling representivity, the parcels that are usually distributed in the whole study area and included in every kind of available habitat, were taken into consideration. As for homogeneity, the temporal and spatial scales of the sampling between the parcels were considered, and had to be similar so that the samples could be compared.

A map of soil coverage and use was elaborated by means of non-supervised photo-interpretation of the satellite image letter using an ArcGis version 9.0 program. From this analysis the main classes of soil coverage and use were identified (kinds of habitats). For the sampling of different kinds of habitats, a parcels grid of 1 ha was ap-

plied (sampling units) on the maps of the habitat types, adding up to 3,187 sampling parcels. The amount of parcels to be sampled in each habitat was determined by means of Size Calculation of a Simple Aleatory Sample, considering a tolerable sampling error of 5%, with 95% of reliability and 90% of expected accuracy. A raffle was made previous to each field phase, to determine in which parcel the sampling would be done. In the field, the parcels were located by means of their central geographic coordinates and were then delimited with the use of 50 cm measuring tape and GPS. There was no repetition of the sampled parcels.

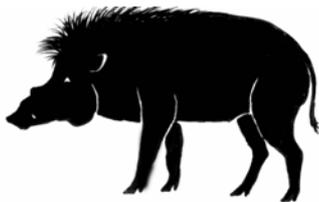
The record of tapir (*Tapirus terrestris*) and the white-lipped peccary (*Tayassu pecari*) in these areas is being made through the confirmation of individual presence, considering traces such as tracks, eschatological material, paths and other signs that testify to the presence of the animals. With this data, the intensity of use will be calculated (based on the collecting percentage of the utilization signs), as will the selection of habitats by the studied species (based on evidence percentage of species on each kind of habitat in relation to availability of this habitat). This analysis, along with the characterization of vegetation structure, food availability, hydrograph and habitat preservation level, will provide information on the landscape functional aspects, that is to say, on the biological answers of the species to the conditions of each habitat. Concomitantly, the landscape structural aspects will be analyzed by means of landscape metric use that allows for identification of the spatial pattern of the different kinds of habitats. To obtain this kind of information, the soft-

---

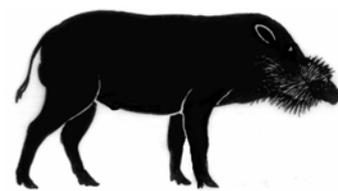
ware Fragstats 3.3, metrics for the soil use and coverage and landscape, were used. The metrics of the area are calculated: the central area, the edge area, of form, of proximity and of intercalation.

For the ecologic importance classification, the structural and functional elements will be integrated by multi-variate analysis, predominantly

of the main components, that will aim to evaluate the data significance, as well as to get information on the main aspects influencing the animals. Besides the controlling area, the data (especially the landscape functional aspects) will be inferred to the adjacent areas with the same environmental characteristics, thereby identifying the key-biotypes and priorities for species preservation in the landscape macro-scale.



## News in Brief



### News in Brief (1) - Heroic pig saves the day

*From the BBC website:*

On the morning of 4 August, 1998, Jo Ann Altsman suffered a heart attack while vacationing in the north woods of Presque Isle, Pennsylvania USA. Alone, apart from the family dog, Bear (who did nothing but bark at Jo Ann after she collapsed and tried to summon help by breaking a bedroom window of the mobile home), she lay on the floor yelling for help.

Another member of the Altsman 'family' was at hand though. Lulu, a housebroken Vietnamese Pot-Bellied Pig came to Jo Ann's aid.

LuLu took one look at Jo Ann and after 'crying' for a moment, crashed through the doggy/piggy door of the mobile home and into the fenced-in yard. Lulu had never left the confines of the yard (except for a walk on a leash), but somehow she managed to push open the gate to get to a nearby road.

Witnesses reported that LuLu would wait until a car approached, then calmly walk out into the road and lay down in front of the oncoming vehicle. Drivers predictably honked and swerved, and one man later confessed to stopping, but being unsure of what the creature was laying in the road he was too afraid of getting out of his car to investigate. When a driver failed to stop, LuLu would return to Jo Ann to check on her, and then leave again to try and summon help. After about forty-five minutes the determined pig finally managed to persuade a young motorist to stop and follow her to the Altsman's mobile home.

The man, who remained anonymous, telephoned the emergency services and paramedics quickly arrived. When LuLu attempted to ride along with Jo Ann to hospital by climbing up into the back of the ambulance, the paramedics had to gently let her know she had done enough for one day. In her rush to get out to find help, LuLu had cut her pot-belly on a sharp edge of the too-small doggy/piggy door. However, this was the only injury she sustained; remarkable considering she lay on a busy highway for lengthy periods of time trying to stop cars.

For her part in saving Jo Ann Altsman's life LuLu the pig received, along with an incredible amount of local media coverage, what she apparently desired most. She got a jam doughnut.

---

---

## News in Brief (2) - Pigs clue to early human colonies

*From the BBC News Website: <http://news.bbc.co.uk/go/pr/fr/-/1/hi/england/6445261.stm>*

*Published: 2007/03/13*

### **A DNA survey of wild and domestic pigs has thrown new light on how early humans reached the remote Pacific.**

Scientists from Durham and Oxford Universities have found a clear genetic link between modern and ancient pigs in East Asia and several Pacific islands.

This suggests that colonists who transported the animals may have travelled from Vietnam via numerous islands, according to the researchers.

Details appear in Proceedings of the National Academy of Sciences journal.

During the study mitochondrial DNA was obtained from the jaw bones or teeth of modern and ancient pigs across East Asia and the Pacific.

**“Given the distances between islands, pigs must have been transported and are thus excellent proxies of human movement”** Dr Greger Larson, Oxford University

Studies of the samples revealed a single genetic heritage shared by modern Vietnamese wild boar and modern feral pigs on the islands of Sumatra, Java, and New Guinea.

The same link was also found between Ancient Lapita pigs in Near Oceania, and modern and ancient domestic pigs on several Pacific Islands.

The findings contradict established theories that colonists originated in Taiwan or Island Southeast Asia, and travelled along routes that pass through the Philippines as they dispersed into the remote Pacific.

Research project director, Dr Keith Dobney, from the Department of Archaeology at Durham University, said: "Many archaeologists have assumed that the combined package of domestic animals and cultural artefacts associated with the first Pacific colonizers originated in the same place and was then transported with people as a single unit.

#### **'New window'**

"Our study shows that this assumption may be too simplistic, and that different elements of the package, including pigs, probably took different routes through Island South East Asia, before being transported into the Pacific."

Dr Greger Larson, lead author of the paper, performed the genetic work while at the University of Oxford.

He said: "Pigs are good swimmers, but not good enough to reach Hawaii. Given the distances between islands, pigs must have been transported and are thus excellent proxies of human movement.

"In this case, they have helped us open a new window into the history of human colonization of the Pacific."

---

## News in Brief (3) - 3 Pigs still have a Lake Forest home

*From the Chicago Tribune (June 2007), by Susan Kuczka*

### Judge rejects plea for swine eviction

A Lake Forest couple who sued their neighbor for keeping three pigs on her North Shore property will look to the Illinois Appellate Court after a Lake County judge refused Tuesday to kick the swine out of town.

Robert and Kathleen Murphy said they want the judge's ruling overturned.

"We just want the pigs to go," Robert Murphy said.

In his ruling, Circuit Judge Mitchell Hoffman upheld the City Council's decision last summer to allow Estelle Gonzales Walgreen to keep her pets at home until at least 2011 -- when an ordinance regulating farm animals takes effect.

Under the new rules, farm animals such as pigs, horses, chickens and donkeys will be allowed only on minimum 10-acre lots and must be kept at least 200 feet from neighboring properties.

"I think the city chose the right path to settle this issue," Hoffman said after a brief hearing in Waukegan.

Walgreen moved her pigs onto her 2.3-acre lot last year to the dismay of the Murphys, who said the pigs were noisy, dirty and posed a threat to their safety if the animals escaped. More than 300 people signed a petition agreeing with the Murphys, but neither the city nor the judge said the pigs -- Pinky, who is 14, Piggy, 13, and Cooper, 2 -- should be evicted.

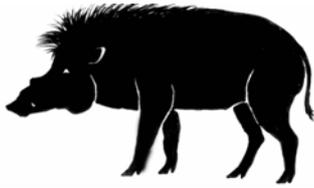
The Murphys' attorney, Robert O'Donnell, argued that zoning rules clearly ban farm animals from residential lots. The judge said because the ordinance does not list a pig as a farm animal, he did not see a need to intervene.

Walgreen, a businesswoman with two young children, did not appear in court Tuesday. "We believe the judge made the right decision," said Charles Byrum, her attorney.

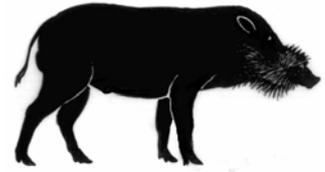
Walgreen, who moved into her Sheridan Road home after her divorce from a member of the Walgreens drugstore family, told city officials she feared moving her two older 200-pound-plus pigs because they have arthritis. She also worried how her two young children would react to losing their favorite playmates, she said.

The Murphys said they would continue the legal battle, , adding that the animals could hurt the value of their property.

"No one wants to live next door to pigs," Robert Murphy said.



# New Literature on Suiformes



## Veterinary and Physiological Studies:

1. Hashimoto, K. Saikawa, Y. Nakata, M. (2007). Studies on the red sweat of the *Hippopotamus amphibious*. Pure & Applied Chemistry. 79(4): 507-517

Abstract: The secretion from the hippopotamus' skin changes its color from colorless to red, and then brown by polymerization of its pigments. The responsible pigments for the coloring reaction were isolated and denoted as hipposudoric acid (the red pigment) and norhippo-sudoric acid (the orange pigment). The syntheses of these pigments and the related derivatives were performed, and the latter were of use to elucidate the structures of these pigments including their tautomeric structures in aprotic and protic solvents. These pigments were estimated to be medicines for the hippopotamus, having the effect of both protecting the skin from sunburn and preventing infection by some microbes.

2. Muwanika, V.B. Nyakaana, S. Siegismund, H.R. Arctander, P. (2007). Population genetic structure of the common warthog (*Phacochoerus africanus*) in Uganda: evidence for a strong philopatry among warthogs and social structure breakdown in a disturbed population. African Journal of Ecology. 45(1): 22-30

Abstract: Fine-scale genetic structure of large mammals is rarely analysed. Yet it is potentially important in estimating gene flow between the now fragmented wildlife habitats and in predicting recolonization following local extinction events. In this study, we examined the extent to which warthog populations from five localities in Uganda are genetically structured using both mitochondrial control region sequence and microsatellite allele length variation. Four of the localities (Queen Elizabeth, Murchison Falls, Lake Mburo and Kidepo Valley) are national parks with relatively good wildlife protection practices and the other (Luwero), not a protected area, is characterized by a great deal of hunting. In the total sample, significant genetic differentiation was observed at both the mtDNA locus ( $F_{ST} = 0.68$ ;  $P < 0.001$ ) and the microsatellite loci ( $F_{ST} = 0.14$ ;  $P < 0.001$ ). Despite the relatively short geographical distances between populations, significant genetic differentiation was observed in all pair-wise population comparisons at the two marker sets (mtDNA  $F_{ST} = 0.21-0.79$ ,  $P < 0.001$ ; microsatellite  $F_{ST} = 0.074-0.191$ ,  $P < 0.001$ ). Significant heterozygote deficiency was observed at most loci within protected areas while no significant deviation from Hardy-Weinberg expectation was observed in the unprotected Luwero population. We explain these results in terms of: (i) a strong philopatry among warthogs, (ii) a Wahlund effect resulting from the sampling regime and (iii) break down of social structure in the disturbed Luwero population.

3. Pinna, W. Nieddu, G. Moniello, G. Cappai, M.G. (2007). Vegetable and animal food sorts found in the gastric content of Sardinian Wild Boar (*Sus scrofa meridionalis*). Journal of Animal Physiology & Animal Nutrition. 91(5-6): 252-255

---

Abstract: Authors report results emerging from gastric content analysis from n. 96 wild boars hunted in Sardinia isle, during the hunting tide (2001-2005), from November to January. Mean pH of the gastric content was 3.77 +/- 0.69. Mean total capacity (TC) of each stomach was 1702 +/- 680 g. Mean Stuff ratio (CW/TC) between the content weight (CW) and stomachs TC was 0.45. Food categories found in animal stomachs were: 19 categories of vegetal species (*Allium* spp., *Arbutus unedo*, *Arisarum vulgare*, *Avena fatua*, *Avena sativa*, *Castanea sativa*, *Cerantonia siliqua*, *Chamaerops umilis*, *Cichorium intybus*, *Hordeum sativum*, *Juniperus oxycedrus*, *Myrtus communis*, *Olea europea*, *Pirus amygdaliformis*, *Pistacia lentiscus*, *Quercus* spp., *Rhamnus alaternus*, *Triticum durum*, *Zea mais*); 11 categories of animal species (*Agriotes lineatus*, *Apodemus sylvaticus dicrurus*, *Chalcides chalcides*, *Chalcides ocellatus tiligugu*, *Crematogaster scutellaris*, *Forficula auricularia*, *Helix aspersa*, *Lumbricus terrestris*, *Ovis aries*, *Podarcis tiliguerta tiliguerta*, *Scolopendra cingulata*); three categories were identified in general terms (insects larvae, hairs of mammals, feathers of birds). Food categories found in the stomach contents of *Sus scrofa meridionalis* confirm observations by other researchers who report the prevalence of vegetables in spite of animal food sorts in the wild boar diet in Italian regions.

4. Li, X. Y. Zhu, Z. M. Mo, D. L. Wang, H. Yang, S. L. Zhao, S. H. Li, K. (2007) Comparative molecular characterization of ADSS1 and ADSS2 genes in pig (*Sus scrofa*). Comparative Biochemistry & Physiology. Part B, Biochemistry & Molecular Biology. 147(2): 271-277.

Abstract: Adenylosuccinate synthetase (ADSS) catalyzes the key step of AMP synthesis. Vertebrates have two isozymes of ADSS, which are named ADSS1 and ADSS2, respectively. In this study, we cloned porcine ADSS1 and ADSS2 genes and comparatively analyzed their sequence, chromosome mapping, mRNA distribution and subcellular localization. According to our results, the ADSS1 gene was predominantly expressed in the striated muscle tissues, while ADSS2 gene distributed widely in all the tissues detected. Additionally, ADSS1 gene was up-regulated significantly along with porcine muscle growth, and ADSS2 gene expression was more constant during the muscle development. Porcine ADSS1 gene was assigned to SSC7q and the linked marker was SSC12B09, ADSS2 gene was mapped on SSC10p and the linked marker was SW497, and porcine ADSS2 protein was subcellular localized in mitochondria. Moreover, we found that one single nucleotide polymorphism (SNP, T/C-70) in the ninth intron of ADSS2 gene was significantly associated with average daily gain trait (ADG,  $P < 0.05$ ) and loin muscle area trait ( $P < 0.05$ ).

5. Tanaka, K. Iwaki, Y. Takizawa, T. Murakami, M. Mannen, H. Maeda, Y. Kurosawa, Y. Dang, V.B. Phith, L.C. Bouahom, B. Yamamoto, Y. Daing, T. Namikawa, T. (2007). The novel polymorphism of the beta 3-adrenergic receptor gene and its distribution in domestic pigs and wild boars in Asia. Animal Science Journal. 78(3): 243-250

Abstract: The beta 3-adrenergic receptor (ADRB3) is a G protein-coupled receptor that is involved in regulating energy homeostasis. We have studied DNA sequences of porcine ADRB3 to find candidate genetic polymorphisms for economically important growth and performance traits in pigs. Five novel haplotypes derived from the three In/dels and 44 SNPs were identified among domestic pigs and wild boars. Three of them encode non-synonymous amino acid sequences by five missense polymorphisms and a frameshift by a thymine insertion. The amino acid polymorphic sites were distributed as follows: one substitution was in extracellular loop 1, three substitutions were in intracellular loop3 and one sub-

---

stitution and the deletion of two amino acids were at the carboxyl-terminal. There was no polymorphism in the transmembrane domains. In addition, we surveyed the allelic frequency of the thymine insertion that cause frameshift in South-east Asian local pigs, including some commercial breeds and wild boars. This thymine insertion was distributed widely in the domestic pigs and wild boars. The frequencies of this allele were relatively low in Western improved breeds, while they were very common in Asian breeds and wild boars in Asia. This result indicates that this insertion originally occurred in ancient Asian wild boars and then circulated among Asian domestic pigs. This allele also spread over Western breeds, probably through the introgression of Asian pigs into European stocks during the 18th and 19th centuries.

6. Acevedo, P. Vicente, J. Hofle, U. Cassinello, J. Ruiz-Fons, F. Gortazar, C. (2007). Estimation of European wild boar relative abundance and aggregation: a novel method in epidemiological risk assessment. Epidemiology & Infection. 135(3): 519-527.

Abstract: Wild boars are important disease reservoirs. It is well known that abundance estimates are needed in wildlife epidemiology, but the expense and effort required to obtain them is prohibitive. We evaluated a simple method based on the frequency of faecal droppings found on transects (FBII), and developed a spatial aggregation index, based on the runs test statistic. Estimates were compared with hunting data, and with porcine circovirus and Aujeszky's disease virus seroprevalences and Mycobacterium tuberculosis complex and Metastrongylus spp. prevalence. The FBII and the aggregation index were correlated with the hunting index, but both of the former estimates correlated better than the latter with the disease prevalences. Hence, at least in habitats with high wild boar densities, the FBII combined with the aggregation index constitutes a cheap and reliable alternative for wild boar abundance estimation that can be used for epidemiological risk assessment, even outside the hunting season and in areas with no available data on hunting activities.

7. Roic, B. Depner, K.R. Jemersic, L. Lipej, Z. Cajavec, S. Tonicic, J. Lojkic, M. Mihaljevic, Z. (2007). Serum antibodies directed against Classical swine fever virus and other Pestiviruses in wild boar (*Sus scrofa*) in the Republic of Croatia. Deutsche Tierärztliche Wochenschrift. 114(4): 145-148

Abstract: The presence of serum antibodies directed against classical swine fever (CSF) virus and other pestiviruses among the wild boar (*Sus scrofo*) population in Croatia was investigated. During 2003, serum samples from 214 wild boars were collected in 10 hunting areas in the continental part of the country. The sera were examined by enzyme immunoassay (ELISA) and in the virus neutralization test (VNT). Out of 214 sera tested 111 (51.87 %) were positive by ELISA and regarding neutralising antibodies, against CSFV 75 (35.05 %) samples were positive. In the VNT with the C-strain (conventional live vaccine strain China) and the strain Uelzen were used, Samples were also tested for neutralizing antibodies against border disease virus (BDV) using the strain 137/4 and against bovine viral diarrhoea virus (BVDV) using the NADL strain. Neutralizing antibodies against the C-strain were detected in 36 sera (16.82 %), against strain Uelzen in 17 sera (7,94 %) and in 22 sera (10.28 %) against both strains. In five sera (2.33 %) neutralizing antibodies against BVDV and BDV were found.

8. Kramer-Schadt, S. Fernandez, N. Thulke, H.H. (2007). Potential ecological and epidemiological factors affecting the persistence of classical swine fever in wild boar *Sus scrofa* populations. Mammal Review. 37(1): 1-20.

---

Abstract: 1. Classical swine fever has increased in economic importance since it has become endemic in some wild boar *Sus scrofa* populations in Europe. The mechanism of disease persistence is still not well understood, and several aspects of both the ecology of boar and the virus are claimed to be responsible for disease persistence.

2. We review literature on the spread and persistence of the disease in free-ranging wild boar. We determine whether the available knowledge can explain the observed patterns via mechanistic processes and their interactions, and assemble knowledge in a conceptual model.

3. We speculate that the most important factor explaining disease persistence is an alteration in disease outcome, resulting in individual courses with prolonged infectiousness or a sustained reproductive population through immunity. This effect is reinforced by high wild boar numbers either within sites or scattered over larger areas.

4. We highlight the sparse knowledge of disease transmission between wild boar. We derive management suggestions for different phases of an outbreak based on the conceptual model and advocate the use of model-based investigations to test alternative management options.

9. Vicente, J. Hofle, U. Garrido, J.M. Fernandez-de-Maria, I.G. Acevedo, P. Juste, R. Barral, M. Gortazar, C. (2007). Risk factors associated with the prevalence of tuberculosis-like lesions in fenced wild boar and red deer in south central Spain. *Veterinary Research*. 38(3): 451-464.

Abstract: In recent decades the management of large game mammals has become increasingly intensive in south central Spain (SCS), resulting in complex epidemiological scenarios for disease maintenance, and has probably impeded schemes to eradicate tuberculosis (TB) in domestic livestock. We conducted an analysis of risk factors which investigated associations between the pattern of tuberculosis-like lesions (TBL) in wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*) across 19 hunting estates from SCS and an extensive set of variables related to game management, land use and habitat structure. The aggregation of wild boar at artificial watering sites was significantly associated with an increasing risk of detecting TBL in both species, which probably relates to enhanced opportunities for transmission. Aggregation of wild boar at feeding sites was also associated with increased risks of TBL in red deer. Hardwood *Quercus* spp. forest availability was marginally associated with an increased risk of TB in both species, whereas scrubland cover was associated with a reduced individual risk of TBL in the wild boar. It is concluded that management practices that encourage the aggregation of hosts, and some characteristics of Mediterranean habitats could increase the frequency and probability of both direct and indirect transmission of TB. These findings are of concern for both veterinary and public health authorities, and reveal tuberculosis itself as a potential limiting factor for the development and sustainability of such intensive game management systems in Spanish Mediterranean habitats

10. Melzer, F. Lohse, R. Nieper, H. Liebert, M. Sachse, K. (2007). A serological study on brucellosis in wild boars in Germany. *European Journal of Wildlife Research*. 53(2): 153-157

Abstract: A recent outbreak of brucellosis in an outdoor pig herd, where wild boars were identified as the most probable source of infection, prompted us to conduct a serological study on wild boars from five federal states of Germany. A total of 885 sera were examined using a combination of screening and confirmatory testing, i.e. indirect enzyme-linked immunosorbent assay (ELISA) followed by com-

---

tected with a probability of 95 per cent at a threshold prevalence of less than 1 per cent for classical swine fever and Aujeszky's disease and less than 1-5 per cent for brucellosis. There was no serological evidence of classical swine fever or Aujeszky's disease, but brucellosis due to *Brucella suis* biovar 2 was confirmed serologically and by bacterial isolation.

12. Bacchetta, R. Mantecca, P. Lattuada, L. Quaglia, F. Vailati, G. Apollonio, M. (2007). The carpal gland in wild swine: Functional evaluations. Italian Journal of Zoology. 74(1): 7-12

Abstract: The carpal organ is a glandular complex implicated in scent communication. To investigate its ethological significance, morpho-functional evaluations were conducted on 67 glands collected from animals of different ages and sex during the 2002 hunting season (October-December) in the Bergamo district, Northern Italy. All samples were histologically and morphometrically examined to determine gland surface and thickness, number of secretory tubules per area and outer diameter of the tubules. Comparative analyses revealed significant differences in the above parameters between sub-adults and adults for both sexes, but no differences were found between adult males and females. However, when all specimens were pooled, males revealed more developed and functional glands than females, with the oldest males having the highest values of gland surface, gland thickness and tubule diameter. Our findings suggest that this organ plays a relevant role in social communication by producing chemical signals involved in territorial definition as well as reproduction.

13. Ruiz-Fons, F. Vidal, D. Hofle, U. Vicente, J. Gortazar C. (2007). Aujeszky's disease virus infection patterns in European wild boar. Veterinary Microbiology. 120(3-4): 241-250

Abstract: Evidence of exposure (i.e. seroprevalence) to Aujeszky's disease virus (ADV) is high among wild boars from south-central Spain. This research aims to determine the presence of ADV by molecular detection, and to describe the patterns of ADV infection in wild boars. Tonsils (TN) and nigerninal ganglia (TG) for ADV molecular detection, and sera were collected from wild boars (n = 192) in 39 hunting estates from south-central Spain (2004/2005). A nested polymerase chain reaction (PCR) for a fragment of the ADV surface glycoprotein 13 was performed on collected tissues. Individual status of presence of viral DNA was tested against explanatory variables by means of a Generalized Linear Mixed Model (GLIMMIX) analysis. Viral detection prevalence was 30.6 +/- 6.7%. Although there was an increasing pattern with age and females presented higher prevalences, no statistically significant influence of sex and age was found for viral presence. Molecular testing in TN and TG allowed classifying infection status into (i) ADV negative (in both TN and TG), (ii) only positive in TN, (iii) only positive in TG and (iv) positive in both TN and TG. ADV DNA was statistically more frequently evidenced in TN in females than in males. With the exception of one individual, all wild boars with presence of ADV DNA in TN and TG or only in TG reacted positive in the ELISA. In contrast, animals with only ADN/DNA in TN seroreacted positively and negatively. Interestingly, 45% of the PCR positive wild boars (n = 59) were seronegative in the serological test, all of them with viral DNA only in TN. Our results provide evidence for latency of ADV in wild boars and stress the fact that antibody detection based tests may fail to detect a proportion of recently infected animals. This is of great concern since current management schemes in our study promote animal translocation for hunting purposes, with the associated risk of under-detecting ADV infected individuals when using serology to screen for ADV infection.

---

14. Muller, M. Naumann, L. Weber, A. Ehrlein, J. Ewringmann, T. Krisch, A. Kahlau, D. (2007). Detection of *Mycobacterium tuberculosis* complex in wild boars by PCR. Tieraerztliche Umschau. 62 (3): 140-143.

Abstract: The lymph nodes (90 mandibular, one mesenteric and one popliteal lymph node) of 92 wild boars from six different Bavarian hunting grounds were investigated for mycobacteria by Ziehl-Neelsen and auramine/rhodamine staining, PCR and bacteriological culture. Mycobacteria demonstrated microscopically in 10 boars. In 19 animals the PCR for *Mycobacterium tuberculosis*-complex yielded a positive result, but all were negative on culture. In contrast to this, *Mycobacterium avium* was demonstrated in seven cases and *M. nonchromogenicum*, *M. terrae* and *M. triviale* in one case each by culture on modified Middle-brook medium (BACTEC MGIT 960 System), Lowenstein-Jensen- and Stonebrink media

15. Servanty, S. Gaillard, J.M. Allaine, D. Brandt, S. Baubet, E. (2007). Litter size and fetal sex ratio adjustment in a highly polytocous species: the wild boar. Behavioral Ecology. 18(2): 427-432

Abstract: For species in which reproductive success is more variable in one sex than the other, the Trivers and Willard model (TWM) predicts that females are able to adjust their offspring sex ratio. High-quality mothers should provide greater investment to one sex than the other. Previous tests of the TWM have been inconsistent, and whether the TWM applies to species with several offspring per litter is unclear due to possible trade-offs between size, number, and sex of the offspring. Williams' model (WM) accounts for confounding effects of these trade-offs on sex ratio variation. Lastly, the "extrinsic modification hypothesis" predicts changes in offspring sex ratio in relation to climatic conditions and population density. Using wild boar as a model, we tested 1) whether the WM fitted observed sex ratio variation and 2) whether sex ratio variations were related to maternal attributes (test of the TWM) and/or to resource availability (test of the extrinsic modification hypothesis). Females adjusted their litter size rather than their litter composition, so that the WM was not supported. Likewise, changes in resource availability did not influence the fetal sex ratio, so that the extrinsic modification hypothesis was not supported. The fetal sex ratio was negatively related to increasing litter size, providing some support for the TWM. Sex ratio was male biased for litter sizes up to 6 and then became female biased in larger litters. Our results provide the first case study showing marked changes in sex ratio in relation to litter size in a large mammal.

### **Taxonomic, Morphological, Biogeographic and Evolutionary Studies:**

1. Tripathi, S. Godfrey, I. (2007). Studies on elephant tusks and hippopotamus teeth collected from the early 17th century Portuguese shipwreck off Goa, west coast of India: Evidence of maritime trade between Goa, Portugal and African countries. Current Science. 92(3): 332-339.

Abstract: Shipwreck findings are indicators of the provenance of artefacts and trade routes. Many shipwrecks datable from the Bronze Age to the modern period have been excavated to yield numerous varieties of artefacts, including cargo, personal belongings of the crew, arms and ammunition, treasure, royal belongings, etc. Similarly, exploration of a Portuguese shipwreck in Goa waters has led to the recovery of a variety of artefacts, including elephant tusks, hippopotamus teeth, the barrel of a handgun, Chinese ceramics, stoneware (Martaban pottery), iron guns, an iron anchor, bases of glass bottles,

---

pieces of lead sheets, copper vessel and strap, stone and clay bricks and dressed granite blocks. A comparative study of the findings and the thermoluminescence date of excavated stoneware dated the wreck to the early, 17th century AD. The C-14 date of ivory is 740 +/- 130 yrs; with a calibrated age range of 740 to 560 yrs BP. The elephant tusks are highly degraded, discoloured and soft to the touch, whereas the hippopotamus teeth are still very hard. Maritime trade records suggest that these tusks are likely to have been brought from African countries to India to make different types of finished artefacts before being sent back to Portugal and her colonies. This article highlights the state and analysis of elephant tusks and hippopotamus teeth recovered from the wreck site with the provenance determined primarily on the basis of maritime trade records that report the importation of these materials from African countries to India.

2. Larson, G. Cucchi, T. Fujita, M. Matisoo-Smith, E. Robins, J. Anderson, A. Rolett, B. Spriggs, M. Dolman, G. Kim, T.H. Thuy, N.T.D. Randi, E. Doherty, M. Due, R.A. Bollt, R. Djubiantono, T. Griffin, B. Intoh, M. Keane, E. Kirch, P. Li, K.T. Morwood, M. Pedrina, L.M. Piper, P.J. Rabbett, R.J. et al. (2007). Phylogeny and ancient DNA of *Sus* provides insights into neolithic expansion in island southeast Asia and Oceania. Proceedings of the National Academy of Sciences of the United States of America. 104(12): 4834-4839

Abstract: Human settlement of Oceania marked the culmination of a global colonization process that began when humans first left Africa at least 90,000 years ago. The precise origins and dispersal routes of the Austronesian peoples and the associated Lapita culture remain contentious, and numerous disparate models of dispersal (based primarily on linguistic, genetic, and archeological data) have been proposed. Here, through the use of mtDNA from 781 modern and ancient *Sus* specimens, we provide evidence for an early human-mediated translocation of the Sulawesi warty pig (*Sus celebensis*) to Flores and Timor and two later separate human-mediated dispersals of domestic pig (*Sus scrofa*) through Island Southeast Asia into Oceania. Of the later dispersal routes, one is unequivocally associated with the Neolithic (Lapita) and later Polynesian migrations and links modern and archeological Javan, Sumatran, Wallacean, and oceanic pigs with mainland Southeast Asian *S. scrofa*. Archeological and genetic evidence shows these pigs were certainly introduced to islands east of the Wallace Line, including New Guinea, and that so-called "wild" pigs within this region are most likely feral descendants of domestic pigs introduced by early agriculturalists. The other later pig dispersal links mainland East Asian pigs to western Micronesia, Taiwan, and the Philippines. These results provide important data with which to test current models for human dispersal in the region.

### **Ecology and Conservation Studies**

1. Treydte, A.C. Halsdorf, S.A. Weber, E. Edwards, P.J. (2006). Habitat use of warthogs on a former cattle ranch in Tanzania. Journal of Wildlife Management. 70(5): 1285-1292

Abstract: We investigated habitat use of the common warthog (*Phacochoerus africanus*) on a large, recently abandoned ranch in Tanzania. Fifty years of ranching had heavily modified the savanna vegetation, especially close to the paddocks where cattle were kept overnight. We recognized 4 characteristic vegetation zones along transects radiating from these paddocks: paddock center (PC), paddock margin (PM), acacia scrub (AS), and unmodified savanna (SV). Within these zones, we recorded warthog

---

traces such as footprints, dung pellet groups, and diggings, and used these data to calculate presence and activity indices. Warthog traces were more abundant in the PM and AS than in PC and SV zones, and during dry periods the presence and activity indices were highest within and close to paddocks. From our results, we concluded that 1) warthogs are pioneer species, being one of the first native ungulates to recolonize cattle-impacted savanna vegetation; 2) areas close to former paddocks are particularly attractive to this species because of their vegetation structure and nutritional quality 3) management to restore wildlife populations in former rangeland should initially focus on those areas where wildlife recolonization commences; and 4) indirect observations help to identify habitat-use patterns and point out key wildlife areas important for future protection.

2. Mysterud, A. Tryjanowski, P. Panek, M. Pettorelli, N. Stenseth, N.C. (2007) Inter-specific synchrony of two contrasting ungulates: wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*). Oecologia. 151(2): 232-239

Abstract: Very few studies on ungulates address issues of inter-specific synchrony in population responses to environmental variation such as climate. Depending on whether annual variation in performance of ungulate populations is driven by direct or indirect (trophic) interactions, very different predictions regarding the pattern of inter-specific synchrony can be derived. We compared annual autumn body mass variation in roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*) from Poland over the period 1982-2002, and related this to variation in winter and summer climate and plant phenological development [the Normalized Difference Vegetation Index (NDVI), derived from satellites]. Roe deer fawns (similar to 1.3 kg increase from year 1982 to 2002) and yearlings both increased markedly in mass over years. There was also an increase for wild boar mass over years (similar to 4.2 kg increase for piglets from 1982 to 2002). Despite our failure to link annual body mass to spring or winter conditions or the NDVI, the body mass of roe deer and wild boar fluctuated in synchrony. As this was a field roe deer population, and since wild boar is an omnivore, we suggest this may be linked to annual variation and trends in crop structure (mainly rye). We urge future studies to take advantage of studying multiple species in order to gain further insight into processes of how climate affect ungulate populations.

3. Engeman, R.M. Stevens, A. Allen, J. Dunlap, J. Daniel, M. Teague, D. Constantin, B. (2007). Feral swine management for conservation of an imperiled wetland habitat: Florida's vanishing seepage slopes. Biological Conservation. 134(3): 440-446

Abstract: Only 1% of the original extent of Florida's seepage slope habitat remains, with Eglin Air Force Base containing some of the largest tracts. Feral swine damage is one of the greatest threats to this wetland habitat. We conducted a multi-year study to evaluate the impacts of sport hunting and supplemental swine removal on damage to seepage slopes. Prior to initiation of removal in 2003, swine damage to seepage slopes in the portion of the base closed to hunting averaged 25.0%, over twice the 10.9% losses in the portion open to hunting. After less than one year of supplemental removal, damage in the closed-to-hunting area dropped to 7.2%. Although supplemental removal was not applied in the open hunting area, damage dropped significantly to 5.6%, statistically indistinguishable from the swine-controlled (closed) portion. After another year of removal, average damage in the closed hunting area dropped further to 5.6%, while the open hunting area dropped to 4.3%, again statistically indistinguishable. Even though removal was only applied to the area closed to hunting, it also

---

produced damage reductions in the open hunting area, as swine were free to move among areas. Declines in damage following implementation of removal corresponded with large drops in swine population indices for the base. Economic valuations of seepage slope damage losses demonstrated substantial benefit-cost ratios for application of removal. Prior to removal, the combined value of swine damage to seepage slopes in areas open and closed to hunting was estimated at \$5.3 million. After only 1.7 years of removal, the value of damage losses was reduced by nearly \$4 million to \$1.5 million. The benefit-cost ratio over the 1.7 years of removal was an impressive 27.5. Moreover, the economic benefits of removal exceeded the costs 55.2-fold for the first year, when management impact would be greatest.

---

## DISCLAIMER

- *with respect to content:*

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

- *with respect to geography:*

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

---

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

### Contact address:

Anne-Marie E. Stewart  
6 Luisa Way  
Hout Bay  
7806  
South Africa

### **Chief Editor:**

Anne-Marie Stewart

### **Associate Editors**

Dr. Kristin Leus  
Mariana Altrichter  
Edsel Amorim Moraes, Jr.

### **Editorial board:**

William L.R. Oliver  
Dr. Colin P. Groves  
Dr. Rebecca Lewison  
Chris H. Gordon

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.

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