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

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

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

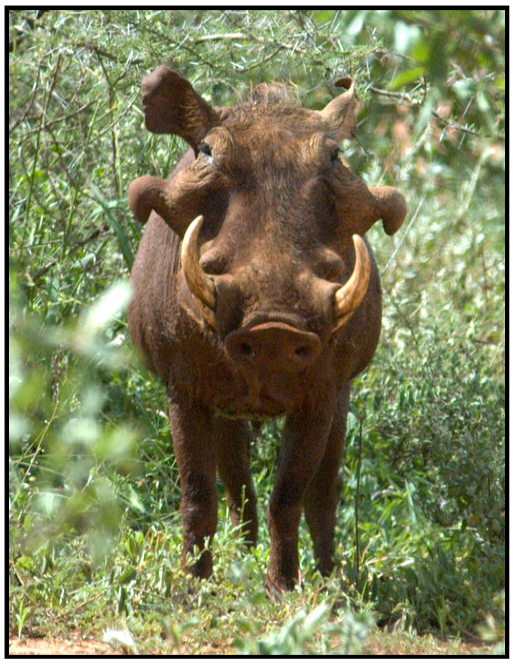

Figure 2: Adult male desert warthog *Phacochoerus aethiopicus* in medium-dense shrub in Tsavo West National Park, southern Kenya. Note the flipped-back ear tips, the hooked warts, the broad, 'egg-shaped', head, and the swollen suborbital area.

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

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

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

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

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

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

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

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

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

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

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The Warthog Debate

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

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

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

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

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

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

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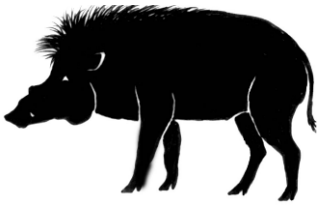

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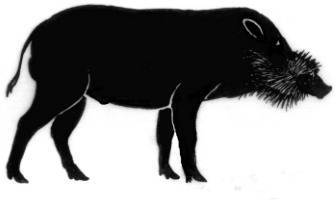

Bearded pig (*Sus barbatus)* predation on Borneo Blood Python (*Python curtus*) in the lower Kinabatangan, Northern Borneo

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

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