Warren C. 2002. *Managing Scotland's Environment*. Edinburgh University Press.
Welander J. 2000. Spatial and temporal dynamics of wild boar *(Sus scrofa)* rooting in a mosaic landscape. *Journal of Zoology* 252: 263-271.
White P. 1979. Pattern, process, and natural disturbance in vegetation. *The Botanical Review* 45: 229-299.
Yalden D. 1999. *The History of British Mammals*. Academic Press.

A female *Sus scofa* and her piglet, Alladale Wilderness Reserve. Photo: Chris Sandom

Hair trap efficacy to sample white-lipped peccaries (*Tayassu pecari*)

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Introduction

Several forest-dwelling species of mammals are elusive and hard to sample. However, recent advances in genetic technology allow us to identify the species, sex and specific individuals without capturing the animals in question, via DNA extracts from faeces, carcasses, and hairs (Taberlet *et al.*, 1999). Faeces, which mark territory boundaries or lodges have been used in carnivore studies (Ernest *et al.*, 2000; Palomares *et al.*, 2002; Miotto *et al.*, 2007). Hair traps have been efficiently used to sample carnivores, such as bears (*Ursus arctos* and *U. americanus*; Woods *et al.*, 1999; Kendal *et al.*, 2009), lynx (*Lynx canadensis*; McDaniel *et al.*, 2000), martens (*Martes americana*; Foran *et al.*, 1997; Mowat, 2006), and ocelots (*Leopardus pardalis*; Weaver *et al.*, 2005), but not to sample other mammals in tropical forests.

White-lipped peccaries (*Tayassu pecari*) are neotropical ungulates that forage in thick vegetation in large herds that can exceed 100 individuals (Peres & Palacios, 2007; Galetti *et al.*, 2009). White lipped peccary populations have been declining and many local extinctions have occurred (Peres, 1996). In order to protect them via appropriate management and conservation programs, genetic parameters (such as genetic diversity, population structure, levels of gene flow, inbreeding coefficients, etc) need to be estimated. Our aims were to investigate the efficiency of barbed wire hair traps in a tropical rainforest and how white-lipped peccaries respond to these traps, in order to evaluate its application for future genetic studies.

Material and Methods

This work was conducted in Cardoso Island (Parque Estadual Ilha do Cardoso), Cananéia, São Paulo State, Brazil (25°03’05” – 25°18’18” S and 48°53’48” – 48°05’42” W). The Cardoso Island is a 15,100 ha protected land-bridge island encompassing several types of Atlantic rainforest, including lowland and montane tropical rain forests, mangroves, dune vegetation and restinga forest (Barros *et al.*, 1991). No reliable information exists on the white-lipped peccary population status in Cardoso Island (see Bernardo, 2004).

We constructed hair traps which consisted of an enclosure of barbed wire of approximately 16 m^2 wrapped around four trees (*Fig. 1*). We used one strand of wire positioned at a height of 40 cm above the ground, which is approximately 15 cm lower than the mean height of an adult white-lipped peccary. We positioned the wire at this height because many genetic parameters are estimated based on adult population (effective population), but juveniles can be sampled using the wire at lower height. Each trap was baited weekly with approximately 0.5 kg of corn and 0.25 kg of salt placed in the centre of the enclosure. We placed four traps in the “Poço das Antas” area, using a spacing distance of ≥ 100 m. Traps were set up in places known to be used by white-lipped peccaries such as foraging trails and rest sites. Traps were checked regularly twice a week, from 30 June to 27 October 2009. Hairs were collected from each trap separately during each checking occasion. When we checked hair traps, we also looked for and collected faeces in the same area where traps were placed. We compared the number of faeces collected with the number of hairs obtained with roots attached, to estimate the success of hair traps to sample white-lipped peccaries. In addition, we utilised one camera trap (ReconyxÒ) at one of the hair traps during two full days in November 2009 and recorded the number of peccaries and other mammal species that visited the trap.

Results and Discussion

Ten white-lipped peccaries and one agouti (*Dasyprocta aguti*) visited one hair trap during two hours of camera recording. On 25 occasions peccaries crossed the hair trap, leaving their hairs in the barbed wire (*Fig. 1*). We collected a total of 795 hairs from the four traps during the whole study period, of which 80 (10.1%) had follicles. In contrast, we collected only 17 faecal samples in the same period and in the same area. In two traps we also found hairs from two other unidentified species, which show the potential of this type of trap to obtain samples from other species of mammals.

Our results demonstrated that barbed-wire hair traps are efficient in sampling white-lipped peccaries and probably other mammals in rainforests. This noninvasive method permitted us to collect samples with low costs and without obvious injury to the animals, which could be determined from the camera trap photos. We had a higher success rate sampling hairs than faeces. Faecal samples usually contain low and highly fragmented DNA and high concentrations of PCR inhibitors (Waits & Paetkau, 2005), and to purify the target DNA it is necessary to use expensive purification kits which increase the final costs of the analyses. Therefore, a barbed-wire hair trap is a good alternative to sample white-lipped peccaries and, with some adaptations, other rainforest mammals at low costs and easy handling. This makes this technique valuable to conservation genetic studies.

Figure 1. White-lipped peccary entering barbed-wire enclosure hair trap. Four of these traps were used to collect hair samples from white-lipped peccaries in Cardoso Island, Southeastern Brazil, from June to October, 2009. (Photo: D. Norris)

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References

Barros F, Melo MMRF, Chiea SAC, Kirizawa M, Wanderley MGL and Jung-Mendaçolli SL. 1991. Caracterização geral da vegetação e listagem das espécies ocorrentes. V.1, Pp.1–184. In: Melo MMRF, Barros F, Wanderley MGL, Kirizawa M, Jung-Mendaçolli SL and Chiea SAC. (eds.) *Flora Fanerogâmica da Ilha do Cardoso*. Instituto de Botânica, São Paulo.

Bernardo CSS. 2004. *Abundância, densidade e tamanho populacional de aves e mamíferos cinegéticos no Parque Estadual da Ilha do Cardoso, SP, Brasil.* Masters Thesis, Universidade de São Paulo, Piracicaba.

Ernest HB, Penedo MCT, May BP, Syvanen MS and Boyce WM. 2000. Molecular tracking of mountain lions in the Yosemite Valley region in California: Genetic analysis using microsatellites and faecal DNA. *Molecular Ecology* 9: 433–441.

Foran DR, Minta SC and Heinemeyer KS. 1997. DNA-based analysis of hair to identify species and individuals for population research and monitoring. *Wildlife Society Bulletin* 25: 840–847.

Galetti M, Giacomini H, Bueno RS, Bernardo CSS, Marques RM, Bovendorp RS, Steffler CE, Rubim P, Gobbo SK, Donatti CI, Begotti RA, Meirelles F, Nobre RA, Chiarello AG and Peres CA. 2009. Priority areas for the conservation of Atlantic forest large mammals. *Biological Conservation* 142: 1229–1241.

Kendall KC, Stetz JB, Boulanger J, Macleod AC, Paetkau D and White GC. 2009. Demography and genetic structure of a recovering brown bear population. *Journal of Wildlife Management* 73: 3–17.

Mcdaniel GW, Mckelvey KS, Squires JR and Ruggiero LF. 2000. Efficacy of lures and hair snares to detect lynx. *Wildlife Society Bulletin* 28: 119–123.

Miotto RA, Rodrigues FP, Ciocheti G and Galetti Jr PM. 2007. Determination of the minimum population size of pumas (*Puma concolor*) through fecal DNA analysis in two protected cerrado areas in the Brazilian southeast. *Biotropica* 39: 647–654.

Mowat G. 2006. Winter habitat associations of American martens, *Martes americana,* in interior wetbelt forests. *Wildlife Biologist* 12: 51–61.

Palomares F, Godoi JA, Piriz A, O'Brien SJ and Johnson WE. 2002. Fecal genetic analysis to determinate the presence and distribution of elusive carnivores: design and feasibility for the Iberian lynx. *Molecular Ecology* 11: 2171–2182.

Peres CA. 1996. Population status of white-lipped *Tayassu pecari* and collared peccaries *T. tajacu* in hunted and unhunted Amazonian forests. *Biological Conservation* 77: 115–123.

Peres CA and Palacios E. 2007. Basin-wide effects of game harvest on vertebrate population densities in amazonian forests: Implications for animal-mediated seed dispersal. *Biotropica* 39: 304–315.

Taberlet P, Waits LP and Luikart G. 1999. Noninvasive genetic sampling: look before you leap. *Trends in Ecology and Evolution* 14: 323–327.

Waits LP and Paetkau D. 2005. Noninvasive genetic sampling tools for wildlife biologists: a review of applications and recommendations for accurate data collection. *Journal of Wildlife Management* 69: 1419–1433.

Weaver JL, Wood P, Paetkau D and Laack L. 2005. Use of scented hair snares to detect ocelots. *Wildlife Society Bulletin* 33: 1384–1391.

Woods JG, Paetkau D, Lewis D, Mclellan BN, Proctor M and Strobeck C. 1999. Genetic tagging of free-ranging black and brown bears. *Wildlife Society Bulletin* 27: 616–627