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DEPARTAMENTO DE CIÊNCIAS DA VIDA

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA

Microwear analysis on Suoid incisors: a new method to study faunal adaptive responses to the environmental changes which shaped Human Evolution

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Dissertação apresentada à Universidade de Coimbra para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Evolução e Biologia Humanas, realizada sob a orientação científica da Professora Doutora Eugénia Cunha (Universidade de Coimbra) e do Doutor Jan van der Made (CSIC – Consejo Superior de Investigaciones Científicas, Espanha)

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*As I was born in the slaughter-yards,
Where souls are but meat to sell,
I must toughen my hide to pass unsinged
The fires of my native Hell.*

*Since I must live in a world of swine,
And feed with the **rooting** herds
(Which trample the flowers and rip the vines
And break the wings of birds),*

*Give me the craft and the strength to win,
Lord, where acorns thickest fall;
Make me a monster of lust and tusk:
The fiercest swine of all.*

*Plant my brain with heartless thorn,
Seed my heart with brainless wrath,
That the cruelest of my brother boars
Shall slink far from my path.*

*Since I must feed in the stinking sty,
And **root** with the grunting pack,
Give me the jaws of the hungriest boar,
And his bristles for my back.*

(Robert E. Howard [1930's], *Native Hell*,
A Rhyme of Salem Town, p. 16)

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Abstract

Microwear analysis consists on the study of microfeatures found on dental surfaces. While this technique has proven to be very useful in determining the diet of many ancient species, no study to date has employed it on fossil suid (=Suidae) incisors, even though incisor microwear may be strongly related to their habit to root, the most important adaptation of this group. Moreover, suids are one of the most abundant groups of large mammals found in hominin fossil sites.

As no reference study has yet been published, the aim of this research work is to develop a methodology to study incisor microwear in extant suoid species, in order to find a microwear signal that could be related to different “rooting styles”, and enable comparison with fossil suid species in future works.

Thirty-eight individuals representing six extant species belonging to the superfamily Suoidea were analyzed from different osteological collections in Spain. Four species belong to the family Suidae (*Sus scrofa*, *Potamochoerus porcus*, *Phacochoerus africanus* and *Babyroussa babyroussa*) and two to the family Tayassuidae (*Tayassu pecari* and *Pecari tajacu*). Incisor wear stage was recorded by using a novel methodology proposed in this work, and then compared with molar wear to test for possible differences in wear rate. Teeth selected were then analyzed under Scanning Electron Microscopy (SEM) at 500x in the lingual side of the incisor, and 200x in the labial side. If original specimens could not be taken to SEM, high-resolution dental replicas were performed for their study. A total of 198 microphotographs were analyzed by selecting an area of 0,16 mm² in each microphotograph, most of them belonging to first and second lower incisors, and length, width and orientation of all microfeatures found was recorded. Microfeatures were then divided as pits or scratches, and categorized depending on size and orientation. A series of ratios and other variables, derived from these categories, were analyzed statistically to account for significant differences between labial and lingual sides, occlusal and non-occlusal facets, enamel and dentine surfaces, crests and valleys, and first and second incisors. Inter-taxon variability was tested for the labial side and the non-occlusal facet/region of the lingual side of the first and second lower incisors.

Apart from the very interesting variability observed between sides, facets, morphological regions and surface types, there were significant differences between

different taxa. It is hypothesized here that different microwear signal on the incisors reflect different “rooting styles” among species. Three main rooting styles may be derived from this study:

1) Low intensity rooting, as in *Tayassu pecari*, characterized by a dental surface with a high proportion of very small scratches (<100 µm) with variable orientation.

2) Longitudinal rooting, as in *Potamochoerus porcus*, *Sus scrofa* and *Peccari tajacu*, characterized by scratches with a longitudinal orientation and longer than 300 µm).

3) Transverse rooting in hard soils seeking for rhizomes, as in *Phacochoerus africanus*, characterized by scratches with predominant transverse orientation.

This work was the first step to enable comparison of incisor microwear in fossil suid specimens, mainly those found associated to fossil hominin sites in East Africa. The ultimate objective is to determinate the “rooting style” of past suids, and relate the changes in suid feeding behavior with climatic changes happening in East Africa along the Plio-Pleistocene, the same environmental context that shaped the evolution of early hominins.

Key-words: rooting, paleoenvironment, climate change, feeding behavior, pig

Resumo

A análise do microdesgaste consiste no estudo das micromarcas encontradas nas superfícies dentárias. Apesar de já ter sido provado que esta técnica facilita a determinação da dieta de muitas espécies antigas, ainda nenhum estudo aplicou esta técnica em fósseis de incisivos de suídeos fósseis (=Suidae), apesar do micro desgaste dos incisivos ser fortemente relacionado com o seu habitat e seus “*rooting styles*”, a adaptação mais importante deste grupo. Além disso, os suídeos são um dos grupos mais abundantes de grandes mamíferos encontrados nos sítios com fósseis de homínídeos.

Como ainda não foi publicado nenhum estudo de referencia, o objectivo desta dissertação é desenvolver uma metodologia para estudar o microdesgaste em incisivos de espécies suídeos existentes de modo a encontrar um sinal de microdesgaste que possa ser relacionado com diferentes “*rooting styles*” e permitir a comparação com fósseis suínos em trabalhos futuros.

Foram analisados trinta e oito indivíduos representando seis espécies existentes que pertencem à superfamília Suoidea, provenientes de diferentes colecções osteológicas de Espanha. Quatro espécies pertencem à família Suidae (*Sus scrofa*, *Potamochoerus porcus*, *Phacochoerus africanus* e *Babyroussa babyroussa*) e duas à família Tayassuidae (*Tayassu pecari* e *Pecari tajacu*). Registou-se o estado do desgaste no incisivo usando uma nova metodologia proposta nesta dissertação. Comparou-se, depois, com desgaste em molares para testar possíveis diferenças no grau de desgaste. Os dentes seleccionados foram então analisados no “*Scanning Electron Microscopy*” (SEM) no lado lingual (500x) e no lado labial (200x) do incisivo. Quando os espécimes originais não pudessem ser analisados no SEM, faziam-se réplicas dentais de alta resolução para o seu estudo. Foi analisado um total de 198 microfotografias seleccionando uma área de 0,16 mm² em cada microfotografia, muitas delas pertencendo a incisivos inferiores centrais e laterais. Registou-se o comprimento, a largura e a orientação de todas as micromarcas encontradas. As micromarcas foram então divididas em pits ou arranhões e depois categorizados em relação ao tamanho e orientação. Uma série de graus e outras variáveis, derivadas destas categorias, foram analisadas estatisticamente de modo a identificar diferenças significativas entre os lados labial e lingual, facetas oclusal e não oclusal, superfícies do esmalte e da dentina, cristas e fissuras e incisivos centrais e laterais. Foi testada a variabilidade inter taxonómica no

lado labial e na faceta não oclusal do lado lingual dos incisivos inferiores centrais e laterais.

Além da variabilidade muito interessante observada entre os lados, facetas, regiões morfológicas e tipos de superfície, observaram-se igualmente diferenças significativas entre as diferentes espécies. Hipotetiza-se nesta dissertação que um sinal diferente de microdesgaste nos incisivos reflete diferentes “rooting styles” entre as espécies. Este estudo avança três principais “rooting styles”:

1) Baixa intensidade, como nos *Tayassu pecari*, caracterizada por uma superfície dental com uma grande proporção de arranhões muito pequenos (<100 µm) com orientação variável.

2) Longitudinal, como nos *Potamochoerus porcus*, *Sus scrofa* e *Peccari tajacu*, caracterizada por arranhões com uma orientação longitudinal e maiores do que 300 µm.

3) Transversal em solos duros para apanhar rizomas, como nos *Phacochoerus africanus*, caracterizadas por arranhões com orientação predominantemente transversa.

Este trabalho foi o primeiro passo para permitir a comparação de microdesgaste de incisivos em fósseis de espécies suídeas, especialmente naqueles encontrados associados aos fósseis de hominíneos, na África Oriental. Agora é possível determinar os “rooting styles” nos suídeos do passado e relacionar as mudanças no comportamento alimentar suídeo com as mudanças climáticas que aconteceram na África Oriental durante o Plio-Pleistoceno, o mesmo contexto ambiental que determinou a evolução dos primeiros hominíneos.

Palavras-chave: rooting, paleoambiente, mudança climática, comportamento alimentar, porco

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1. Introduction

Many of the basic questions about human origins and evolution that paleoanthropologists asked themselves, could be answered with the many fascinating finds of human fossils during the past century, or by the application of new techniques to these fossils. However, none of these questions could have been satisfactorily addressed without the aid of paleoecological and paleoenvironmental studies (e.g. Bobe & Behrensmeyer, 2004; Reed & Rector, 2006). The debate regarding key events in human evolution, such as the origin of bipedalism or brain growth, is still open, and most of the arguments supporting different hypotheses involve climatic change or environmentally-driven factors (Larsen, 2010).

The basic goal of paleoecological research is to make inferences about biotic communities and their ecological associations, or the habits and habitats of their individual members (Wing *et al.*, 1992). Human paleoecology, for instance, is not only the reconstruction of habitat; it is also the study of the interactions of past hominins with their environment. The paleoenvironment includes essentially the factors that make up an ecosystem, including the faunal community (Reed & Rector, 2006).

One of the main classic sources to information on the environment, in which early hominins evolved, is the study of bone assemblages of the contemporaneous mammals. The functional or biomechanical interpretation of the morphological changes along time provides information on changing environment and climate (e.g. Reed & Rector, 2006). The patterns of distribution and abundance of mammals have been used to interpret aspects of the habitat of a particular region and time (e.g. Bobe & Behrensmeyer, 2004). Now that geochemical and geophysical methods provide increasingly more detailed, precise and exact information on environment and climate, the study of the complex ecological interaction of environment and the different species becomes possible. Furthermore, the good comprehension of the mammalian community can shed light on possible ecological interactions which early hominins must have faced (Reed & Rector, 2006). This is the true context to the study of human evolution.

1.1. Importance of the family Suidae in the analysis of fossil hominin sites: paleoecology and paleoenvironmental reconstruction.

One of the most abundant groups of large mammals in the Late Miocene to Pleistocene of East Africa is the family Suidae (pigs, hogs) (Figure 1), and without the slightest doubt suids were very familiar and important to our ancestors. These medium-sized artiodactyls may have posed a danger, but they may also have served as food. Their remains have been recovered from all major hominin sites. Because they evolved rapidly, they serve as very good biochronological indicators and therefore this group is exceptionally well studied. The basic understanding of their evolution and temporal distribution is well established since a long time (Cooke, 1976, 1978, 1985; Harris & White, 1979; White & Harris, 1977), though minor corrections and additions have been proposed. Though the sequence of appearance and disappearance of the different suid species is precisely known, the key factors that drove the replacement of one species by the other have hardly been addressed. The study of the relation between climatic/environmental change and suid adaptive responses to these changes, may help understand the ecological complex surrounding suids along time and by extension, that of hominins. The abundance of the Suidae, their well-known evolution and temporal distribution and their relative taxonomic stability makes the group ideal for ecological studies of the context of human evolution.

Since the spreading of grasslands and the increasing wet-dry seasonality was countered by adaptations of the different large mammals (e.g. Bobe & Behrensmeyer, 2004), the habit of seasonal migration, so well-known from living equid and bovid species, may have originated during these times. Probably early hominins and suids did not migrate. Suids have the habit to root, and in the different living species this behavior shows a definite seasonal variation in intensity. During hard seasons, when many other ungulates migrate elsewhere, suids tap their underground resources, for which they have no competitors among the other large mammals.

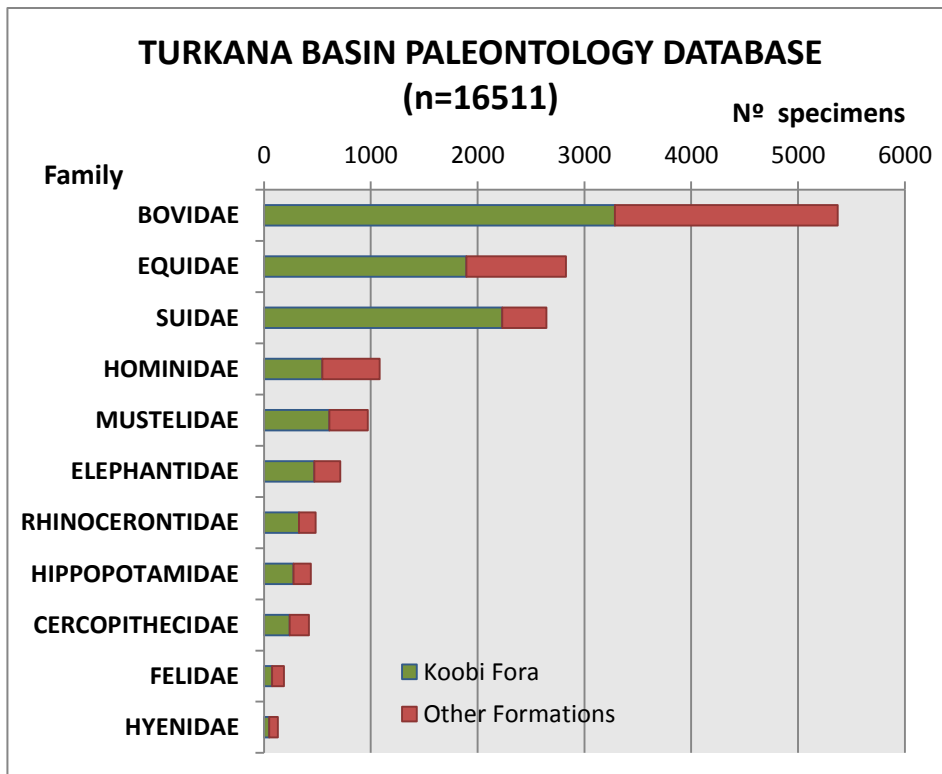


Figure 1. Number of specimens (grouped by family) stored at the Kenyan National Museums, which were recovered from Koobi Fora and other Miocene to Pleistocene sites in the Turkana Basin (Kenya) during the last century. Suidae are second or third in abundance in major hominins fossil sites (groups such as Hippopotamidae are infra-represented). Data obtained from the Turkana Basin Paleontology Database (Bobe *et al.*, 2011) (Accessible online at <https://www.museums.or.ke>)

There are different styles and capacities of rooting in the Suidae (e.g. Sicuro & Oliveira, 2002). Morphological adaptations to rooting, involving the morphology of the skull and incisors, are documented from the Oligocene onward (Van der Made *et al.*, 2010) and similar work in progress suggests that different African lineages of suids evolved different styles of rooting. General diet and rooting style seem to be related in the different African lineages.

If the rooting style of the suid species associated to fossil hominin sites could be addressed, it would be possible to infer characteristics of the environment, such as those related to different seasonality thresholds (which are related to humidity and temperature), because rooting styles are adaptations to environments with different amount of cover, soil type or vegetation. If we could understand how the climate change influenced the environment, and how suids adapted their feeding behavior (or rooting behavior) to these new environments, we would gain further resolution about the

ecological and paleoenvironmental context in which human evolution took place. Furthermore, if the timing of the appearance of different rooting styles in suids can be related to environmental changes that also marked the appearance of key adaptations in the human lineage along the Plio-Pleistocene, that would give us important clues to understand the role of climatic and paleoenvironmental change in shaping our early ancestors. Hypotheses on suid rooting styles, based on functional morphology of the incisors and skull, can be tested by studying microwear on the incisors, which is related to actual use of the incisors.

1.2. Dental microwear as a paleoenvironmental proxy

The study of a single taxon or taxonomic group and how their functional morphology, mostly feeding and locomotor adaptations, are related to their ecology and their habitat, is one method that has been used to understand past habitats (Robinson, 1963; Vrba, 1975, 1980; Kay, 1975; Grine, 1981; Stern and Susman, 1983; Kappelman, 1988a,b; Spencer, 1995; Bishop, 1999; Elton, 2002; DeGusta and Vrba, 2003, 2005; Merceron *et al.*, 2007; DeMiguel *et al.*, 2010; Curran, 2012). Dental studies are of great value to this end, because teeth are abundant in the fossil record and they have been shown to provide a wide range of taxonomic, functional and ecological information. Indeed, inferring palaeoecology of extinct mammals from their dentition is a subject of great interest in vertebrate palaeontology and archaeology (Hillson, 2005). Data regarding one of the key biological aspects which can be obtained from dental studies is diet and feeding behavior.

While faunal composition, geochemical analyses and floral remains provide important clues to the paleoenvironments, they do not provide direct evidence of resources exploited by the mammals that lived in a certain period (Ungar *et al.*, 2012). Direct evidence may be gathered from the analysis of stable isotopes in teeth, analysis of organic and inorganic particles found in dental calculus, and dental microwear. Before the use of these modern techniques, classic paleontological work on paleodiets was based on the uniformitarian assumption that species ate what their own ancestors evolved to eat or that they eat what closely-related forms eat today (Sponheimer *et al.*, 1999; Ungar *et al.*, 2012). Therefore, direct methods to infer diet of a fossil mammal can serve as a valuable proxy for the resources that an individual exploited in the past

(e.g., Vrba, 1980, 1985; Wing *et al.*, 1992; Spencer, 1997; Bobe and Eck, 2001; Ungar *et al.*, 2012). In spite of the mentioned advantages of modern direct methodologies, paleontologists should not discard classical methods, but rather exploit the combination of both.

Examination of stable isotope values is a technique that has proven to be useful to examine past environments (e.g. WoldeGabriel *et al.*, 2009) and ecology (mainly diet) in ancient mammals (e.g. Cerling *et al.*, 1997; Cerling *et al.*, 2010). Carbon and oxygen isotopic composition of the tooth enamel of both extant and fossil specimens, for instance, can be used to determine dietary preferences and water dependence of past suid species, thus revealing the environment they inhabited. Stable carbon isotope analysis on the enamel of fossil bovid teeth, for instance, have been a useful tool for inferring the presence of savanna and relative tree cover during the Plio-Pleistocene (e.g., Sponheimer *et al.*, 1999; Schoeninger *et al.*, 2003). However, concerning the study of paleodiets, this methodology only applies to the differentiation of diet consisting of plants with different photosynthetic pathways (C3 and C4), but does not answer many other interesting questions on diet or behaviour.

Dental microwear analyses have proven to be a very useful tool to infer paleodiets (e.g. Ungar *et al.*, 2012). Dental microwear analysis consists of the study of microscopic scar patterns on wear facets (Solounias & Semprebon, 2002). Many works have detected dietary differences between and even within species (e.g. Walker, *et al.*, 1978; Covert & Kay, 1981; Teaford & Walker, 1984; Grine & Kay, 1988; Vanvalkenburgh *et al.*, 1990; Teaford & Glander, 1990, 1996; Silcox & Teaford, 2002; El Zaatari *et al.*, 2005; Grine *et al.*, 2006 a, b; Merceron & Madelaine, 2006; Scott *et al.*, 2005, 2006; Ungar *et al.*; 2008; Peigne *et al.*, 2009; Green & Resar, 2012). Microwear studies have been carried out on a variety of extant and fossil taxa, most of them focusing on primates (e.g. Teaford & Oyen, 1989; Daegling & Grine, 1994, 1999; Ungar, 1996; Ungar *et al.*, 1995, 2006, 2008; Scott *et al.*, 2009a; Ramshardan *et al.*, 2012) and ruminants artiodactyls (Solounias & Hayek, 1993; Mainland, 2000, 2003; Merceron *et al.*, 2004a, b, 2005; Semprebom & Rivals, 2010; Rivals *et al.*, 2010, 2011), but most recently also perissodactyls (Joomun *et al.*, 2008; Rivals & Semprebom, 2010), squirrels (Nelson *et al.*, 2005), carnivores (Schubert *et al.*, 2010), lemurs (Scott *et al.*, 2007, 2009b), rodents (Townsend & Croft, 2008), representatives of the Order Xenarthra, like sloths and armadillos (Green, 2009; Green & Resar, 2012) and even

dinosaurs (Williams *et al.*, 2009).

Indeed, the analysis of microwear patterns in teeth has been applied to a number of anthropoid and primate fossil taxa, including *Paranthropus* and *Australopithecus* (Grine, 1981, 1986, 1987; Grine & Kay, 1988; Ryan, 1989; Ryan & Johanson, 1989; Ungar & Grine, 1991; Grine *et al.*, 2006; Ungar *et al.*, 2008; Estebananz *et al.*, 2009, 2012), *Sivapithecus* (Covert & Kay, 1981; Teaford & Walker, 1984), *Gigantopithecus* (Daegling & Grine, 1994), *Ouranopithecus* (Merceron *et al.*, 2005) and representatives of the superfamily Cercopithecoidea (Teaford, 1993; Daegling & Grine, 1999; El-Zaatari *et al.*, 2005), among others. To this end, a huge and growing inventory of data on the microwear of extant primates is now available, which provides a framework by which the different patterns observed in extinct taxa may be compared (Teaford & Walker, 1984; Teaford, 1985, 1993; Ryan, 1989; Teaford & Robinson, 1989; Ungar, 1990, 1994; Kelley, 1990; Teaford & Glander, 1991; Teaford & Runestad, 1992; Daegling & Grine, 1999; Merceron *et al.*, 2005b; Teaford *et al.*, 2010).

For suids, there are not many studies dealing with isotope analyses (e.g. Harris & Cerling, 2002, Schoeninger *et al.*, 2003) and dental microwear (e.g. Bishop *et al.*, 2006). Surprisingly little effort has been paid to the study of pigs (Suoidea) dental microwear. Only data published in the dental microwear study of Ward & Mainland (1999) in molars of modern rooting and stall-fed pigs and Bishop *et al.* (2006) in extant and fossil African suids, may be used as comparative references to study microwear in suid fossil specimens. The reinforcement of this comparative frame is indispensable, in order to apply the results to the study of fossil suidae from East Africa or other geographical regions. At present not all suid lineages are covered in this respect and much work remains to be done in order to date the changes within each of the different lineages.

Recently, only Vanpoucke *et al.* (2009) has applied the results gathered by Ward and Mainland (1999) to infer husbandry practices (wild pigs vs. domestic pigs) in an archeological context, and both studies are only focused on the Wild Hog (*Sus scrofa*). Concerning dental microwear studies on fossils, the few studies carried out are those of Hunter and Fortelius (1994) on the Miocene genus *Listriodon*; the already mentioned Bishop *et al.* (2006), on a multiproxy approach to infer the paleoecology of the abundant East-African Plio-Pleistocene suid, *Kolpochoerus heseloni*; and the work of Weil and Pignataro (2007), which included suids in their study about dental microwear

in multituberculate mammals. We still know very little about the patterns of dental microwear in most fossil species, and none of them assesses the question of microwear in suid incisors.

The studies of Ward and Mainland (1999), Bishop *et al.* (2006) and Vanpoucke *et al.*, (2009), all use the first or second molar as a target of microwear analysis in their works, and also the premolar in the case of Hunter and Fortelius (1994). Literature on microwear analysis of suid incisors does not exist. This is partly because suid incisors are less abundant in the fossil record than molars, less effort has been made to assign incisors to the species level, and because the majority of classic morphological studies have focused on molars (e.g. Harris and White, 1979; Cooke, 2007). In East Africa, for example, suid third molars were intensively used for biochronological purposes. However, there are other remarkable changes occurring in dentition along suid evolution, such as in the incisors (Van der Made, 1996), which may reflect a very important feeding adaptation in suids. Incisors are used to dig into the ground in search of roots and tubercles and as precision instruments to extract this food.

The information obtained from the analysis of these teeth, together with the morphology of the cranium and the post-cranial skeleton can help us to better understand the ecology of these animals, their adaptations, and their evolutionary patterns. The evolution or change in “rooting styles” along time in Africa may be related to climatic and environmental shifts that also affected the way in which hominins evolved and adapted. Dental microwear analysis of incisors serves as a complementary tool to infer past suid diets and feeding strategies.

The aim of this work is to develop a qualitative and quantitative microwear methodology to analyze microwear features present in extant suid incisors, in order to categorize different “rooting styles”. The resultant microwear signal will allow comparison with fossil suids in the near future, mainly those related to fossil hominin sites in East Africa, and interpret their paleoecology. But to make this comparison possible, it is indispensable to understand the relation between the microwear signal in incisors and “rooting style” in different species of extant suids.

1.3. Biological and ecological background of the species of the superfamily Suoidea selected in this work

The superfamily Suoidea is a lineage of artiodactyl mammals that includes the family Suidae (“Old World Pigs”) and Tayassuidae (“New World Peccaries”), including their fossil kin, and the extinct Palaeochoeridae (“Old World peccaries”) (Van der Made, 1996, 2010). The oldest fossil suoids date from the late Eocene of China (Tong & Zhao, 1986; Liu, 2001) and Thailand (Ducrocq, 1994; Ducrocq *et al.*, 1998).

The first representatives of the family Suidae (pigs and hogs) are known from the earliest Miocene of Europe (Ginsburg, 1974, 1980, Van der Made, 1990, 1996, 2010), reaching the subcontinent of India and Africa during the Miocene (Van der Made, 1996, 1999). Nowadays, up to sixteen extant species of pigs and hogs grouped in six genera make up the family Suidae. These are *Sus*, *Potamochoerus*, *Phacochoerus*, *Babyrousa*, *Hylochoerus* and *Porcula* (a more conservative taxonomy would include this genus in *Sus*) (Nowak, 1999; Wilson & Reeder, 2005).

The Palaeochoeridae are primitive Suoidea which appear in the Early Oligocene of Europe and became extinct in the Old World around the end of the Miocene (Dal Piaz, 1930, *in* Van der Made, 2010; Ginsburg, 1974). The Tayassuidae appeared first in North America during the Late Eocene (Wright, 1998; Van der Made, 2010) and reached South America between two and three million years ago in the Late Pliocene or Early Pleistocene, during the Great Faunal American Interchange, due to the formation of the Isthmus of Panama (Mayer & Wetzel, 1987; Gasparini, 2013). The oldest known fossil attributed to the family Tayassuidae found in South America belongs to the Middle Pliocene (Gasparini, 2013). New molecular (Gongora and Moran, 2005) and fossil (Frailey & Campbell, 2012) evidence partly supports a much earlier dispersal in the Late Miocene, a hypothesis that was already proposed two decades before by Wright (1989), but more fossils need to be found to confirm it. There are three extant species of the family, grouped in three genera, *Tayassu*, *Pecari* and *Catagonus* (Nowak, 1999; Gongora & Moran, 2005; Wilson & Reeder, 2005).

The representatives of the superfamily Suoidea are the most generalized of the living, even-toed, hoofed mammals (Artiodactyla). They are medium-sized animals characterized by a large head, short neck, and powerful but agile body, with a coarse, bristly coat (MacDonald, 2010). They have a mobile snout, which ends in a disk-like

cartilaginous nose perforated by two nostrils. The snout is used for turning up surface soil and it is strengthened by an unusual bone, the prenasal, situated below the tip of the nasal bones of the skull (Nowak, 1999; MacDonald, 2010). The most striking feature of the skull is the elevation and backward slope of the occipital crest, formed by the union of the supraoccipital and parietal bones (Figure 2). Some members of the Suidae also have skin growths without a bony support or core on the face, called warts (Nowak, 1999). The structure of the snout, tusks, and facial warts is intimately linked to diet, mode of feeding, and fighting style (MacDonald, 2010).

Other key features of wild pigs and peccaries are their large canine teeth and brachyodont (low-crowned) molars with bunodont cusps (blunt-rounded crowns, a typically omnivore dentition (Seydack, 1990; MacDonald, 2010). The dental formula varies among the different genera; a general formula is (i 1-3/3, c 1/1, pm 2-4/2, m 3/3) = 34 to 44. In *Potamochoerus*, *Sus*, and *Hylochoerus* the dental formula is: (i 3/3, c 1/1, pm 4/4, m 3/3) = 44; in *Babyrousa* it is: (i 2/3, c 1/1, pm 2/2, m 3/3) = 34; and in *Phacochoerus* it is: (i 1/3, c 1/1, pm 3/2, m 3/3) = 34. The peccaries (*Tayassu* and *Peccari*) have a similar dental formula: (i 2/3, c 1/1, pm 3/3, m 3/3) = 38). In general, the upper incisors decrease in size from the first to the third, and the lower incisors are high, narrow, set closely together, and almost horizontal in position. The incisors and the canines have sharp lateral edges (Nowak, 1999). The continuous contact between superior and inferior upper and lower tusks produces sharper edges that constitute an important defense weapon, and are also used actively in male fighting during mating periods and to mark trees (Rosell *et al.*, 2001).

It is commonly written, as in some of the classic general manuals of zoology, that suoids have a simple nonruminating stomach (Nowak, 1999; MacDonald, 2010). However, anatomical, histological and dietary studies carried out by Langer (1978, 1979), Leus (1994), Leus *et al.* (1999, 2004), Clauss *et al.* (2008a,b), Schwarm *et al.* (*in press*), among others, give an idea of its real complexity. In spite of the fact that suid stomach is indeed different to that of ruminants, there is also important variability between species, as a result of dietary diversification and evolutionary history.

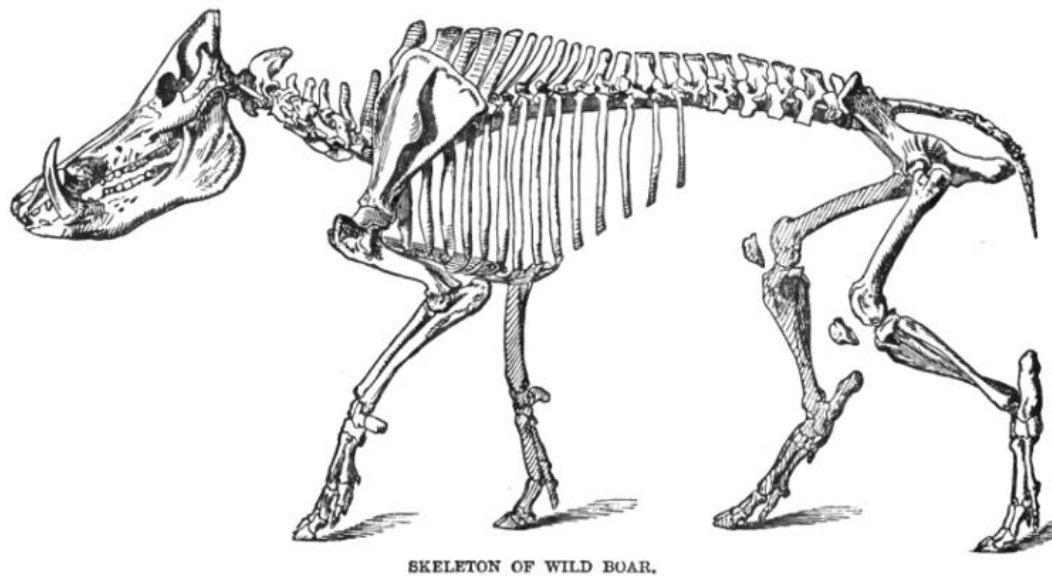


Figure 2. General diagram of the skeleton of a wild boar. From Lydekker (1893).

Pigs live in many kinds of habitat but generally where there is some vegetation for cover (Nowak, 1999), for the most part forests or woodlands, and the majority of the species are active mainly at night (a notable exception is *Phacochoerus*, which inhabits open savannah and is mainly diurnal) (Nowak, 1999; MacDonald, 2010). Suids are generally omnivores. They feed on a wide range of plants (fungi, ferns, grasses, leaves, roots, bulbs, and fruits), and they root in litter and moist earth to take insect larvae, small vertebrates (frogs, rodents, reptiles, young birds), eggs, and earthworms. However, it is reasonable to expect significant differences in diet, when considering differences in habitat preferences and foraging methods (Leus and Macdonald, 1997). For instance, the giant forest hog and the warthog are more specialized herbivores (Cumming, 1975; MacDonald, 2010). Interestingly and contrary to popular belief, a wild pig rarely will overeat (Nowak, 1999).

Many of the suoids are key species affecting plant population demographics by influencing the survival of early successional stages when depredating seeds and roots (Hulme, 1998; Gómez and Hódar, 2008) (Figure 5a), and modifying soil structure (mixing of layers) (Sims, 2005). Species such as the Wild Hog or the Red River Hog can destroy complete crop fields, dig up buried animals, eat those recently died on the surface or devour all individuals at nesting places of amphibians or birds. Therefore, suids play a pivotal role in the regeneration, colonization and spatial distribution of

plants and animals, influencing the ecosystem they inhabit very visibly (Hulme, 1998; Rossel *et al.*, 2001; Sims, 2005) (Figure 5a).

In this work, a number of extant species have been selected to study patterns of wear and microwear in incisors, each of them ranging different geographical regions, dietary, physiological adaptations and rooting styles.

1.3.1. The Wild Boar (*Sus scrofa* LINNAEUS, 1758)



	<p>Habitat: wide range but mainly associated with forested areas</p> <p>Distribution: Eurasia and North Africa (domestic pig introduced to Sub-Saharan Africa, Australia and America)</p> <p>Diet: mainly nuts, seeds, plant material, and underground resources</p>
<p style="text-align: center;">The Wild Boar (<i>Sus scrofa</i> LINNAEUS, 1758)</p>	<p>Rooting style: rooting very deep almost all the year</p> 

Figure 3. Basic biological information relative to the Wild Boar (*Sus scrofa*). Images: upper left - General image of an individual digging with the snout in a forest (The Encyclopedia of Life (Available at <https://www.eol.org>)); lower left - Lateral view of a cranium (Lydekker, 1893).

The Common Wild Boar (*Sus scrofa* L.) represents the genetic origin of actual domestic pigs and is one of the mammal species most linked to humans since

prehistoric times. The appearance in the fossil record occurs in Europe in the Middle Pleistocene, and according to DNA analysis by Larson *et al.* (2005), there were multiple centers of domestication, one of them in Europe some 8.000 to 9.000 years ago, and at least other two in Asia. Nowadays, the wild boar is an important economic and game resource, and a key piece of the numerous ecosystems they occupy (Sims, 2005).

The eight species that belong to the genus *Sus* live mainly in Asia, but the Eurasiatic wild boar (*Sus scrofa*) has a wider historical area of distribution which includes Europe, Asia and northern Africa, being the most abundant species of the genus (Rosell *et al.*, 2001). It has been introduced in America, Australia, New Zealand, and many other islands around the world (Figure 4).

The International Union for Conservation of Nature (IUCN) recognizes 17 subspecies of *Sus scrofa* (Sjarmidi & Gerard, 1988; Oliver, 1995). Two of them have been cited in the Iberian Peninsula (Rosell *et al.*, 2001), even though the phenotypical variations induced by hybridation between wild and domestic species adds difficulty to the taxonomical categorization of the species:

- *S. s. scrofa*, with a distribution that ranges from the center of the Iberian Peninsula to Northern and Eastern Europe. (= *S. s. castilianus*¹, a name applied to individuals from northern Spain)
- *S. s. meridionalis*, from the South of the Iberian Peninsula, and the islands of Corsica and Sardinia (= *S. s. baeticus*, a name applied to individuals from southern Spain).

The adult Wild Boar has a characteristic corporal morphology that reaches its maximum height at the region of the anterior limbs, with a short neck, an elongated snout and wide zygomatic arches (Figure 2 and 3). It is variable in size, depending on the latitude and food availability, but males can easily weight more than 100 kg (Garzón, 1991). In Europe, corpulence increases from the south of the Iberian Peninsula towards the eastern regions, reaching maximum sizes in the area of the Carpathians, where adult males can reach 300 kg (Groves, 1981).

¹Specimens of wild hog selected for this work are all classified as *S.s. castilianus*.

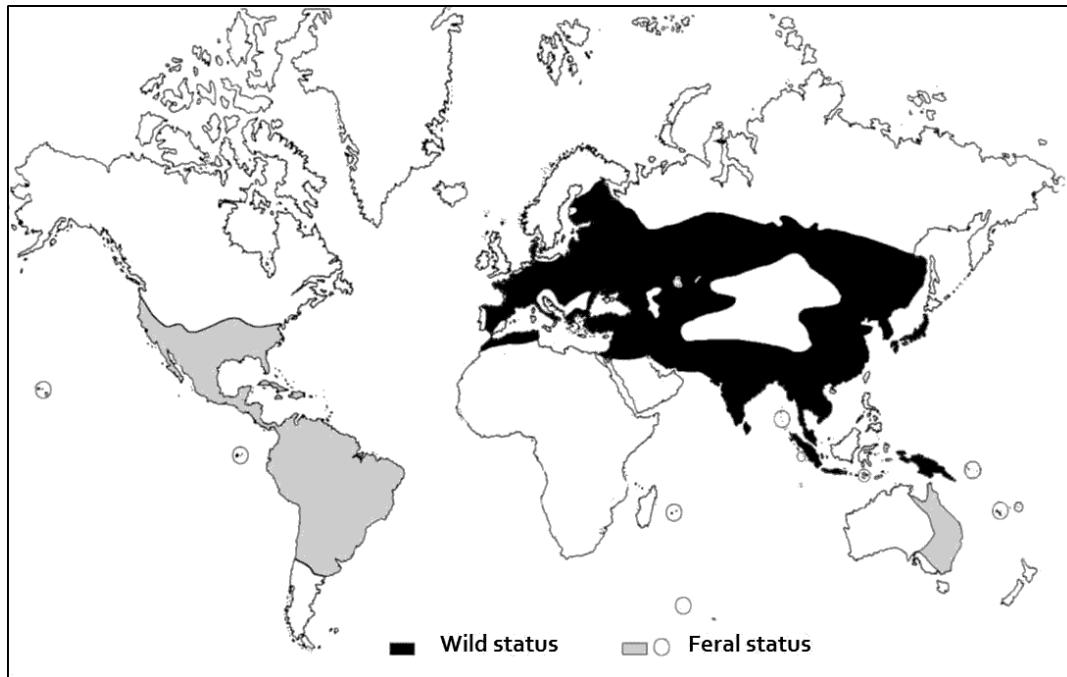


Figure 4. Geographical distribution of wild and feral forms of *Sus scrofa*. As recognized by Groves (1981). Adapted from Sjarjadi & Gerard (1988), in Rosell *et al.* (2001). The Figure does not include areas of recent recolonization, like Sweden or the United Kingdom.

Their most developed sense is the olfactory system, because it is of great importance for the exploration of the environment, the intraspecific communication and the recognition of danger. Hearing is second in importance while vision is the least developed (Rosell *et al.*, 2001).

Attending to their reproductive biology, it is a prolific species that bases its high reproductive capability in three factors: the early age in which sexual maturity is reached, its relatively short gestation (120 days), and the high average offspring per litter (3-5 individuals). Offspring is born with hair covering all the body and with all locomotor and sensorial capacities completely developed for the exploration of the environment (Rosell *et al.*, 2001).

Both females and males reach puberty very soon, when they are just 10 months (Mauget & Pepin, 1985, *in* Rosell *et al.*, 2001), but males are not capable of competing for females until they are 2 years old (Rosell *et al.*, 2001). They can reach an age of thirteen years, but in Iberian populations the maximum age reached is eleven years (Herrero, 1996, *in* Rosell *et al.*, 2001). However, wild boar populations are composed mainly of young individuals, and more than 60% of the populations is less than two

years old (Rosell, 1998; Rosell *et al.*, 2001).

Reproductive parameters and population densities in wild boars are intensively affected by food availability and climatic conditions (Rosell *et al.*, 2001), to the point that some authors attribute it a demographic pattern different to other ungulates and more similar to micromammals (Spitz & Bourliere, 1975). Rosell *et al.* (2001) suggest that it is probably one of the species among the large extant mammals whose ecological strategy is closer the “r”: high reproductive potential and intense annual demographic increments. Indeed, its great reproductive potential and its ecological plasticity makes this species capable of taking advantage of changing conditions in its habitats, and answer effectively to these by increasing its population and expanding its range of distribution to agropastoral areas and even to the periphery of human towns (Rosell *et al.*, 2001).

While the Wild Boar is always associated to wild forested areas, it is really a cosmopolitan species, capable of occupying a wide range of habitats, from semi-deserts to grasslands, forests or agricultural areas (Oliver *et al.*, 1993; Leus and Macdonald, 1997). Actually, dense populations are found in marshes near the sea, in dense forested areas, in shrub and woodland, and even in subalpine meadows up to 2.400m (Rosell *et al.*, 2001). Mixed habitats or ecotones, like forest boundaries, may be relevant for them, probably because they both take advantage of the resources offer by more open environments and the quick refuge of the trees (Table 1).

Table 1. Wild boar population density in four principal ecosystems in the National Park of Doñana. Data from Fernández-Llario *et al.* (1996).

ECOSYSTEM	Ecotone	Bushland	Pine forest	Marsh
Density (Ind/100Ha)	9,4	1,4	7,9	2,4

Wild boars have a wide spatio-temporal variability in their diet (Leus & Macdonald, 1997). They are opportunists and generalists, but they are also selective. They will take advantage of the most nutritive and digestible food items available (Rosell *et al.*, 2001). Acorns and beech nuts may comprise up to 80% of their diet, from October to February (Briedermann, 1967, 1990). Herbal material becomes very

important when other resources are unavailable (Leus & Macdonald, 1997). The study of gastric contents and fecal composition (Figure 5b) revealed high quantities of plant material (Groot-Bruinderink *et al.*, 1994). Much of this plant content is composed of roots and tubercles for which the wild boar has to dig into the substrate with its nostril and incisors. The marks of this action are very visible at field, as a result of the action of moving big rocks and digging profound holes in the earth (Figure 5a). Earthworms may also be a target of digging. Vertebrate and invertebrate animal sources are quantitatively lower but still an indispensable nutritional complement (Genov, 1981).

Sus scrofa can be considered as the major digger of all the extant suids, digging deep holes in soft to moderate hard soil throughout all the year (Figure 5a). The intense exploitation of underground resources (including agricultural products) plays a key role in the astonishing adaptability of this common suid species and may explain in part its large success in contemporaneous habitats. Due to their great adaptability and the geographical range they occupy, it was listed as one of the 100 worst invasive alien species in the world by the IUCN (Lowe *et al.*, 2000).

In this list the reader can find:

“*Sus scrofa* (feral pigs) are escaped or released domestic animals which have been introduced to many parts of the world. They damage crops, stock and property, and transmit many diseases such as *Leptospirosis* and Foot and Mouth disease. Rooting pigs dig up large areas of native vegetation and spread weeds, disrupting ecological processes such as succession and species composition. *Sus scrofa* are omnivorous and their diet can include juvenile land tortoises, sea turtles, sea birds, endemic reptiles and macro-invertebrates. Management of *Sus scrofa* is complicated by the fact that complete eradication is often not acceptable to communities that value feral pigs for hunting and food.”

a)



b)



Figure 5. a) Evidence of rooting by a Wild Hog (*Sus scrofa*). These holes excavated in the ground with the snout may be as deep as 30cm; **b) Feaces belonging to a Wild Hog (*Sus scrofa*).** Note the presence of fragments of plant matter, insects, roots, fruits, seeds and nuts. Photograph taken near the river Manzanares, very close to the medieval bridge “El Batán”, in a northern area with woody cover at the north of Madrid, Spain.

1.3.2. The red river hog (*Potamochoerus porcus* LINNAEUS, 1758)



	<p>Habitat: moist forest</p> <p>Distribution: West and Central Africa</p> <p>Diet: mainly nuts, seeds, plant material, and underground resources</p> <p>Rooting style: rooting very deep almost all the year</p>
<p style="text-align: center;">Red River Hog <i>(Potamochoerus porcus</i> LINNAEUS, 1758)</p>	

Figure 6. Basic biological information relative to the Red River Hog (*Potamochoerus porcus*). Images: upper left - General image of an individual removing earth with the snout (The Zoo of San Diego (Available at <https://www.sandiegozoo.org>)); lower left - Lateral view of a cranium (Leus & Vercammen, 2013).

Red River Hogs (*Potamochoerus porcus*) and Bushpigs (*Potamochoerus larvatus*) are the least specialized and the smallest of the African suids (Cooke & Wilkinson, 1978; Seydack, 1990; Grubb, 1993). The phylogenetic relationships of the genus *Potamochoerus* remain controversial. Some authors, on morphological grounds, consider the genus *Potamochoerus* to be the sister genus of *Sus*, and Seydack (1990) even proposed to include the species in this genus. However, also based on morphology, it might be a more closely related to *Babyrousa*, as reflected by the classification in the Babyrousinae proposed by Van der Made (1997), with whom it may share a common ancestor in Asia. *Potamochoerus* are traced back to fossil forms in Africa of about three or even more millions of years of age (Harris & White, 1979; Harris & Leakey, 2003),

but others believe its presence in Africa may be much more recent (e.g. Cooke, 1978; White, 1995).

The Red River Hog is widely, but patchily, distributed through the West and Central African rainforest belt, from Senegal in the west, throughout the Guinea-Congo forest to at least west of the Albertine Rift (Nowak, 1999) (Figure 7). It is found in a variety of habitats, typically associated with rainforest and gallery forest, but also found sporadically in dry forest, savanna woodland and cultivated areas, although usually in close proximity to dense cover (Seydack, 1990; Leus & Vercammen, 2013). Their distribution is apparently limited by food, water and cover availability (Beaune *et al.*, 2012), and mainly confined to forested regions with limited seasonality in terms of moisture stress (Vercammen *et al.*, 1993). Kingdon (1979) wrote that it lives wherever there is sufficient moisture to support dense vegetation throughout the year and to keep the ground moderately soft. Red River Hogs, as Wild Boars, are highly adaptable animals and may even benefit from the opening up of former forested areas by the creation of secondary habitats, like cultivated areas, and of course by reductions in the numbers of their natural predators (Vercammen *et al.* 1993; Leus & Vercammen, 2013).

There are many similarities between *Potamochoerus* and *Sus*, both in cranial, dental and body plan characteristics (Seydack, 1990). In contrast to *Sus*, however, they are characterized by several important differences, such as a lower occipital, a relatively horizontal auditory canal, dorsally flattened nasals, which are laterally expanded, and a braincase that bulges outward below the temporal ridges (Leus & Vercammen, 2013) (Figure 6). Other differences include the conical main cusps of the P_{4s} and P_{3s}, while these teeth tend to be sharper, as with a cutting edge, in *Sus*. They have lower crowned I_{1s}, shorter I_{2s}, and I_{1s} with a different occlusal morphology; they also have simpler M_{3s}, and a gap in the size between the P₂ and P₃. On the contrary, in *Sus* the size changes in the tooth row are more gradual (Cooke & Wilkinson, 1978).

Red River Hogs are known seed predators in Afrotropical forests (Ghiglieri *et al.*, 1982; Blake & Fay, 1997; Hart, 2001; Jori & Bastos, 2009; Beaune *et al.*, 2012) and they have powerful jaws adapted to this end (Herring, 1985), and a keen sense of smell (Milstein, 1971). According to Leus & Macdonald (1997), they have a preference for fruit and aerial herbaceous material. During dry seasons, they feed almost entirely on shrub roots in woodlands, especially after light rain or humidity have softened the soil (Jones, 1984). Phillips (1926) listed fern rhizomes, as well as monocotyledon and

dicotyledon roots, bulbs, tubers, stems and foliage, and fruits of mangoes, guavas, avocado, pears and pawpaws (tropical fruits). Seydack (1990) analyzed the stomach composition of *Potamochoerus porcus* and found 40% subterranean plant parts (such as roots, tubers, rhizomes and corms), 30 % herbage, 13% fruit, 9% animal matter and 8% fungi.

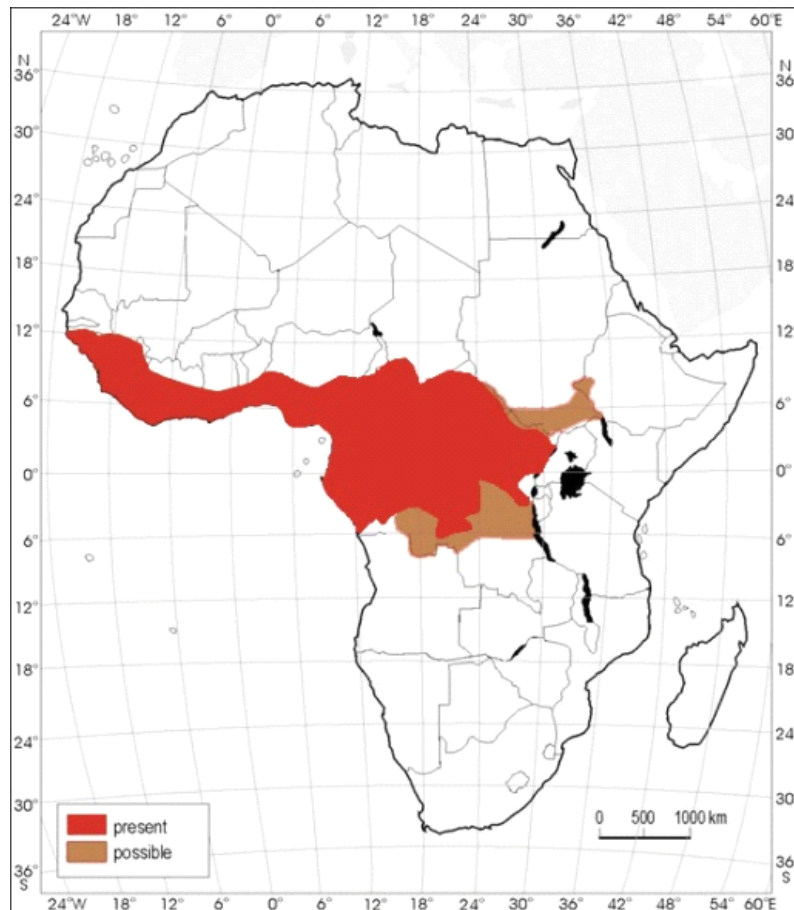


Figure 7. Actual distribution of *Potamochoerus porcus*. Adapted from Jori & Bastos (2009).

Many reports refer to the animal food taken by the Bushpig, very similar to that of the Red River Hog, including young birds, mammals, and carrion (Phillips, 1926; Shortridge, 1934; Maberly, 1967; Milstein, 1971). They are even capable of attacking and eating newborn human kids and lamb (Milstein, 1971). Interestingly, it has been observed at Charters Creek in Zululand (Breytenbach unpubl., in Skinner *et al.*, 1976), that Bushpig dig under female *Antidesma venosum* trees once the tiny fruit have started dropping. The explanation for this seems to be the possibility of obtaining insect larvae

that start their breeding cycle in the fruit of these trees. No digging occurred under male trees. According to Seydack (1990) the cyclic utilization of digging patches to obtain earthworms and insect larvae may be of some ecological significance.

Digging may be similar to some extent to that of *Sus scrofa*, regarding dietary composition and the similar morphological adaptations of crania and dentition. *Potamochoerus porcus* is considered a deep digger in this work, and it is expected that the microwear signal in the incisors is related to that found in *Sus scrofa*.

1.3.3. The Common Wart Hog (*Phacochoerus africanus* GMELIN, 1788)

	<p>Habitat: open plains and lightly-wooded savannah</p> <p>Distribution: Sub-Saharan Africa</p> <p>Diet: grazers (wet season); rhizome eaters (dry season)</p> <p>Rooting style: excavates sun-baked soil with back-and-forth lateral movements</p>
<p>The Common Wart Hog (<i>Phacochoerus africanus</i> GMELIN, 1788)</p>	

Figure 8. Basic biological information relative to the Common Warthog (*Phacochoerus africanus*). Images: upper left - General image of an individual grazing (Source=The Encyclopedia of Life (Available on <https://www.eol.org>); lower left - Lateral view of a crania (Harris, 2013).

The Common Warthog (*Phacochoerus africanus*) is one of the two extant species of the tribe Phacochoerini, the other called Dessert Warthog (*Phacochoerus aethiopicus*) (Cooke & Wilkinson, 1978; Grubb & Oliver, 1991; Grubb, 1993, 2005; Harris, 2013). The latter is restricted to certain regions in East Africa, while the former is extended through all the open plains and light to semi-open savannahs in sub-saharan Africa (D'Huart & Grubb, 2005; Jori & Bastos, 2009; Harris, 2013). DNA analysis support that the two species belong to two deeply divergent monophyletic lineages, which might have originated at the end of the Pliocene (Randi *et al.*, 2002).

Warthogs are without the slightest doubt, the most specialized of all the extant suids. The several important aspects that make them different are related to their mode of feeding. While other suids such as *Potamochoerus* or *Sus*, are more generalists or mixed-feeder omnivores, *Phacochoerus* is a grazer (Cumming, 1975; Nowak, 1999) or even sometimes considered an hypergrazer (Cerling *et al.*, 2005). In contrast to most suids, it is normally diurnal, becoming nocturnal when it is molested by people. Holes in the ground are a very important component of their habitat; they use them to sleep, to rear young, to avoid overheating and to refuge from predators (Cumming, 1975). Its eyesight seems poor, but its senses of hearing and smell are acute (Nowak, 1999).

The most striking morphological feature is their complex, elongated and very high-crowned (hypsodont) third molars and the morphology of the skull, which slopes forward from the braincase to the nostrils. The posterior part of the occipital (the supraoccipital crest) is hanging out and the rostrum is considerably elongated (Cumming, 2013), leaving a wide area for the attachment of massive neck muscles. The paraoccipital processes are long and the orbits are small (Figure 8). In comparison to other suids, they have proportionally long limbs (Cumming, 2013). Males have prominent warts (Nowak, 1999) and the adult upper and lower incisors have deep roots and prominent crowns, which converge and make contact (Cumming, 2013). However, they rapidly wear all of the dentition, including incisors, so that adult individuals usually survive with just the large third molar.

Warthogs occur on treeless open plains and in lightly wooded savanna (D'Huart & Grubb, 2005), but avoid densely wooded vegetation without grass. Even though they are predominantly grazers, they may also consume sedges, fallen fruits, berries, the bark of young trees, and certain forbs. In the wet season, >90% of the diet is almost entirely composed of the leaves of a few species of grasses (Cumming, 1975). On the contrary,

in the dry season, warthogs preferentially consume rhizomes of different grass species (50-85% diet) (Cumming, 1975; Leus and Macdonald, 1997). Accordingly, warthogs appear to be much less water dependent than *Potamochoerus* (Cumming, 1975; Mason, 1982; Radke, 1991; Oliver, 1993).

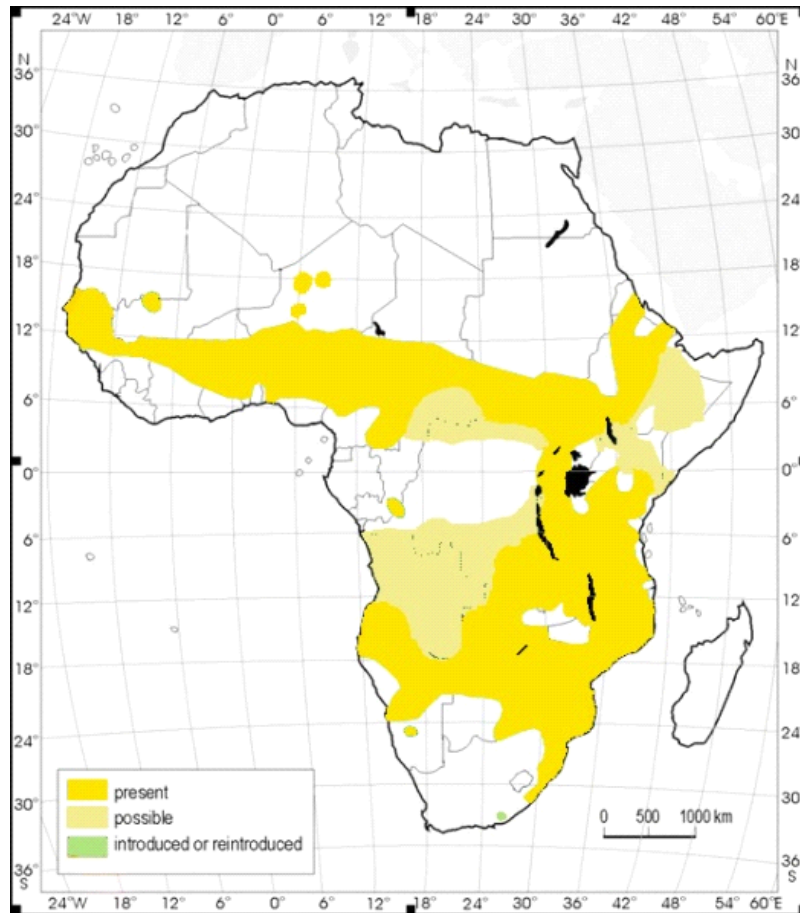


Figure 9. Actual distribution of *Phacochoerus africanus*. Adapted from Jori and Bastos (2009).

In words of Cumming (2013), “Common Warthogs are suids beautifully adapted to dry savannas and steppes”. In the dry season they may be able to subsist without drinking water by rooting for succulent rhizomes and bulbs. In periods of drought, rooting can suppose >90% of their feeding mode (Cumming, 1975), therefore exemplifying the maintained importance of digging adaptations in spite of their strong specialization. In Zimbabwe, Cumming (1975) found *Phacochoerus* to be almost entirely granivorous, being specialized both for grazing on short, seasonally succulent

grasses and for digging grass rhizomes with its powerful rhinarium in hard, dry soils.

According to Ewer (1958), based on observations made in the field, the significance of the reduced incisors in *Phacochoerus* is apparent. The animal is not cropping as other grazers do, but is using its small inwardly pointing incisors like a pair of tweezers to pluck out the selected food. In the dry season, when grass is scarce, Warthog often feed on tufts of grass growing at the base of thorny bushes and thus not easily accessible to ordinary grazers. They also make back-and-forth lateral movements, in order to push aside the unwanted vegetation and work the snout down to the grass tips. In this, the upper tusks are also important in pushing aside thorns and allowing the grass to be reached without endangering the eyes (Cumming, 1975). While feeding, it also drops on its padded wrists and frequently shuffles along in this position (Cumming, 1975).

Unlike *Potamochoerus* and *Sus*, which tend to dig deep holes in soft to moderate hard soil, *Phacochoerus* is digging more superficially, making transverse movements to reject unwanted material. Only warthogs, with the aid of their tusks and strengthened rhinarium, can excavate sun-baked soil in search of energetic and succulent roots in the open plains of Africa (Cumming, 1975).

1.3.3. The Babirusa (*Babyrousa babyrussa* LINNAEUS, 1758)


	<p>Habitat: rain forest.</p> <p>Distribution: Indonesian islands.</p> <p>Diet: mainly frugivorous.</p> <p>Rooting style: due to the lack of a well-developed rostral bone, it is considered the least able to root within Suidae, and only able to do so in very loose soil.</p>
<p>The Babirusa (<i>Babyrousa babyrussa</i> LINNAEUS, 1758)</p>	

Figure 10. Basic biological information relative to the Babirusa (*Babyrousa babyrussa*).

Images: upper left - General image of an individual having a mud bath (Source=ARKive (Available on <https://www.arkive.org>); lower left - Lateral view of a crania (Guillemard, 1889).

The Babirusa (*Babyrousa babyrussa*) is probably the most remarkable of all suids in terms of appearance and other characteristics. It is native to the tropical rain forests of Sulawesi, Buru and Togian Islands of Indonesia (Patry *et al.*, 1995; Nowak, 1999; MacDonald, 2010). Some specialists describe three subspecies, depending on the island inhabited by each babirusa. These islands are found in Indonesia: Sulawesi, the nearby Togian and Sulu islands, and Buru Island in the Moluccas (Laurie and Hill, 1954). According to Groves (1980), its presence on Buru and possibly Sula islands is a result of human introduction.

The most striking feature at first sight is the morphology and position of their tusks. Differently from other swine, the tusks of Babirusa are not directed sideways out of the mouth, but upwards, and perforate the soft tissue of the snout, curving backward toward the forehead (Nowak, 1999). Sometimes, inferior tusks grow long enough to perforate the mandible right below the beginning of the tusk. MacKinnon (1981) suggested that these strange tusks are used as weapons: the upper tusks have a general defensive function while lower tusks are used offensively. On the contrary, Oliver (1993) affirms that the function of the tusks is unclear; tusks are rarely used in combat between males, possibly because the form in which they are inserted in the maxilla does not support the application of too much force.

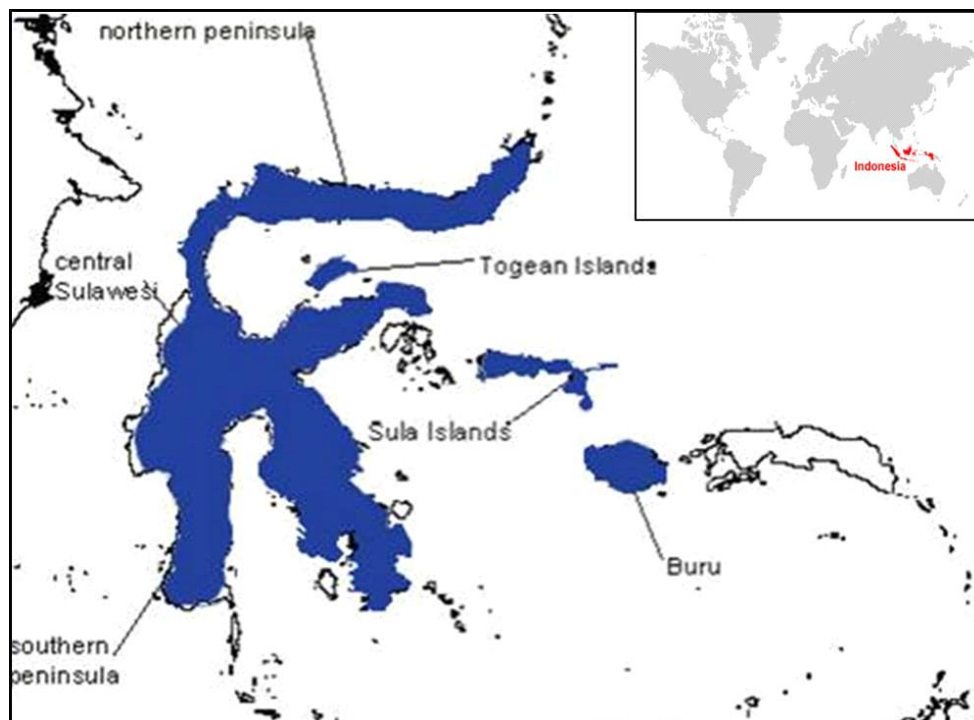


Figure 11. Distribution of *Babirusa babirusa*. Actual distribution could be patchier. Adapted from Meijaard & Groves (2002).

The preferred habitats of the Babirusa are moist forests, canebrakes and the shores of rivers and lakes (Nowak, 1999). Information on the diet of this species is anecdotal and not very well-known (Leus and Macdonald, 1997). Fruit have been reported to be the main dietary item for this species (Leus, 1994, 1997), but they also consume a wide variety of leaf, root, fruit and animal material (Oliver, 1993).

Macdonald and Leus (1995) observed captive individuals browsing the leaves off trees.

Its jaws also seem to be strong enough to crack very hard nuts with ease (Peters, 1985), and the cranial muscular anatomy is very similar to that of *Sus* (Kneepkens and MacDonald, 2010). Even though the species' intestinal tract is similar to that of the domestic and wild pig (*Sus scrofa*) (eg Langer, 1988; Agungpriyono *et al.*, 2000), the stomach is more far more complicated. The Babirusa is likely to be a non-ruminant foregut-fermenting frugivore/concentrate selector (Leus *et al.*, 1999), which is related to their relatively large diverticulum in comparison to other suid species (Leus, 1994). There are substantial differences in the presence of glands in the stomach (Leus *et al.*, 1999), and endocrine cells in the digestive tract (Agungpriyono *et al.*, 2000), suggesting adaptations to frugivory.

According to Nowak (1999), the babirusa does not exhibit the rooting behavior typical of other suids. They do not seem to root with their snout as do *Sus* and *Potamochoerus*, probably due to the lack of a rostral bone in the nose (Leus and Macdonald, 1997). And if they do so, they just do it in mud and swampy ground (Nowak, 1999). However, field reports are scarce, and the complete understanding of its rooting behavior is yet to be completely clarified; a comprehension that can aid in the conservation and management of this unique species.

1.3.4. The White-Lipped Peccary (*Tayassu pecari* LINK, 1795)



	<p>Habitat: mainly wet rain-forests</p> <p>Distribution: Central and northern South America</p> <p>Diet: mainly frugivorous</p> <p>Rooting style: lesser root habits</p>
<p>White-Lipped Peccary (<i>Tayassu pecari</i> LINK, 1795)</p>	

Figure 12. Basic biological information relative to the White-Lipped Peccary (*Tayassu pecari*). Images: upper left - General image of a male individual (Source= “El Pantanal” Web Page (Available on <https://www.pantanalwildlife.com>); lower left - Lateral view of a crania (Source = Discover Life Web Page (Available on <https://www.discoverlife.com>))

The White-Lipped Peccary (*Tayassu pecari*) is one of the three species of the Family Tayassuidae actually recognized (Keuroglhian *et al.*, 2013). Like all peccaries, *T. pecari* has a body form very similar to that of the Old World pigs (family Suidae). They inhabit predominately humid tropical forest, but there are some populations occupying wet and dry grasslands and woodlands, xerophitic areas like the Gran Chaco in Paraguay, tropical dry forests, and coastal mangroves (Wetzel & Lovett 1974; Sowls 1984; Altrichter & Boaglio 2004; Keuroglhian *et al.*, 2013).

White-lipped Peccaries occupy the American Neotropical Region, from southeastern Mexico, throughout Central America and as far south as Entre Rios in northern Argentina and Rio Grande do Sul in southern Brazil (March, 1993; Sowls 1997; Keuroglhian *et al.*, 2013). While some authors recognize up to five subspecies of

White-lipped Peccary (Groves & Grubb, 1993), this has not been validated through genetic or morphological research (Taber *et al.*, 2011). It ranges altitudinally from sea level to over 1,900 m on the eastern slopes of the Andes, but they tend to frequent areas close to water and may even visit coastal beaches to forage (Keuroghlian *et al.*, 2013). Because *T. pecari* depends on large tracts of wilderness and rainforest, and such habitat is rapidly disappearing, it has now disappeared or become rare in southern Mexico and northern Argentina (Mayer & Wetzel, 1987).



Figure 13. Actual distribution of *Tayassu pecari*. Adapted figure caption from The IUCN Red List of Threatened Species 2013 (Available at <https://www.iucnredlist.org>).

Adults show a coarse black coat of hair that covers the entire body except for regions in the pelvis and the snout, where they have stripes of white hair running from the corner of the mouth to the jowls and under the throat, extending up to the tip of the chin (Nowak, 1999; MacDonald, 2010). White-lipped Pecaries, as other extant

representatives of the family Tayassuidae, are smaller in size to the species of Suidae studied in this work, and have large, sharp canines orientated downwards (or upwards in the case of inferior canines) (Mayer & Wetzel 1987; Nowak, 1999). Males have longer canines and females have a larger braincase. Dimorphism is absent (Mayer & Wetzel 1987; Van der Made, 1993), or yet not discriminated.

While being omnivore (March, 1993; Nowak, 1999), they are considered to be strongly frugivorous (Husson 1978; Kiltie, 1981; March, 1993; Carillo *et al.*, 2002; Keuroghlian & Eaton, 2004; Beck 2005), complementing their diet with leaves, seeds, roots, invertebrates, small vertebrates, fungi, bird eggs, and carrion (Mayer & Wetzel, 1987; March, 1993). Beck (2006) determined that they fed on at least 144 plant species in Neotropical forests, thus being an important predator and disperser of seeds (Altrichter *et al.*, 1999; Keuroghlian & Eaton 2004; Beck 2005; Keuroghlian *et al.*, 2013). Palm nuts appear to be particularly favored (Kiltie, 1981; Keuroghlian & Eaton, 2004). Some authors argue that White-lipped Peccaries are well-adapted to cracking these tough nuts, as dislocation of the jaw is prevented by the canine teeth, which interlock and prevent any sideways motion (Kiltie, 1981; Nowak, 1999). However, other pigs, such as *P. porcus* and *S. scrofa*, which effectuate lateral movements with the jaw, are also used to cracking hard nuts.

The most exclusive social feature of *T. pecari* among the Suoidea is their habit to cluster and form large herds that can often exceed 100 individuals, though groups of as few as 5 to more than 200 individuals have also been reported (Kiltie & Terborgh, 1983; Reyna-Hurtado *et al.*, 2009). Oliver (1993) argued that its tendency to form large herds may have important consequences on the composition of ground plant communities and the drainage of surface water, merely as a result of their intense rooting activity. Mayer and Wetzel (1987) also reported *T. pecari* to raid crops. For Sicuro & Oliveira (2002), however, it is much less capable to root than feral pigs (*S. scrofa*). From all the suois studied in this work, this is probably the one with lesser rooting habits.

1.3.5. The Collared Peccary (*Pecari tajacu* LINNAEUS, 1758)


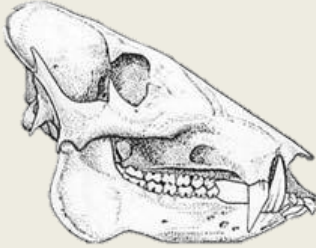
	<p>Habitat: varied hábitat, from wet and dry tropical forest to xerophitic areas and grassland</p> <p>Distribution: Sub-Saharan Africa</p> <p>Diet: Grazers (wet season); rhizome eaters (dry season)</p> <p>Rooting style: Excavates sun-baked soil in search of succulent roots</p>
<p>Collared Peccary (<i>Pecari tajacu</i> LINNAEUS, 1758)</p>	

Figure 14. Basic biological information relative to the Collared Peccary (*Pecari tajacu*). Images: upper left - General image of a male individual (Source= “A-Z Animals” Web Page (Available on <https://www.a-z-animals.com>); lower left - Lateral view of a crania (Source = Discover Life Web Page (Available on <https://www.discoverlife.com>).

The Collared Peccary (*Pecari tajacu*) was originally placed in family Dicotylidae and genus *Tayassu* by Jones *et al.* (1992), but was definitively moved to Tayassuidae and genus *Pecari* by Grubb (2005). Its genus had been also a matter of debate. DNA studies support the recognition of this species within genus *Pecari* (Theimer & Keim, 1998, Gongora & Moran, 2005), and suggest that *P. tajacu* may consist of at least two major clades or lineages comprising specimens from North/Central and South America (Gongora *et al.*, 2006).

The Collared Peccary is widely distributed along South and Central America, the entire Amazon basin, the Pacific coastal forest of Colombia, Ecuador and Peru, the

grasslands and lowland forest of Venezuela, the Guianas and Suriname, all of Brazil, Bolivia, the Gran Chaco of Paraguay and in the upper Parana and Paraguay river basins of Argentina (Keuroghlian *et al.*, 2013). Contrary to *T. pecari*, they extend their range far into dessertic areas of southwestern United States, such as Arizona, New Mexico, and Texas in the USA (Albert *et al.*, 2004), where they are considered a game animal and hunting them is officially regulated (Sowls, 1984). (Figure 15)



Figure 15. Actual distribution of *Pecari tajacu*. Adapted from The IUCN Red List of Threatened Species 2013 (Available at <https://www.iucnredlist.org>).

Very similar in morphology to *T. pecari*, though slightly smaller, *P. tajacu* is however, not only the most widely distributed of the peccaries, but it is also by far the most adaptable. It inhabits humid rainforest to hot desert areas, and other areas with low seasonal temperature below 0°C (Oliver, 1993). The diet of the species varies in accordance with the type of habitat. They are mainly vegetarian, feeding on cactus fruit,

berries, tubers, bulbs, and rhizomes. They also consume shrubs and occasionally snakes and other small vertebrates. They frequent water holes, or in the tropics, stay near running streams (Nowak, 1999). In tropical forests, diet is dominated by palm fruits and supplemented with invertebrate animal material (Kiltie, 1981; Bodmer, 1989). In desert environments, their diet is dominated by the cladophylls of prickly pear cactus (*Opuntia spp*) (Corn and Warren, 1985).

In words of Nowak (1999), “*their sense of smell is keen enough to locate a small coveana bulb 5-8 cm underground before the new shoots are visible*”. Because they are very adaptable animals, it is possible that they also root very actively, in order to support dry seasons or environments. The extent to which they do so is a matter of question that could be answered along this work.

1.4. Suoid incisor morphology

Suoid incisors are characterized by their high crowns. Though they can be relatively low in *Tayassu pecari*, they can be very high in species, which are adapted to extensive rooting, like *Sus scrofa* or *Potamochoerus porcus*. Having low-crowned incisors is considered primitive in suoids and high-crowned derived (Van der Made, 1996). Therefore, rooting habits (especially those in which incisors are significantly implicated), shall be regarded as a derived condition in suoids. Estimating hypsondocy in suoid incisors is difficult, because in many occasions, part of the crown is worn, so that measuring its total height is not possible. In derived suoids, especially *Sus scrofa*, enamel expands more posteriorly in the labial side than in the lingual side (thus difficulting the correct measurement of the crown). This may be an adaptation to intense rooting, in order to protect the root in the labial side, and this is considered a future topic of research.

The labial side of incisors can be defined as a curved but homogenous surface. On the contrary, the lingual side is less curved but at the same time more irregular, with a number of valleys and crests displayed parallel to the longitudinal axis (or saggital plane) of the tooth. The names of the different crests and fossids are given in Figure 16. For a matter of simplicity, the suoid incisor may be defined as having a crest-and-valley morphology.

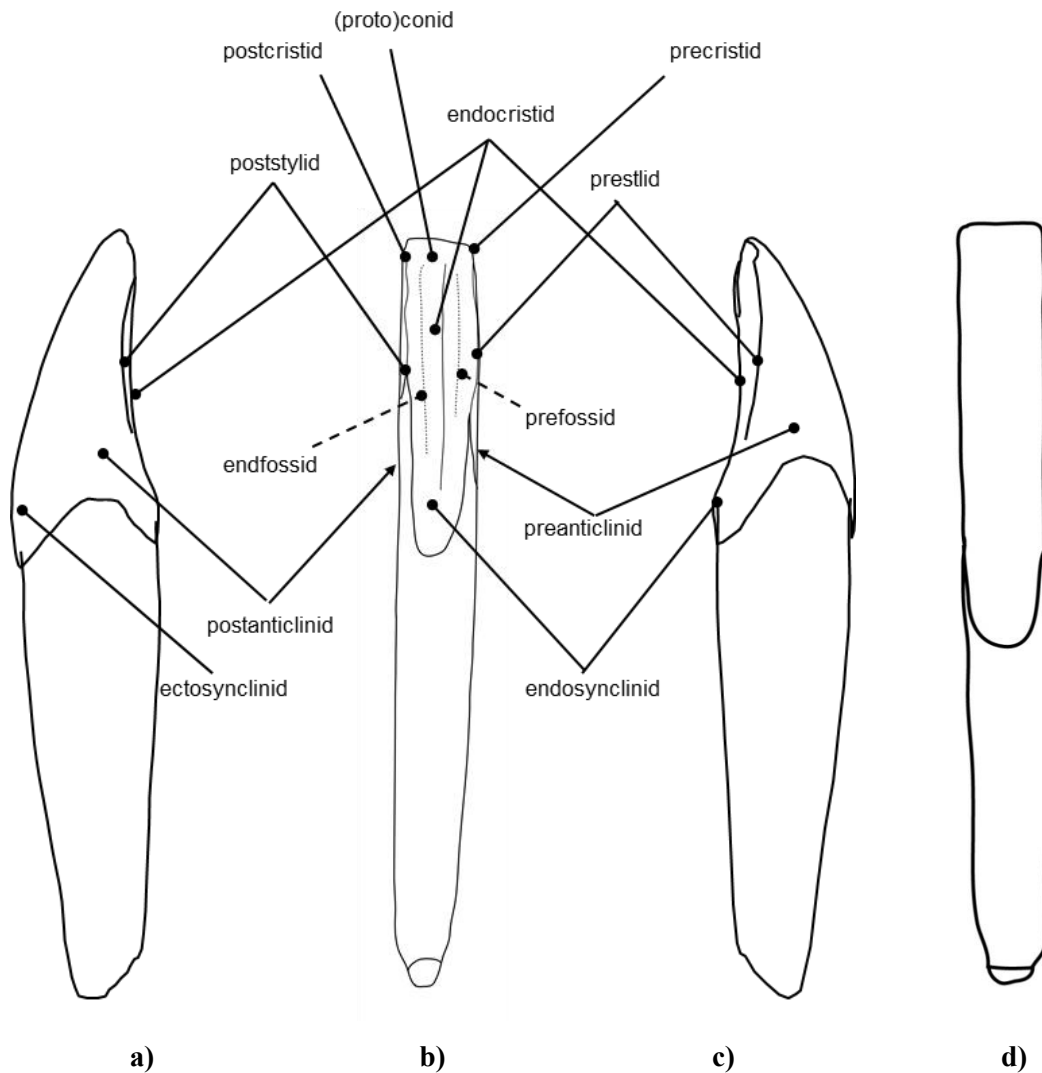


Figure 16. Diagram showing the valley-and-crest morphology of the first lower incisor in *Sus scrofa*. (Right incisor) a) medial view; b) lingual view; c) lateral view; d) labial view. Nomenclature from Van der Made (1996).

1.5. Suoid incisor wear/facet complex

The suoid incisor wear/facet complex is characterized by occlusal and non-occlusal facets. Occlusal facets are those produced by contact between lower and upper dentition, mainly by tooth-to-tooth contact, or by exogenous particles in-between (Lucas, 2004). Non-occlusal facets are also produced by exogenous particles, but not by tooth-to-tooth contact. In suids, Herring (1972) interpreted non-occlusive facets as being mainly produced by rooting. These facets, and the regions nearby, are the target of the present microwear analysis, because it is here where different microwear patterns may account for different “rooting styles”.

As it is illustrated in Figures 17 and 18, occlusal facets in lower incisors are produced by the contact of different anatomical regions of the upper incisors, and the other way around. Non-occlusal facets are situated posteriorly to occlusal facets in the lower dentition, while they are anterior to these facets in the upper dentition.

It may also be important to indicate that the lingual side in lower second incisors is orientated more medially, while the first lower incisors are orientated parallel to the transverse plane. In the upper first incisor, while the more anterior facet is caused by contact with the soil, while the occlusal facet is posterior.

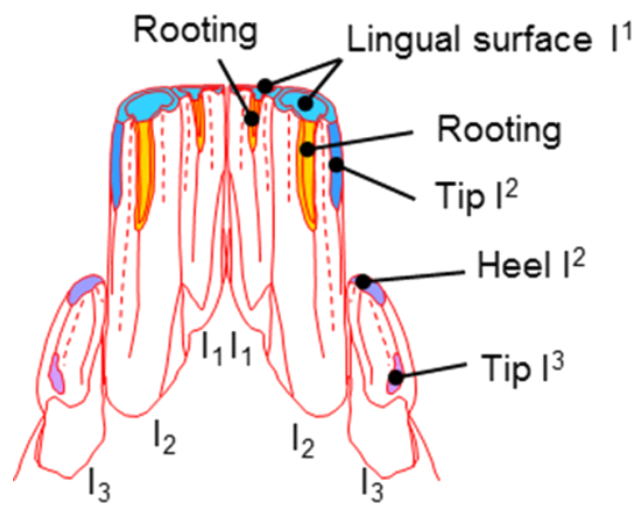


Figure 17. Suoid incisor wear/facet complex in the lower dentition.

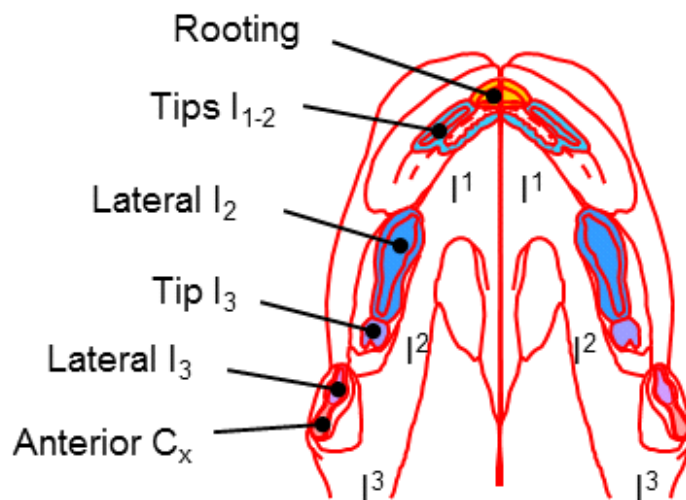


Figure 18. Suoid incisor wear/facet complex in the upper dentition.

2. AIMS

The main purpose of this work is to develop a method to understand adaptive responses related to feeding behavior (rooting) of the family Suidae to environmental and climatic change at important fossil hominin sites, mainly Plio-Pleistocene in East Africa, by the creation of a comparative incisor microwear framework with qualitative and quantitative data of extant species that would enable future comparison with fossil specimens.

To this end, this study has several specific objectives:

- To describe and analyze the suoid **incisor wear/facet complex** under **Light Microscopy and Scanning Electron Microscopy (SEM)**.
- To develop of a **new method** to record **suoid incisor wear stage**, and compare incisor wear to molar wear.
- To adapt **quantitative methodologies** to obtain comparable **suoid incisor microwear data** under **SEM**, in order to determine intra- and inter-tooth variability (lingual vs labial side, occlusal vs non-occlusal facets/regions, enamel vs dentine, crests vs valleys, first incisors vs second incisors) and inter-species variability (labial side and non-occlusal facets/regions between taxa).
- Categorize different **“rooting styles”** in relation to their **microwear signal**, so that it is possible to classify fossil specimens and understand their rooting behavior.

3. MATERIAL AND METHODS

3.1. Material

3.1.1. Specimen selection:

Thirty-eight (38) specimens representing seven (7) extant species belonging to the superfamily Suoidea were analysed from the National Museum of Natural History (MNCN – CSIC), the Anatomical Museum of Valladolid University (MAV - Department of Medicine) and material recovered from the field, from the personal collection of Jan van der Made (JVDM - MNCN) and the Natural Reserve of Riofrío (Madrid, Spain). Four species belong to the family Suidae [*Sus scrofa* (n=17), *Potamochoerus porcus* (n=4), *Phacochoerus africanus* (n=4), *Babyrousa Babyrousa* (n=4)] and two to the family Tayassuidae [*Tayassu pecari* (n=2), *Pecari tajacu* (n=7)] (Table 2). All specimens were adult and preserved at least one complete first or second (lower or upper) incisor.

Teeth belonging to wild individuals were chosen if available, because diet is likely to differ in captive individuals (e.g. Superina *et al.*, 2008), and therefore feeding behavior (rooting habit) would differ as. Unfortunately, it was not possible to study specimens of wild *Babyrousa babyrussa*.

When possible, original samples were selected to be analyzed. Before cleaning, all the original samples were examined under a binocular lens in order to search for possible post-mortem damage or any deposit of interest, such as dental calculus, grit or organic material. If any taphonomical alteration affected the whole surface of the teeth, samples were discarded for the microwear analysis. On the other hand, if deposits of interest were found, teeth were not cleaned and they were directly taken to Scanning Electron Microscopy to be analyzed. If original material could not be directly taken to SEM, high-resolution replicas were performed.

Table 2. List of specimens selected for this study.

Collection	Nº	Species	Sex	Procedence	SEM	Original / Cast
MAV	2182	<i>B. Babyrousa</i>	Female	Madrid Zoo	Yes	Cast
MAV	3535	<i>B. Babyrousa</i>	Male	Madrid Zoo	No	-
MAV	6176	<i>B. Babyrousa</i>	Male	Madrid Zoo	No	-
MNCN	14236	<i>B. Babyrousa</i>	Male	Madrid Zoo	Yes	Original
JVDM ¹	1	<i>P.africanus</i>	Male	Unknown	Yes	Original
MAV	2525	<i>P.africanus</i>	Male	Antonio Pérez (Granada)	Yes	Cast
MAV	6470	<i>P.africanus</i>	Female	Bioparc Valencia	No	-
MNCN Coll. Pal. ²	U	<i>P.africanus</i>	Ind	Unknown	Yes	Original
MAV	747	<i>P. tajacu</i>	Female	Madrid Zoo	No	-
MAV	1423	<i>P. tajacu</i>	Male	Iquitos (Perú)	Yes	Cast
MAV	1764	<i>P. tajacu</i>	Ind	Iquitos (Perú)	Yes	Cast
MAV	2223	<i>P. tajacu</i>	Male	Madrid Zoo	No	-
MAV	2246	<i>P. tajacu</i>	Male	Matapozuelos Zoo (Madrid)	No	-
MAV	2801	<i>P. tajacu</i>	Ind	Requena (Perú)	Yes	Cast
MAV	3881	<i>P. tajacu</i>	Male	Valwo(VA)	Yes	Cast
MAV	2356	<i>P.porcus</i>	Male	West Africa	Yes	Cast
MAV	6418	<i>P.porcus</i>	Male	Bioparc Fuengirola	No	-
MNCN	18955	<i>P.porcus</i>	Male	West Africa	Yes	Original
MNCN	18957	<i>P.porcus</i>	Male	West Africa	Yes	Original
MNCN	4910	<i>S. scrofa</i>	Male	P.N. Doñana (Huelva, Spain)	Yes	Original
MNCN	18365	<i>S. scrofa</i>	Male	Olvega (Soria, Spain)	No	-
MNCN	18385	<i>S. scrofa</i>	Female	P.N. Monfragüe (Caceres, Spain)	Yes	Original
MNCN	18534	<i>S. scrofa</i>	Male	Moncayo (Zaragoza, Spain)	Yes	Original
MNCN	18535	<i>S. scrofa</i>	Male	Moncayo (Zaragoza, Spain)	Yes	Original
MNCN	18537	<i>S. scrofa</i>	Female	Cadalso (Cáceres, Spain)	Yes	Cast
MNCN	18538	<i>S. scrofa</i>	Female	P.N. Monfragüe (Caceres, Spain)	No	-
MNCN	18548	<i>S. scrofa</i>	Female	Bullaque (Ciudad Real, Madrid)	Yes	Original

(Continued next page)

MNCN	18558	<i>S. scrofa</i>	Female	P.N. Monfragüe (Caceres, Spain)	Yes	Original
MNCN	21494	<i>S. scrofa</i>	Female	Mondejar (Ciudad Real, Spain)	Yes	Original
MNCN	21495	<i>S. scrofa</i>	Male	Mondejar (Ciudad Real, Spain)	No	Original
MNCN	21498	<i>S. scrofa</i>	Female	Jerez (Cádiz, Spain)	No	Original
MNCN	21499	<i>S. scrofa</i>	Male	Cañamero (Cáceres, Spain)	Yes	Original
MNCN	21501	<i>S. scrofa</i>	Female	Bullaque (Ciudad Real, Spain)	Yes	Original
MNCN	21510	<i>S. scrofa</i>	Male	Campón (Extremadura, Spain)	Yes	Original
MNCN	21511	<i>S. scrofa</i>	Male	Navahondilla (Ávila, Spain)	No	Original
RIOFRIO ³	1	<i>S. scrofa</i>	Ind	Riofrío (Segovia, Spain)	Yes	Original
JVDM ¹	2	<i>T. pecari</i>	Female	Unknown	Yes	Original
MAV	3776	<i>T. pecari</i>	Female	Paraguay	Yes	Original

¹ Personal collection of Jan van der Made

² Collection of Paleobiology of the MNCN. “U”: Uncatalogued.

³ Specimen taken from the field (Reserve Game Park of Riofrío, Segovia, Spain)

The number of specimens analysed here per species is comparable to other microwear studies, which typically include a range from four to ten or more individuals per species (e.g. Estebanz et al., 2009, 2012; Green & Resar, 2012), though it is always desirable to widen the sample.

3.2. Methods

3.2.1 Specimen preparation

One or two days before the SEM analysis, the original specimens, which were not submitted to casting procedures, and those without taphonomical or other interesting features, were cleaned by submerging them in distilled water in an ultrasound cleaner (Figure 20) for 30 minutes, and left to dry. Then they were taken to the microscopy lab (MNCN – CSIC), trying not to touch the dental surface of interest, in order to avoid pollution of the surfaces with dust or organic material from hands.

If original specimens could not be analyzed under SEM, as is the case of the material belonging to the Anatomical Museum of Valladolid, high-resolution replicas were performed. The methodology follows basic casting procedures adapted from classic standards described in detail elsewhere (Solounias & Semprebon, 2002; Merceron *et al.*, 2004). In order to remove dust before the casting procedure, teeth were thoroughly but gently cleaned by applying an ethanol solution (95%) and distilled water with a very soft brush, so as to avoid scratching of the dental surface. After leaving the teeth to dry completely, a high-resolution hydrophilic vinyl polysiloxane resin (EXAFLEX®) was extended on the surface of interest in order to make negative moulds (Figure 19). Using a low viscosity variety it is possible to obtain replicas of great resolution that can preserve detail for more than a year (Estalrich & Rosas, 2013). These moulds were included in a formwork made with lab putty, in order to give support to the positive cast, following the same logic of Merceron *et al.* (2004) and preventing liquid casting material from spilling out (Green, 2009).

Polyurethane resin (Ferapur PR-55®) and transparent epoxy resin (Epofer EX402 + E430®) were used to make positive replicas. Polyurethane has a moderately fast drying time, and optimum viscosity and fluidity, allowing detailed reproduction of the tooth surface (Estalrich & Rosas, 2013). Transparent epoxy resin has a slower drying time (though the process could be accelerated with an enzyme). While working with these casting materials is reasonably easy, results can vary greatly depending on practice. The main problem involves the creation of air bubbles that result in undesirable holes in the positive cast. To prevent the formation of these air bubbles, we followed some of the recommendations indicated by Merceron *et al.* (2004), heat the transparent epoxy resin at 30°C during 1 hour and then leave to polymerize during 72 hours at 20°C. Polyurethane has a much smaller working time so the only way to prevent air bubbles is to mix the compound and tip it out on the mould very gently. Polyurethane is mostly used in SEM microwear studies (e.g. Green & Resar, 2012; Estalrich & Rosas, 2013) while transparent epoxy resin is normally used in microwear studies involving light microscopy (e.g. Merceron *et al.*, 2004; Green, 2009).

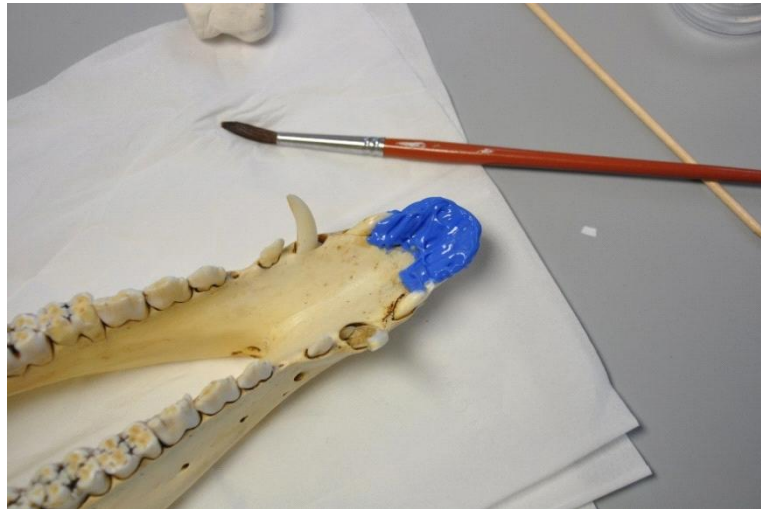


Figure 19. High-resolution hydrophilic vinyl polysiloxane resin (EXAFLEX) applied to the inferior anterior dentition of a wild hog (MNCN – CSIC).



Figure 20. Suoid incisors submerged in an ultrasound cleaner with distilled water, in order to remove dust before SEM analysis.

3.2.2 Macroscopic analysis and examination under light microscopy. Wear stage recording methodologies: a new method for suoid incisors.



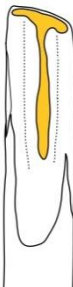





As already mentioned, all samples were observed under a binocular lens to seek for taphonomical or pos-mortem damage and deposits of interest. Before taking samples selected to SEM, it was indispensable to understand the wear/facet system in each tooth, and how this system relates to different incisor morphology. Though wear can be

observed macroscopically, it is recommended here to complement the examination under very low magnification microscopy (20x or 40x). This way it is possible to differentiate regions where dentine is exposed or facets are present, and distinguish between occlusal (tooth-to-tooth contact) and non-occlusal facets.

Molar wear was categorized adapting the methodology proposed by Desbiez & Keuroghlian (2009) for age estimation in feral pigs, which was a combination of the categorical classifications of Rolett & Chiu (1994), and Grant (1982). Age divisions were grouped in four wear categories, which basically depend on the number of cusps with visible wear and the amount of dentine exposed (Figure 21).

In this work, a similar logic was behind the development of a new methodology to classify suid incisor wear, using a new standardized scale (1 to 4) (Table 3). The advantage of this method is that it is independent of incisor size. It is however, very dependent on the differential eruption times between taxa. Incisor wear was then compared to molar wear, to test for possible differences of wear rate between individuals of the same or different taxa. In this way it is potentially possible to detect higher incisor wear rates that may give a first clue of their use.

Table 3. The criteria to categorize wear rate in suoid incisors.

WEAR STAGE	DESCRIPTION	DIAGRAM	PHOTO
<p style="text-align: center;">1 (Low)</p>	<p style="text-align: center;">Wear facet may be visible in the enamel. Dentine may be visible, but only in one crest (occlusal or lingual)</p>		
<p style="text-align: center;">2 (Medium)</p>	<p style="text-align: center;">Dentine exposure in at least two crests (occlusal and lingual). Dentine exposure in different crests may join a form a characteristic “T”- shape. Crest-and-valley morphology is still visible</p>		
<p style="text-align: center;">3 (High)</p>	<p style="text-align: center;">Dentine is more visible than enamel in the occlusal and lingual regions. Crest-and-valley morphology is not visible anymore</p>		
<p style="text-align: center;">4 (Very high)</p>	<p style="text-align: center;">Dentine occupies the whole lingual and occlusal surface of the tooth and enamel is completely, or almost completely, worn away on the lingual side (though very small lakes of enamel may remain)</p>		

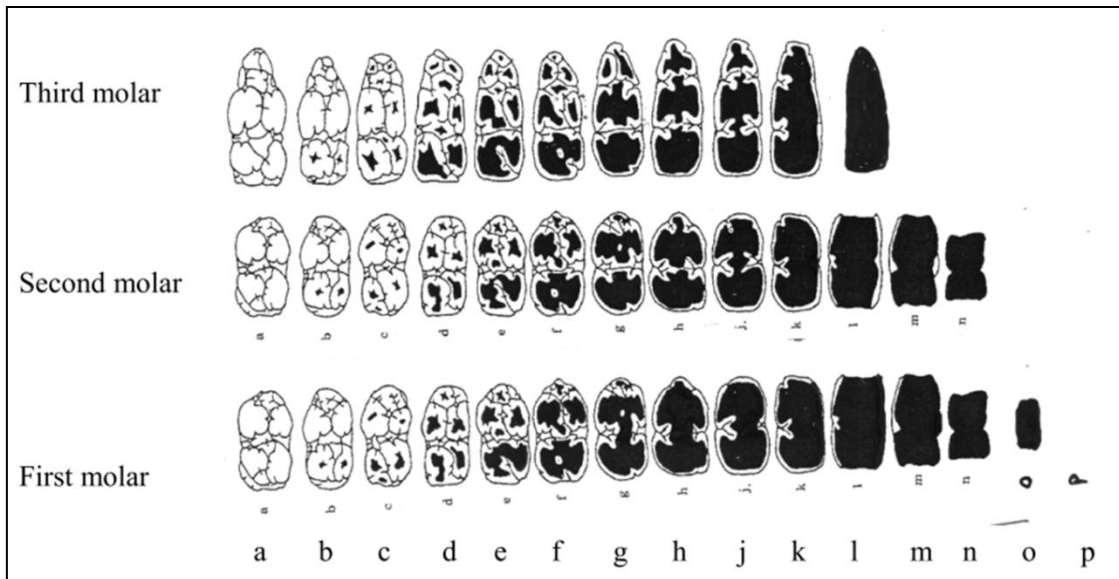


Figure 21. Classification categories of molar wear. Adapted from Rollet and Chiu (1994) and Grant (1982), in Desbiez & Keuroghlian (2009).

Table 4. Adaptation of age estimates in months to a four-category wear stage system.
Adapted from Desbiez & Keuroghlian (2009).

Second molar	Third molar	Mandible	Wear stage
	V	less than 22	
c,d,e	1-2 cusps	21 to 30	1
d,e,f	3 cusps to a	30 to 42	2
e,f,g,h	b to c	42 to 54	3
g,h,j,k,l	d to e	54 to 66	4
k,l,m,n,x	f to g	66 to 78	

3.2.3. Microwear analysis under SEM microscopy:

Teeth selected were examined under Environmental Scanning Electron Microscope (ESEM Fei-Quanta 200 located in the National Museum of Natural History (MNCN-CSIC) in Madrid) at magnifications that ranged from 32x to 1000x. Working

distance varied from 9.6 mm to 14.8 mm, depending on the size of the tooth, though wide general images for reference required up to 24.3 mm. Voltage ranged from 20 to 28 kv.

Non-overlapping digital images of microwear features were taken along different areas in both lingual/occlusal and labial sides of inferior and superior first and second incisors. The majority of microwear studies have selected one or two facets in the first or second lower or upper molar, taking one or two microphotographs on each of these facets, in order to homogenize the anatomical point analyzed and enable better comparison between taxa (e.g. Green & Resar, 2012). The few microwear analysis carried out on suid molars had followed the same logic (e.g. Ward & Mainland, 1999; Bishop *et al.*, 2006). However, both morphology and wear/facet complex on suid incisors are very different to that of molars, thus complicating homologous comparison.

Unfortunately, there is also an almost complete lack of information concerning wear patterns on suid incisors except for brief commentaries in the work about suid canine morphology by Herring (1972). Furthermore, there are only two microwear studies on ungulate incisors to date, the work concerning an extant population of moose by Young & Marty (1986) and more recently, on zebras by Rivals & Semprebon (2010). Incisor morphology is very different between suoids and the taxa analyzed in these works. So it was not possible to use reference publications as a starting point for the presented analysis.

Therefore, it was necessary to study the wear facet complex on suid incisors in order to understand their genesis and to find a potential homologous region for comparison between different individuals of different species. Only the first lower incisor could be analyzed in all species. It was opted to map the whole lingual side of the lower incisors and the occlusal side of upper incisors (the latter was only performed in *Sus scrofa* and *Babyrousa babyrussa* as a preliminary test to check for correlations between upper and lower facets), under Scanning Electron Microscopy (SEM). Two or three rows of three or four SEM images were taken at 500x magnification both in dentine and enamel to track possible differences in the microwear signal in different areas of the teeth. The counting area was standardized to 0,16 mm² (400 x 400 μm). Counting procedures are explained below in this section. This first step was performed only on original samples of *Sus scrofa* (n=3), *Potamochoerus porcus* (n=2), *Babyrousa babyrussa* (n=1), *Phacochoerus africanus* (n=1) and *Tayassu pecari* (n=1). (see Table 2

for a detailed list of teeth used and number of images taken on each individual). *Pecari tajacu* was not included because only cast samples of this species were available.

After this procedure, which was basically orientative (results are illustrated in Figures 31-36). The second step was to compare data concerning similar anatomical regions within taxa, in order to discern patterns related to different rooting styles. At least two microphotographs were taken for each individual, mainly in the I₁ and I₂, both in the lingual and labial side. Microphotographs were taken at 500x magnification on the lingual and 200x on the labial side (area = 0,16mm²; 400 x 400 μm) at a relative point in the mid-way from the cementum-enamel junction to the tip of the crown, either in enamel or exposed dentine regions.

Table 5. Specimens and teeth analyzed in the first step (tooth microwear mapping) analysis under SEM.

Collection Number	Species	Teeth	N	Side	Images analyzed per tooth (n)
MNCN - 18385 MNCN - 18558 Riofrío – 1 ³	<i>Sus scrofa</i>	I ₁ , I ₂ , I ¹ , I ²	3	Left	8
MNCN - 18955 MNCN - 18957	<i>Potamochoerus porcus</i>	I ₁	2	Left and right	8
MNCN - 14236	<i>Babyrousa babyrussa</i>	I ₁ , I ₂ , I ¹ , I ²	1	Left	7
MNCN Coll. Pal. ²	<i>Phacochoerus africanus</i>	I ₁ , I ₂	1	Left	7
JVDM-2 ¹	<i>Tayassu pecari</i>	I ₁ , I ₂	1	Left	6

¹ Personal collection of Jan van der Made

² Collection of Paleobiology of the MNCN.

³ Specimen taken from the field (Reserve Game Park of Riofrío, Segovia, Spain)

3.2.4. Microfeature counting procedure

All microphotographs were analyzed using free semi-automatic software ImageJ, by using the “Set and Measure” plugin to count and measure all the microfeatures within the area selected, both in length and width. The first measure corresponds to the length and the second to the width of the microfeature. Contrast and

brightness were adjusted by using the “Auto” function in ImageJ or by adjusting it manually if necessary, to maximize microfeature visualization. Microfeatures were then categorized as pits or scratches, on the basis of the 1:4 relationship followed by almost all microwear studies (e.g. Merceron *et al.*, 2004; Green and Resar, 2012). Orientation of scratches was also recovered.

The raw data were then exported to Excel and processed using Macros (Visual Basic C++). The processed data were then copied to a spread sheet to calculate a series of variables (Table 6) that were used to test intra-tooth, inter-tooth and inter-species variability. Additionally, processed raw data concerning scratches (= excel file filtered for pits) were exported to software Oriana v4.0 (Kovach Computing Services©) to build two different types of angle graph charts that illustrate preferred scratch orientation for each microphotograph. One type of scratch orientation graph is constructed as a histogram, in which the length of the bar represents the relative number of scratches with similar orientations. A second type of linear-angle graph charts represents angles related to a linear (quantitative) variable, in this case length. Each gross line in the graph is the reflection of the relative length of that scratch and its orientation in the image analyzed. The visual information obtained from each type of graph is therefore related but complementary.

Table 6. List of variables used in this work.

Abbreviation	Variable	Condition
TM	Total Microfeatures	
TS	Total Scratches	
VSS	Very Small Scratches	Length <100 µm
SS	Small Scratches	Length (100 – 200) µm
LS	Long Scratches	Length (200 – 300) µm
VLS	Very Long Scratches	Length (300 – 400) µm
HLS	Hyper Long Scratches	Length >400 µm
Lt (VLS + HLS)	Longitudinal (Very Long + Hyper Long) Scratches	Length >300 µm
NS	Narrow Scratches	Width <5 µm
BS	Broad Scratches	Width >5 µm

(Continued next page)

LtS	Longitudinal Scratches	Orientation (60°-120°)
TrS	Transverse Scratches	Orientation (0°-30°) U (150°-180°)
ObS	Oblique Scratches	Orientation (30°-60°) U (120°-150°)
TP	Total Pits	
SP	Small Pits	Max diameter <5 µm
WP	Wide Pits	Max diameter >5 µm
HWP	Hyper Wide Pits	Max diameter >15 µm
X Length	Average length scratches	
X Width	Average width scratches	
R_LtS.TS %	Ratio (Longitudinal Scratches / Total Scratches)	
R_ObS.TS %	Ratio (Transverse Scratches / Total Scratches)	
R_TrS.TS %	Ratio (Longitudinal Scratches / Total Scratches)	
R_LtS.TrS	Ratio (Longitudinal Scratches / Transverse Scratches) ¹	
R_VSS.TS %	Ratio (Very Small Scratches / Total Scratches)	
R_SS.TS %	Ratio (Small Scratches / Total Scratches)	
R_LS.TS %	Ratio (Long Scratches / Total Scratches)	
R_VLS.TS %	Ratio (Very Long Scratches / Total Scratches)	
R_HLS.TS %	Ratio (Hyper Long Scratches / Total Scratches)	
R_Lt.HLS.TS %	Ratio (Longitudinal (Hyper Long Scratches / Total Scratches)	
R_Lt.VLS.HLS.TS %	Ratio (Longitudinal (Very Long + Hyper Long) Scratches / Total Scratches)	
R_TP.TMF %	Ratio (Total Pits / Total Microfeatures)	
R_SP.TP %	Ratio (Small Pits / Total Pits)	
R_WP.TP %	Ratio (Wide Pits / Total Pits)	
R_HWP.TP %	Ratio (Hyper Wide Pits / Total Pits)	
R_BS.NS	Ratio (Broad Scratches / Narrow Scratches)	
R_P.S	Ratio (Pits/Scratches)	
R_WP.HWP.SP	Ratio ((Wide Pits + Hyper Wide Pits) / Small Pits)	

¹ Not included in the analysis but used as orientative in figures 31-36 on Section 4.3.3.2

3.2.5. Statistical analysis

All data for each species were tested for normality and homogeneity of variances using the Kolgomorov-Smirnov test (and Shapiro-Wilkinson test) with Lilliefors's correction and Levene's test for homogeneity of variances, respectively (Zar, 1996; Merceron et al., 2004). To meet these underlying assumptions of parametric statistical analyses, measures and variables were either square-root-, arcsin- or log-transformed. Statistical comparisons involved single factor ANOVA followed by Tukey's HSD (Multiple Comparisons) test (Zar, 2007), and non-parametric Kruskal-Wallis Test, to understand the possible interspecific variation.

4. RESULTS

4.1. Macroscopic observation: grades of dental wear on molars and incisors

A total number of 37 first lower incisors and 35 second lower incisors belonging to 38 specimens representing 6 species and 2 families were analyzed in this study. Molar wear stage was determined using the categories proposed by Desbiez and Keuroghlian (2009) for age estimation in feral pigs, which was a combination of the categorical classifications of Rolett and Chiu (1994) and Grant (1982). Age divisions were grouped in four wear categories, which basically depend on the number of cusps with visible wear and the amount of dentine exposed. In this work, a similar logic was used to develop a new methodology to classify suid incisor wear in four categories (Table 3). A summary of wear stages for all the specimens examined in this work are found in Table 7.

Table 7. Summary of molar and incisor wear stages. (“Coll” = Collection; “Indet” = Indeterminate)

Coll.	N°	Species	Sex	Incisor wear		Molar wear		
				I1 Stage	I2 Stage	M2 Substage	M3 Substage	Category
MAV	2182	<i>B. Babyrousa</i>	Female	4	4	d	b	2
MAV	3535	<i>B. Babyrousa</i>	Male	4	4	l	k	4
MAV	6176	<i>B. Babyrousa</i>	Male	4	4	l	k	4
MNCN	14236	<i>B. Babyrousa</i>	Male	4	4	d	a	2
JVDM ¹	1	<i>P.africanus</i>	Male	4	4	P	4	4
MAV	2525	<i>P.africanus</i>	Male	4	Indet	J	Indet	4
MAV	6470	<i>P.africanus</i>	Female	3	3	e	b	3
Coll. Pal ²	U	<i>P.africanus</i>	Ind	3	Indet	p	Indet	4
MAV	747	<i>P. tajacu</i>	Female	1	1	d	b	2
MAV	1423	<i>P. tajacu</i>	Male	2	3	e	d	3
MAV	1764	<i>P. tajacu</i>	Ind	1	1	a	a	1
MAV	2223	<i>P. tajacu</i>	Male	2	2	e	c	3
MAV	2246	<i>P. tajacu</i>	Male	2	2	l	l	4
MAV	2801	<i>P. tajacu</i>	Ind	1	1	a	a	1
MAV	3881	<i>P. tajacu</i>	Male	2	2	e	b	3
MAV	2356	<i>P.porcus</i>	Male	3	3	f	c	3

(Continued next page)

MAV	6418	<i>P.porcus</i>	Male	4	4	G	d	4
MNCN	18955	<i>P.porcus</i>	Male	2	Indet	D	a	2
MNCN	18957	<i>P.porcus</i>	Male	3	Indet	D	b	2
MNCN	4910	<i>S. scrofa</i>	Male	4	3	E	c	3
MNCN	18365	<i>S. scrofa</i>	Male	2	2	D	a	1
MNCN	18385	<i>S. scrofa</i>	Female	3	2	C	a	1
MNCN	18534	<i>S. scrofa</i>	Male	2	2	C	b	1
MNCN	18535	<i>S. scrofa</i>	Male	1	1	B	a	1
MNCN	18537	<i>S. scrofa</i>	Female	3	1	D	b	2
MNCN	18538	<i>S. scrofa</i>	Female	3	2	E	b	3
MNCN	18548	<i>S. scrofa</i>	Female	4	4	F	c	3
MNCN	18558	<i>S. scrofa</i>	Female	x	2	D	b	2
MNCN	21494	<i>S. scrofa</i>	Female	2	1	D	a	1
MNCN	21495	<i>S. scrofa</i>	Male	2	1	D	b	2
MNCN	21498	<i>S. scrofa</i>	Female	2	1	D	a	1
MNCN	21499	<i>S. scrofa</i>	Male	3	2	D	c	2
MNCN	21501	<i>S. scrofa</i>	Female	2	2	D	b	2
MNCN	21510	<i>S. scrofa</i>	Male	1	1	B	a	1
MNCN	21511	<i>S. scrofa</i>	Male	3	2	E	c	3
RIOFR. ³	1	<i>S. scrofa</i>	Ind	4	4	Indet	Indet	Indet
JVDM ¹	2	<i>T. pecari</i>	Female	2	2	E	e	4
MAV	3776	<i>T. pecari</i>	Female	4	4	L	j	4

¹ Personal collection of Jan van der Made

² Collection of Paleobiology of the MNCN. "U". Uncatalogued.

³ Specimen taken from the field (Reserve Game Park of Riofrio, Segovia, Spain)

The lower molar and incisor wear stage was recorded and compared within species. Summary frequencies and percentages are found in Table 8 for the first incisor and Table 9 for the second incisor. Chi-square tests indicate a significant relationship between species and differential molar/first-incisor wear stage (χ^2 [8; N = 31] = 19,72; $p = 0,011$; $\alpha = 0,05$) but show no significant relationship between species and molar/second-incisor wear stage (χ^2 [8; N = 31] = 10,48; $p = 0,233$; $\alpha = 0,05$). *Phacochoerus africanus* was excluded from the analysis because molar wear stage methodology was not applicable to the hypsodont (instead of brachyodont) morphology of molar crowns. Specimens for which molar or incisor wear stage was not possible to determinate were also excluded.

Table 8. Frequencies and percentages indicating the relation between lower first incisor wear stage and molar wear stage for the different species. “I1>M” (Wear stage in the first incisor is higher than in the molars); “I1<M” (Wear stage in the first incisor is lower than in the molars); “I1=M” (Wear stage is the same both in the first incisor and molars); “Indet” (=Indeterminate).

			I1			Total
			I1>M	I1=M	I1<M	
Species	<i>B. babyrussa</i>	Count	2	2	0	4
		% within species	50,0%	50,0%	,0%	100,0%
	<i>P. tajacu</i>	Count	1	2	4	7
		% within species	14,3%	28,6%	57,1%	100,0%
	<i>Pot. porcus</i>	Count	0	3	0	3
		% within species	,0%	100,0%	,0%	100,0%
	<i>Sus scrofa</i>	Count	9	6	0	15
		% within species	60,0%	40,0%	,0%	100,0%
	<i>T. pecari</i>	Count	0	1	1	2
		% within species	,0%	50,0%	50,0%	100,0%
Total		Count	12	14	5	31
		% within species	38,7%	45,2%	16,1%	100,0%

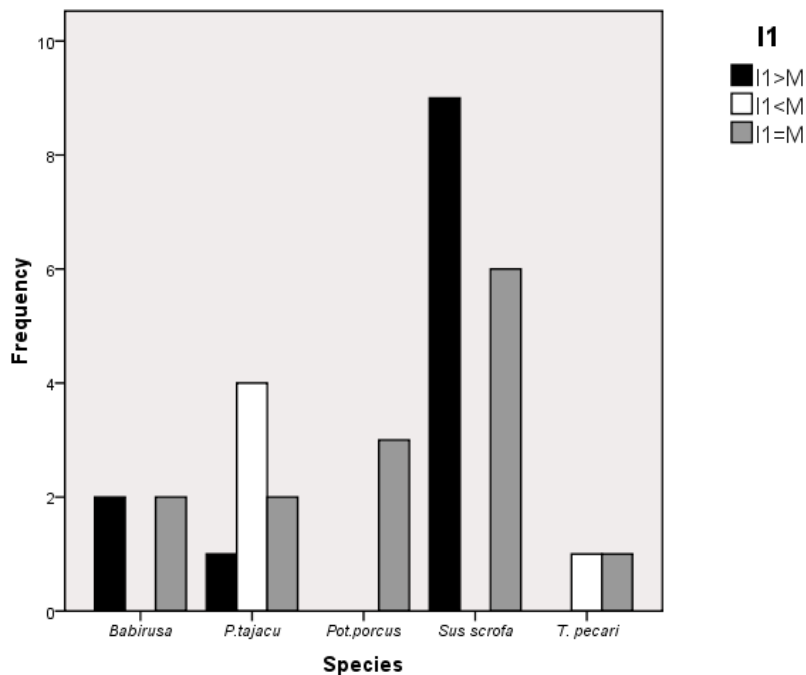


Figure 22. Histogram showing frequencies of the differential wear stages between inferior first incisors and molars within species.

It was expected that incisor wear stage was equal to molar wear stage in the majority of the specimens, or that there was a random but homogenous distribution along all the sub-variables proposed. This is the case of *Potamochoerus porcus* both for first and second incisors. However, *Babyrousa babyrussa* and *Sus scrofa* show unexpected higher cases where lower incisor wear stage is higher than molar wear stage (for the first lower incisor, 50% and 60% respectively; only *B. babyrussa* maintains a higher percentage for the second lower incisor, 50% again) (Table 9). On the other hand, the two representatives of the family Tayassuidae, *P. tajacu* and *T. pecari* show higher values where lower incisor wear stage is lower than the molar wear stage (for the first and second lower incisors, 57% and 50% respectively) (Table 9). Frequencies are illustrated in Figure 22 and 23.

Table 9. Frequencies and percentages indicating the relation between lower second incisor wear stage and molar wear stage for the different species. “I2>M” (Wear stage in the first incisor is higher than in the molars); “I2<M” (Wear stage in the first incisor is lower than in the molars); “I2=M” (Wear stage is the same both in the first incisor and molars); “Indet” (=Indeterminate).

			I2			Total	
			I2>M	I2=M	I2<M		
Species	<i>B. babyrussa</i>	Count	2	2	0	4	
		% within species	50,0%	50,0%	,0%	100,0%	
	<i>P.tajacu</i>	Count	0	3	4	7	
		% within species	,0%	42,9%	57,1%	100,0%	
	<i>Pot.porcus</i>	Count	0	3	0	3	
		% within species	,0%	100,0%	,0%	100,0%	
	<i>Sus scrofa</i>	Count	4	7	4	15	
		% within species	26,7%	46,7%	26,7%	100,0%	
	<i>T. pecari</i>	Count	0	1	1	2	
		% within species	,0%	50,0%	50,0%	100,0%	
	Total		Count	6	16	9	31
			% within species	19,4%	51,6%	29,0%	100,0%

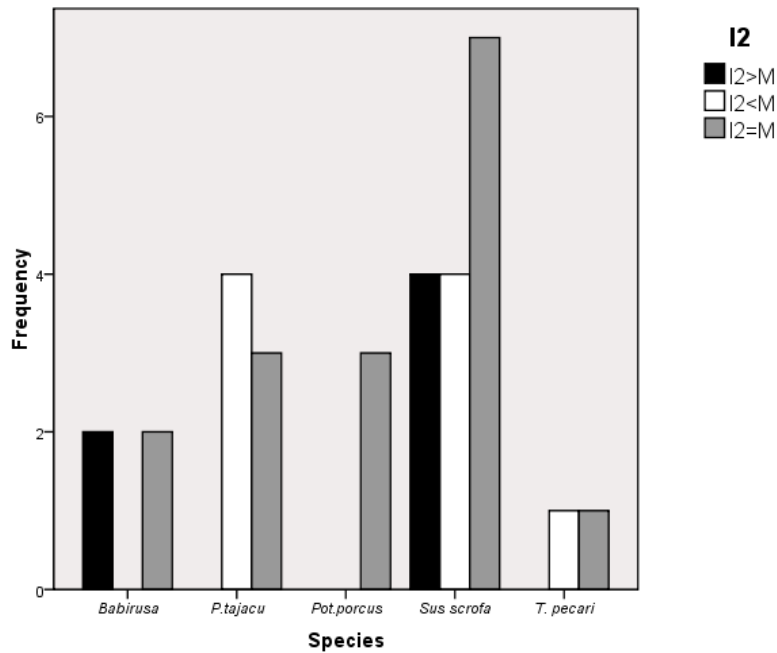


Figure 23. Histogram showing frequencies of the differential wear stages between second incisor and molars within species.

4.2. SEM Analysis: Descriptive Analysis

4.2.1. Lingual vs labial side. Occlusal vs non-occlusal facet

The examination of lower and upper, first and second suid incisors has revealed qualitative differences, depending on the type of facet, tooth, wear stage and the species in which the image was taken, even before the quantitative analysis was performed. The most remarkable differences occur in the lingual side of the incisor, in comparison to the labial side. The labial side has no distinguishable regional differences regarding the majority of these aspects, though other interesting characteristics had been observed, as it is explained below (Figure 25).

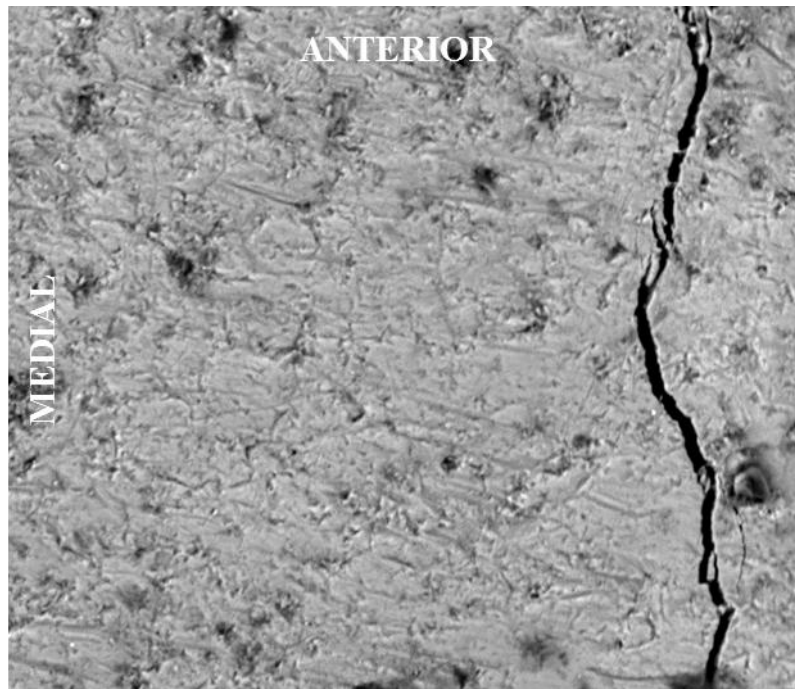
In the lingual/apical side of the incisor, two facets are distinguished, the occlusal facets (formed by tooth-to-tooth contact and exogenous particles in between) and non-occlusive facets (produced by exogenous material, mainly food and soil particles). Transverse scratches are dominant on occlusal facets, which are the result of the lateral movements of the lower incisors against the uppers. (Figure 24a) Facets in the first

lower incisor, for instance, are usually produced by first and second upper incisors, as it has been explained in the introduction (Section 1.5).

On the other hand, non-occlusive facets are characterized by a heterogeneous surface with a variable number of scratches and pits, which differ in size, morphology and orientation (Figure 24b). The formation of these facets and the microfeatures found in them is the result of the impact and scratching of exogenous particles (grit and food), as a result of masticatory or non-masticatory movements of the mandible or the crania. Again, the formation of these marks is also depends on the material that composes the surface in which the exogenous particles impact: dentine or enamel.

By contrast, there is no facet formation on the labial side of the incisor. The labial microfeatures are the result of the impact of the incisor with soil particles present in the ground or any other surface and may be originated mostly by non-masticatory movements. On the labial side there are no regions where the dentine is visible, only if the tooth is broken as a result of a trauma. Enamel breakage and the formation of big pits (with a diameter that can easily surpass 1 mm diameter), is common in the most anterior part of the incisors, and these traumatic events are the consequence of strong movements against any hard surface. Some of these events result in the total exposure of dentine/enamel fibrous microstructure (Figure 25).

a)



b)

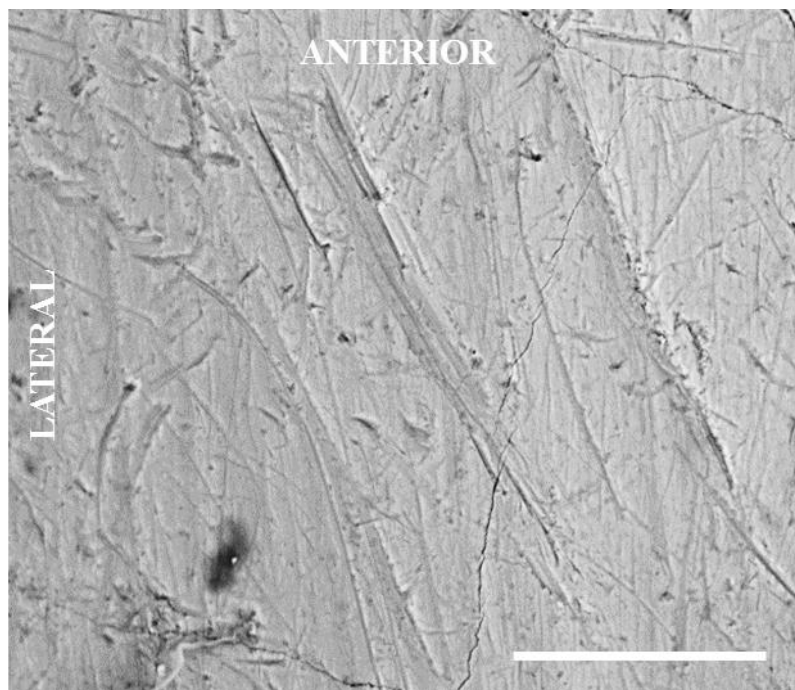


Figure 24. SEM images taken at occlusal and non-occlusal facets. a) Occlusal facet (tooth-to-tooth contact) on the lingual side of the right second lower incisor of specimen MNCN-21510 (*Sus scrofa*). Note the transverse orientation of the scratches, the high pitting and the irregular surface with lakes of microstructure exposure. **b)** Non-occlusal facet on the lingual side of the left first lower incisor of specimen MNCN-18535 (*Sus scrofa*). Note the heterogeneous aspect of the surface, with pits and scratches of different size, morphology and orientation. [Images taken at 500x. Scale bar = 200 μ m].

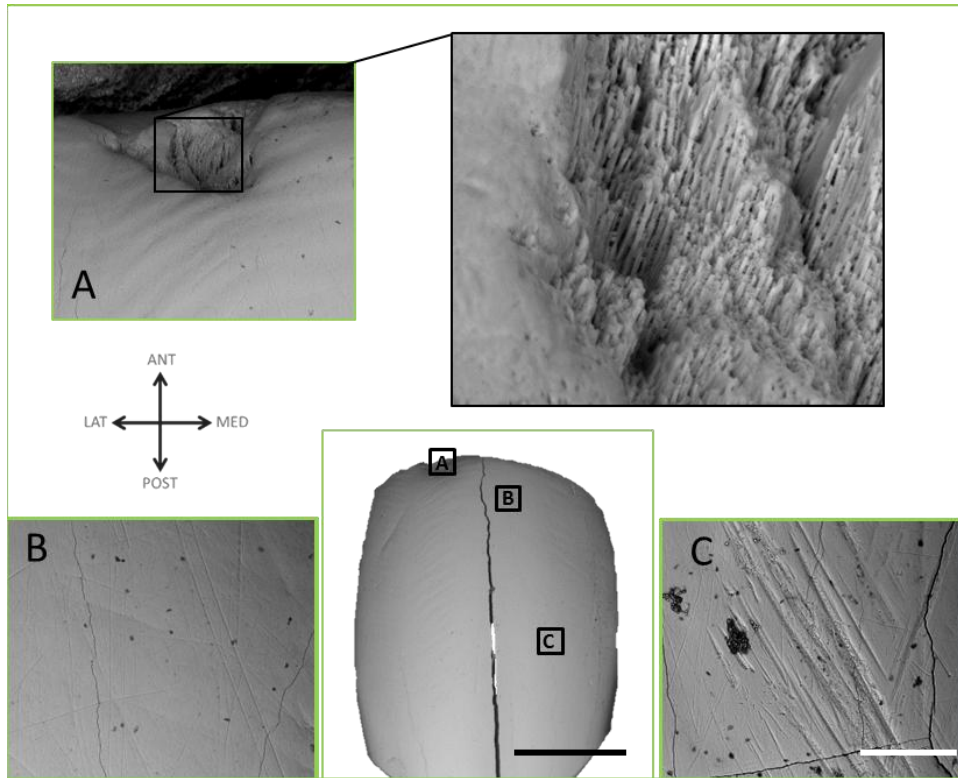


Figure 25. Labial view of the crown of the left second lower incisor and SEM images taken at three different points of the crown surface. Incisor belongs to specimen MNCN-18385 (*Sus scrofa*). A) Ante-mortem wide pit, situated in the most anterior tip of the crown, showing internal enamel tubular microstructure, which is visible in the adjacent magnification (zoom=1000x); B) Microfeatures in the anterior region of the crown. C) Microfeatures in the lateral region of the crown, note the marked visibility of the wide scratches crossing the entire image with a longitudinal orientation (explained below in this section). SEM images were taken at 200x. Black scale bar = 3 mm; White scale bar = 500 μ m.

4.2.2. Microfeatures: morphology, orientation, size and genesis. Mastication biomechanics.

Microfeatures have different size, morphology, and orientation, which depend basically on the size, hardness, sharpness, impact angle and impact strength of the particles that cause them. Following previous microwear studies (e.g. Merceron *et al.*, 2002; Green & Resar, 2012), pits are defined here as microstructures with a length that is up to four times the width. Pits are classified depending on their size.

Similarly, scratches or striations are usually classified on the basis of their size (length and width), but there are other characteristics that have been used to distinguish instrumental or cultural striations (e.g. Lozano *et al.*, 2008; Estalrich and Rosas, 2013). These striations show the same morphological features as those observed in bone cut-marks, like Hertzian cones, scratches with a “V”-shaped section and internal microstriation (this is, microscratches in the bottom of the striation) (e.g. Estalrich & Rosas, 2013) (Figure 26). It is also possible to establish the directionality of the striation, because scratches are usually broader at the point where the striation starts than in the end point. Different stone tool materials have been shown to leave different varieties of cultural striations, so that it could be possible in some cases to know the type of rock or mineral that produced the scratches. Scratches similar to cultural or instrumental striations have been found on the suoid incisors. In fact, some of them are indistinguishable from those that appear in those studies (e.g. Lozano *et al.*, 2008; Estalrich & Rosas, 2013). Though the formation of cultural striations and those found in this study do not have the same etiology, it can be deduced that they are produced by the same material. This means that they are the result of tooth impact with soil particles of different mineral composition. Quartz, for instance, is a material much harder than enamel, and has sharp edges that may be responsible of causing the visible features described above. The categorization of scratches base on these morphological features has not been carried out here, but it will be interesting to do this in the future.

On the other hand, narrower striations without any observable feature are more likely to have been produced by dietary silica components, mainly phytoliths. However, some of these marks could have also been produced by soil particles. Different microfeatures are illustrated in Figure 26.

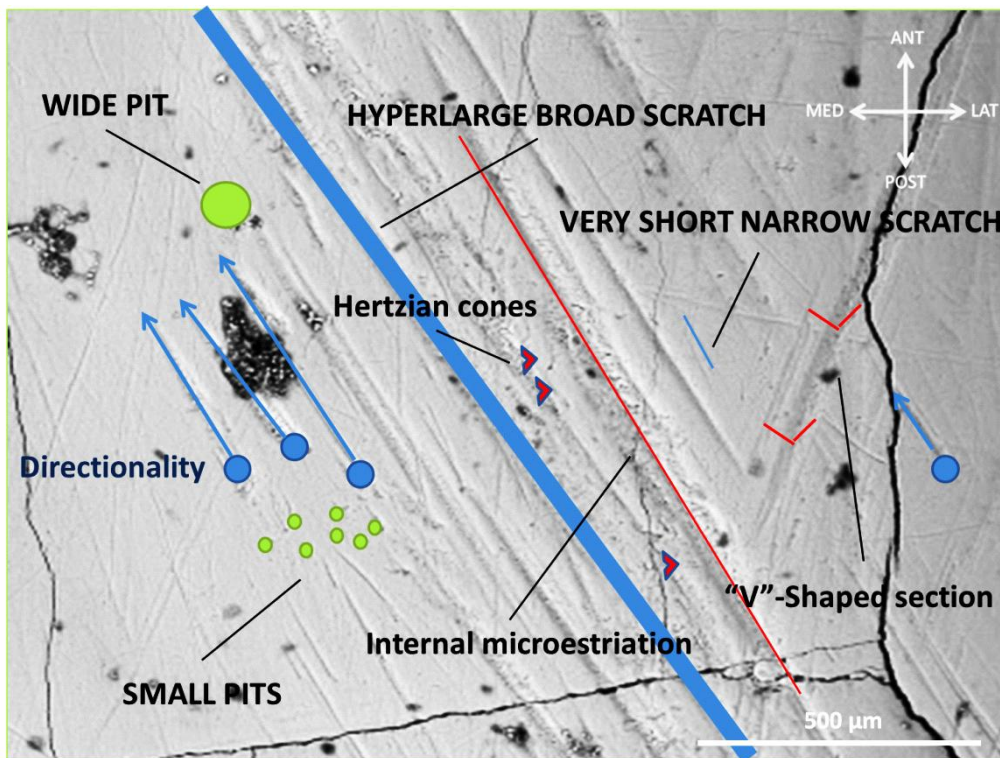
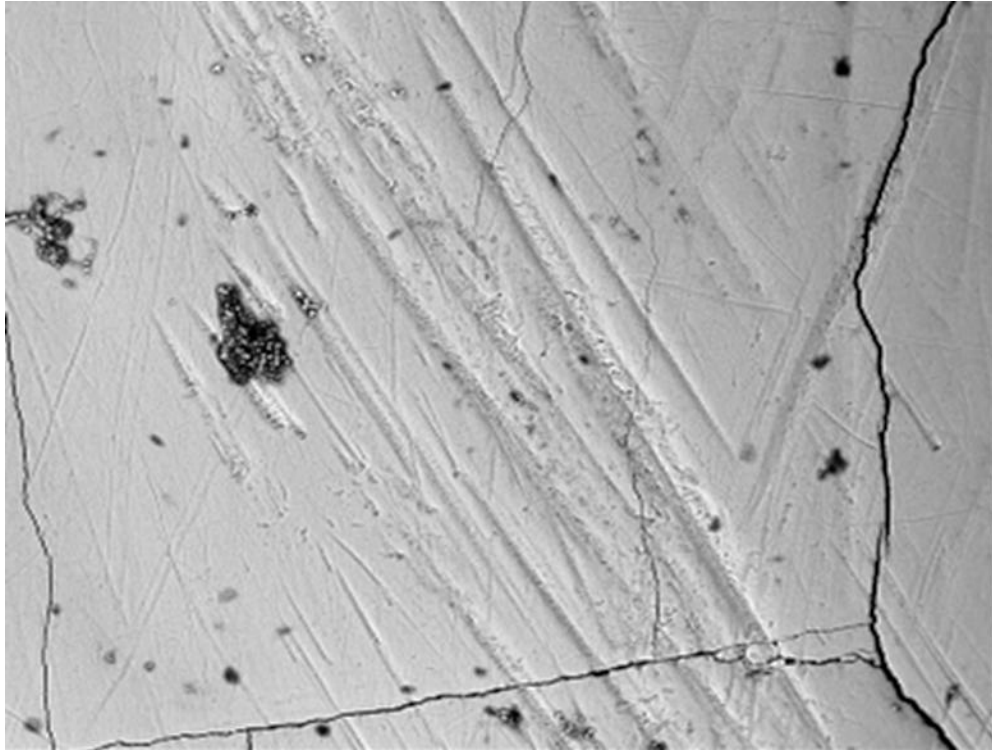


Figure 26. SEM microphotograph showing different types of microfeatures. Microphotograph taken on the labial side of the left first lower incisor of specimen MNCN-18385 (*Sus scrofa*). Upper image: original microphotograph. Lower image: the same microphotograph showing different types of microfeatures and some distinguishable morphological characteristics. Microphotograph taken at 200x.

As it had been already explained, some microfeatures in the facets present in the lingual side of the tooth originated from the contact of the lower incisors against the upper incisors. The result is normally the formation of parallel transverse or oblique scratches, which could be as long as the size of the facet. The orientation of these scratches reveals therefore, to what extent and in which direction the mandible moved when biting.

Condylar movement of the mandible varies between different taxa, depending on their diet, so that morphological and functional adaptations to eat can be inferred from the analysis of microfeatures in occlusive facets. It is also possible to infer which teeth are occluding, thus helping in the reconstruction of the facet/wear complex already explained in the introduction (section 1.5). Furthermore, the correct recognition of microfeatures produced by tooth-to-tooth contact is essential to understand the origin of the former and interpret the counting results appropriately. While inferences about mastication biomechanics have not been realized in this work, it is interesting to note the potential of this technique, as it is illustrated in Figure 26.

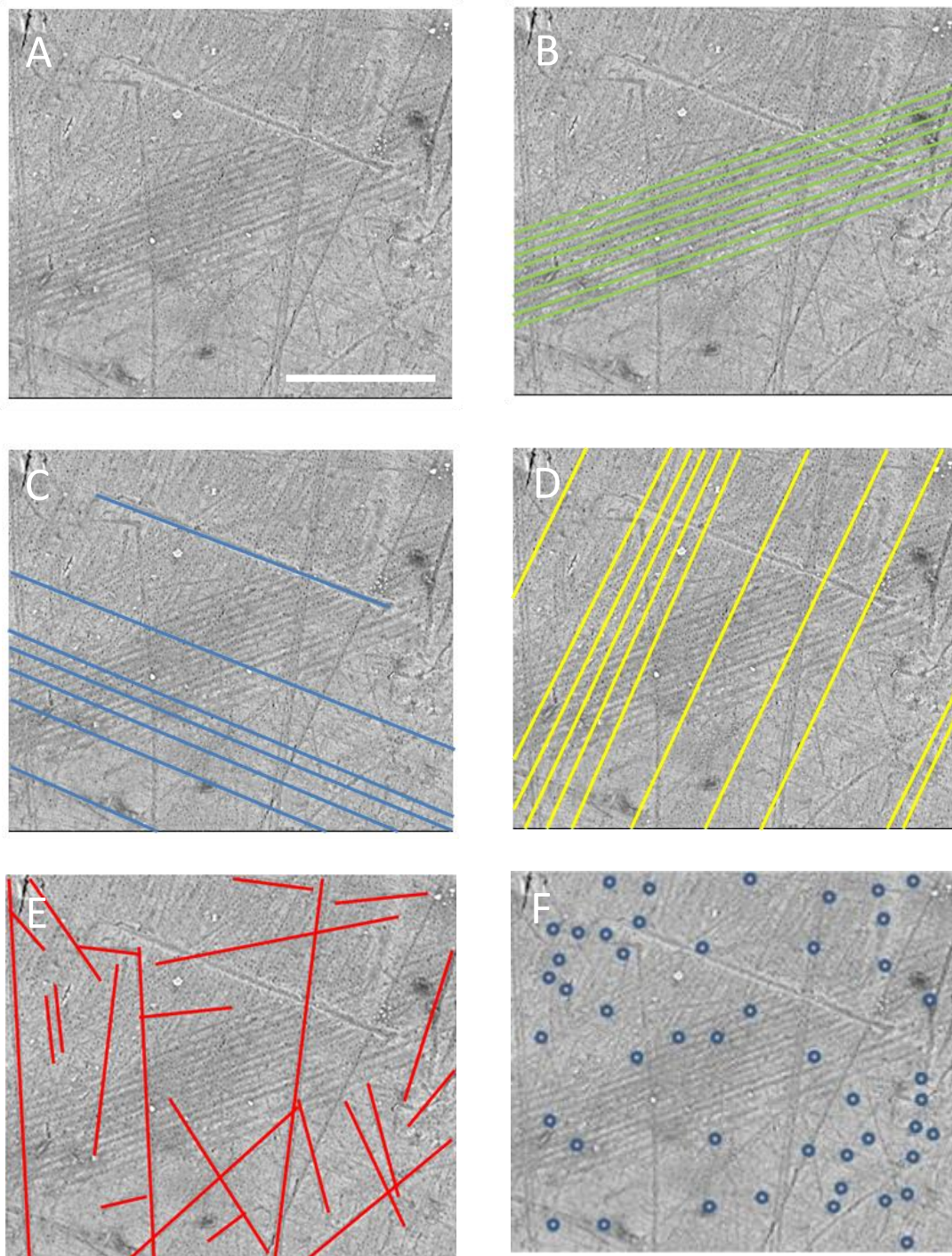


Figure 27. SEM image taken on the dentine in the lingual side of the left first lower incisor of MNCN-14236 (*Babryousa babyrussa*) showing microfeatures (pits and scratches) and different scratch orientation. Different scratch orientation patterns are illustrated in colors. A) Original image; B) Right oblique scratch orientation pattern. This was an isolated event in all the surface and its origin is difficult to know; C) Left oblique scratch orientation pattern produced by contact with the left first upper incisor; D) Logitudinal orientation pattern produced by contact with the left second upper incisor. E) Scratches with no recognizable orientation pattern, related to diet or grit; F) Pits. Upper part of the image is anterior and the right part is medial. Image was taken at 500x. Scale bar = 200 μm .

4.3. SEM: Quantitative analysis

A total of 196 microphotographs were taken under SEM on incisors belonging to 27 individuals representing the 6 species presented before in this work. The number of individuals per species, and the frequencies and percentages of microphotographs taken on each species are summarized in Table 10. More than 50% of the SEM images were taken on specimens belonging to *Sus scrofa* (n=101; 51.5%).

Frequencies and percentages concerning the location (tooth type, arcade, laterality, side and surface type) where microphotographs were taken, are summarized in Table x. Most of the microphotographs were taken on the enamel of the lingual side of left lower first incisors. All of the labial microphotographs were taken on enamel, because no dentine is visible on this side. Therefore, the 49 images taken on the dentine correspond to the lingual side of lower and upper incisors. Differences between the labial and lingual sides (side), first and second incisor (tooth type), enamel and dentine (surface type), occlusal and non-occlusal facets, and crest and valley, are tested below in this section (section 4.3.1). Differences between upper and lower incisors (position) were not tested due to the lack of specimens. For simplicity, lack of important differences between left and right incisors (laterality) was assumed.

Some of the results of tooth mapping in the lingual side of lower incisors for each species are illustrated in Figures 31-36. Though these figures are not referred again in the text, they are valuable diagrams to get a preliminary idea of the existing differences between regions in the tooth and between taxa.

Table 10. Summary of frequencies and percentages of microphotographs taken on each species, and number of individuals of each species analyzed under SEM.

SEM ANALYSIS			
Species (N=6)	Individuals (N=27)	Microphotographs (N=196)	
		Frequency	Percent
<i>Babyrousa babyrussa</i>	2	16	8,2
<i>Pecari tajacu</i>	4	17	8,7
<i>Phacochoerus africanus</i>	3	14	7,1
<i>Potamochoerus porcus</i>	3	33	16,8
<i>Sus scrofa</i>	12	101	51,5
<i>Tayassu pecari</i>	2	15	7,7

Table 11. Summary of the frequencies and percentages of the different variables concerning the location of microphotographs taken under SEM.

SEM MICROPHOTOGRAPHS (N=196)			
Location		Frequency	Percent
TOOTH TYPE	I1	125	63,8
	I2	71	36,2
POSITION	Lower	169	86,2
	Upper	27	13,8
LATERALITY	Left	162	82,7
	Right	34	17,3
SIDE	Lingual	145	74,0
	Labial	51	26,0
SURFACE TYPE	Enamel	147	75,0
	Dentine	49	25,0
FACET (N=145)	Occlusal	52	35,9
	Non-Occlusal	93	64,1
MORPHOLOGICAL REGION (N=48)	Crest	31	64,6
	Valley	17	36,4

The results of the Kolgomorov-Smirnoff and Shapiro-Wilkinson tests indicated that there is variability in the normality of the data, depending on the variable and the further subgrouping of the data (lingual versus labial; enamel vs dentine; occlusal vs non-occlusal; crest vs valley). Levene's test revealed that in some instances homogeneity of variances could not be assessed. In order to meet these assumptions, the data were transformed, either by square root, logarithm on the basis of ten, or sinarc. In a few instances, data still did not meet the assumptions of normality and homogeneity of variances, or the sample number was very low, so it was decided to carry out both parametric (one-way ANOVA) and non-parametric (Kruskal-Wallis) tests. These tests were performed using the supplementary data given in Appendix I. Even though the

number of images and individuals included in the study is comparable to that in other studies, increasing their number would assure more robust statistical comparisons.

4.3.1 Intra-tooth variability

4.3.1.1 Lingual vs. labial side

Microphotographs were taken either in the lingual side or the labial side of each tooth, in order to test for significant differences between species. However, differences between the two sides were expected a priori; firstly, because the morphology is drastically different. The labial side has a thick and homogeneous surface of enamel, which extends further down to the tip of the root in comparison to the lingual side. The lingual side, on the contrary, is constituted by less thick and heterogeneous surface, with different crests and valleys, and facets that are the consequence of tooth-to-tooth contact or are caused by the action of exogenous particles, during the mastication process. As wear continues, enamel is worn off, exposing the dentine.

Therefore, it is important to test for differences in the microwear signal between lingual and labial side, and interpret the sources of these variations.

Table 12. Microwear summary statistics and statistical tests for comparison between lingual and labial sides. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

[LINGUAL VS LABIAL] (N=196)						
SUMMARY STATISTICS					STATISTICAL TESTS	
Variables/ Ratios	Lingual (n=145)		Labial (n=51)		ANOVA	KRUSKAL -WALLIS
	Mean	Std. Deviation	Mean	Std. Deviation		
TMF	133,79	49,170	129,69	27,048	NO	NO
X_Lenght	154,11	51,625	192,57	33,940	YES*	YES*
X_Width	3,95	1,472	3,64	1,136	NO	NO
R_LtS.TS %	51,03	18,787	53,55	13,656	NO	NO
R_ObS.TS %	22,84	9,807	24,85	6,868	NO	YES
R_TrS.TS %	26,13	15,791	21,57	10,443	NO	NO
R_VSS.TS %	46,86	17,675	32,76	10,963	YES*	YES*
R_SS.TS %	24,95	8,028	27,84	6,351	YES	YES
R_LS.TS %	10,39	5,971	14,33	4,690	YES*	YES*
R_VLS.TS %	7,46	6,003	9,43	3,973	YES	YES*
R_HLS.TS %	10,34	10,827	15,64	8,186	YES*	YES*
R_Lt.HLS.TS %	7,92	10,144	11,79	6,915	YES	YES*
R_Lt.VLS.HLS.TS %	11,85	12,045	17,66	8,661	YES*	YES*
R_TP.TMF %	47,56	15,072	28,56	8,217	YES*	YES*
R_SP.TP %	53,85	17,012	52,24	16,447	NO	NO
R_WP.TP %	30,13	12,336	31,72	12,612	NO	NO
R_HWP.TP %	16,01	10,255	16,04	10,346	NO	NO
R_BS.NS	,29	,230	,25	,171	NO	NO
R_P.S	1,11	,757	,42	,168	YES*	YES*
R_WP.HWP.SP	1,08	,764	1,14	,790	NO	NO

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

Both parametric and non-parametric tests, regarding differences in the variables between lingual and labial side, reveal very similar results (Table 12). There are no

significant differences ($p < 0,05$) in the total number of microfeatures observed, striation width, the amount of transverse and oblique scratches, the ratio of wide and hyperwide pits against small pits, or the ratio of broad scratches against narrow scratches.

Other variables show significant differences ($p > 0,05$), with higher values in the labial side for striation average length ($X_{\text{Labial}} = 192,57$ vs $X_{\text{Lingual}} = 154,11$), proportion of short scratches ($X_{\text{Labial}} = 27,84$ vs $X_{\text{Lingual}} = 24,95$), proportion of long scratches ($X_{\text{Labial}} = 14,33$ vs $X_{\text{Lingual}} = 10,39$), proportion of very long scratches, ($X_{\text{Labial}} = 9,43$ vs $X_{\text{Lingual}} = 7,46$), proportion of hyperlong scratches ($X_{\text{Labial}} = 15,64$ vs $X_{\text{Lingual}} = 10,34$), proportion of longitudinal hyperlong scratches ($X_{\text{Labial}} = 11,79$ vs $X_{\text{Lingual}} = 7,92$), and the proportion of the combination of longitudinal very long and hyperlong scratches).

On the contrary, the lingual side shows higher significant mean values ($p < 0,05$) of very small scratches ($X_{\text{Lingual}} = 9,43$ vs $X_{\text{Labial}} = 7,46$), and proportion of pits ($X_{\text{Lingual}} = 47,56$ vs $X_{\text{Labial}} = 28,56$), which is also indicated by the ratio of pits against scratches ($X_{\text{Lingual}} = 1,11$ vs $X_{\text{Labial}} = 0,42$). Kruskal-Wallis Test reveal significant differences ($p < 0,05$) for oblique scratches ($X_{\text{Labial}} = 24,85$ vs $X_{\text{Lingual}} = 22,84$).

In summary, these results indicate that striation length presents higher mean values at the labial side, while the lingual side presents a higher percentage of pits. The results are congruent, because pits are formed by crushing or vertical movements of the jaw, occurring in the lingual side of the incisor. In the labial side, without the occurrence of mastication forces, longer scratches are predominant, which may be the result of the impact of the incisor with the soil, while feeding or digging. Orientation appears not to be a discriminant factor, but longitudinal very long and hyperlong scratches present higher frequencies in the labial side, which may be a signal of antero-posterior movements of the jaw while rooting.

However, as it has been mentioned before, the labial side does not present visible facets, while the lingual side presents both occlusal (tooth-to-tooth contact) and non-occlusal facets. The differentiation between these two facets is fundamental to understand the wear/facet complex.

4.3.1.2 Occlusal vs. Non-Occlusal Facet

Occlusal facets are those produced by tooth-to-tooth contact (or particles in-between) in the lingual side of the incisor, and originated by jaw movements against the maxilla. Non-occlusal facets may be formed by the action of items inside the mouth, with the collaboration of jaw movements, but not by the occlusion of lower against upper teeth. The microwear signal on non-occlusal facets may be related to other aspects different to mastication, like digging or rooting. This shall be the key to compare microwear data between taxa. Testing for differences between these two types of facets is compulsory to carry out further analysis.

Both parametric and non-parametric tests, regarding differences in variables between occlusal and non-occlusal facets, reveal that there are no significant differences ($p > 0,05$) in the proportion of short scratches, long scratches, small pits, wide pits, hyperwide pits, the ratio of broad scratches against narrow scratches and the ratio of the combination of wide pits and hyper wide pits against small pits (Table 13).

Other variables show significant differences ($p < 0,05$), with higher values in the non-occlusal facet for striation length average ($X_{\text{Non-Occlusal}} = 165,16$ vs $X_{\text{Occlusal}} = 134,35$), proportion of longitudinal scratches ($X_{\text{Non-Occlusal}} = 58,19$ vs $X_{\text{Occlusal}} = 38,21$), very long scratches ($X_{\text{Non-Occlusal}} = 8,55$ vs $X_{\text{Occlusal}} = 5,49$), hyperlong scratches ($X_{\text{Non-Occlusal}} = 12,14$ vs $X_{\text{Occlusal}} = 7,13$), longitudinal hyperlong scratches ($X_{\text{Non-Occlusal}} = 10,83$ vs $X_{\text{Occlusal}} = 2,71$), and the proportion of the combination of longitudinal very long and hyperlong scratches ($X_{\text{Non-Occlusal}} = 16,20$ vs $X_{\text{Occlusal}} = 4,08$).

On the contrary, the occlusal facet shows higher significant ($p < 0,05$) mean values of the proportion of striation width average ($X_{\text{Occlusal}} = 4,33$ vs $X_{\text{Non-Occlusal}} = 3,74$), oblique scratches ($X_{\text{Occlusal}} = 26,13$ vs $X_{\text{Non-Occlusal}} = 20,99$), transverse scratches ($X_{\text{Occlusal}} = 35,64$ vs $X_{\text{Non-Occlusal}} = 20,81$), and the percentage of pits ($X_{\text{Occlusal}} = 58,39$ vs $X_{\text{Non-Occlusal}} = 41,51$), which is also indicated by the ratio of pits against scratches ($X_{\text{Occlusal}} = 1,59$ vs $X_{\text{Non-Occlusal}} = 0,84$).

Table 13. **Microwear summary statistics and statistical tests for comparison between lingual occlusal and non-occlusal facets.** The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

[LINGUAL OCCLUSAL VS NON-OCCLUSAL FACET] (N=145)						
SUMMARY STATISTICS					STATISTICAL TESTS	
Variables/ Ratios	Occlusal (n=52)		Non-occlusal (n=93)		ANOVA	KRUSKAL-WALLIS
	Mean	Std. Deviation	Mean	Std. Deviation		
TMF	143,40	42,849	128,41	51,816	NO	YES*
X_Lenght	134,35	47,803	165,16	50,604	YES*	YES*
X_Width	4,33	1,527	3,74	1,405	YES	YES
R_Lt.S.TS %	38,21	14,945	58,19	16,850	YES*	YES*
R_Ob.S.TS %	26,13	10,204	20,99	9,124	YES*	YES*
R_Tr.S.TS %	35,64	16,049	20,81	12,956	YES*	YES*
R_VSS.TS %	52,43	16,248	43,74	17,758	YES*	YES*
R_SS.TS %	25,80	8,732	24,48	7,614	NO	NO
R_LS.TS %	9,15	5,211	11,08	6,277	NO	NO
R_VLS.TS %	5,49	5,223	8,55	6,154	YES*	YES*
R_HLS.TS %	7,13	12,030	12,14	9,704	YES*	YES*
R_Lt.HLS.TS %	2,71	6,017	10,83	10,822	YES*	YES*
R_Lt.VLS.HLS.TS %	4,08	4,533	16,20	12,748	YES*	YES*
R_TP.TMF %	58,39	10,852	41,51	13,678	YES*	YES*
R_SP.TP %	56,21	15,880	52,53	17,559	NO	NO
R_WP.TP %	28,39	11,559	31,11	12,707	NO	NO
R_HWP.TP %	15,40	9,490	16,36	10,693	NO	NO
R_BS.NS	,32	,239	,28	,225	NO	NO
R_P.S	1,59	,757	,84	,616	YES*	YES*
R_WP.HWP.SP	,96	,700	1,15	,793	NO	NO

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

While ANOVA's mean comparison for the total number of microfeatures is not significant ($p > 0,05$), ranked non-parametric Kruskal-Wallis Test supports a highly significant difference ($p < 0,01$). Mean values for TMF are higher in the occlusal facet ($X_{\text{Occlusal}} = 143,40$) than in the non-occlusal facet ($X_{\text{Non-Occlusal}} = 128,41$).

In general, occlusal facets present higher mean values of longitudinal and oblique scratches and the ratio of pits against scratches, confirming the crushing actions provoked by tooth-to-tooth movements. This type of *facet* also presents high mean values of very small scratches and striation width average, meaning that occlusal movements in suid incisors do not provoke the longer and narrower scratches seen in the non-occlusal facet. Whatever the style or rooting, it seems that the impact of tooth against tooth (and particles in between) provokes shorter and wider microfeatures than those provoked by digging.

4.3.1.3. Enamel vs Dentine

Both lingual occlusal and non-occlusal facets are characterized by the exposure of dentine after prolonged wear. Because dentine structure and composition differs from that of enamel, the microfeatures produced on these materials are likely to be different. Testing for differences in the quantity and category of microfeatures may be very important to discuss morphological teeth adaptations in different mammal lineages, which usually implies the folding and differential distribution of dentine and enamel, depending on diet.

Furthermore, because limitations of the fossil record, it is not always possible to select teeth for their wear stage. It is conceivable that specimens with an advanced wear stage, where only dentine is visible, have to be studied in one case, while in another case, little worn specimens have to be studied. Therefore, it is fundamental to understand the basic differences of microwear signal in the two surfaces.

Both parametric and non-parametric tests regarding differences in the variables between enamel and dentine reveal that there are no significant differences ($p > 0,05$) in the striation length average, the proportion of oblique scratches, very short scratches, large scratches, very large scratches, hyper large scratches, small pits, wide pits, hyperwide pits and the ratio of the combination of wide pits and hyper wide pits against small pits (Table 14).

Table 14. Microwear summary statistics and statistical tests for comparison between enamel and dentine surfaces. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

[ENAMEL VS DENTINE] (N=196)						
SUMMARY STATISTICS					STATISTICAL TESTS	
Variables/ Ratios	Enamel (n=147)		Dentine (n=49)		ANOVA	KRUSKAL-WALLIS
	Mean	Std. Deviation	Mean	Std. Deviation		
TMF	141,77	44,522	105,57	31,561	YES*	YES*
X_Lenght	164,39	50,543	163,29	50,859	NO	NO
X_Width	3,75	1,333	4,23	1,532	YES	NO
R_Lt.TS %	53,58	16,527	46,01	19,583	YES*	YES*
R_ObS.TS %	23,25	8,338	23,70	11,369	NO	NO
R_TrS.TS %	23,16	13,325	30,29	17,291	YES*	YES*
R_VSS.TS %	42,49	17,722	45,28	16,042	NO	NO
R_SS.TS %	26,75	7,177	22,58	8,481	YES*	YES*
R_LS.TS %	11,39	5,635	11,51	6,745	NO	NO
R_VLS.TS %	7,91	5,380	8,13	6,288	NO	NO
R_HLS.TS %	11,46	9,521	12,49	12,922	NO	NO
R_Lt.HLS.TS %	9,87	9,790	6,12	8,248	YES	YES
R_Lt.VLS.HLS.TS %	14,88	11,807	8,81	9,361	YES*	YES*
R_TP.TMF %	40,76	16,250	48,21	13,781	YES*	YES*
R_SP.TP %	52,61	15,895	55,91	19,372	NO	NO
R_WP.TP %	31,11	12,029	28,87	13,426	NO	NO
R_HWP.TP %	16,29	9,877	15,22	11,375	NO	NO
R_BS.NS	,26	,189	,34	,278	YES	NO
R_P.S	,87	,718	1,11	,718	YES	YES*
R_WP.HWP.SP	1,11	,731	1,06	,882	NO	NO

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

Other variables show significant differences ($p < 0,05$), with higher values in the dentine for striation width average ($X_{Dentine} = 4,23$ vs $X_{Enamel} = 3,75$), proportion of

transverse scratches ($X_{Dentine} = 30,29$ vs $X_{Enamel} = 23,16$), ratio of broad scratches against narrow scratches ($X_{Dentine} = 0,34$ vs $X_{Enamel} = 0,26$), and the proportion of pits ($X_{Enamel} = 48,21$ vs $X_{Dentine} = 40,76$), which is also indicated by the ratio of pits against scratches ($X_{Dentine} = 1,11$ vs $X_{Enamel} = 0,87$).

On the contrary, the enamel shows higher significant ($p < 0,05$) mean values of the proportion of longitudinal scratches ($X_{Enamel} = 53,58$ vs $X_{Dentine} = 46,01$), short scratches ($X_{Enamel} = 26,75$ vs $X_{Dentine} = 22,58$), longitudinal hyperlong scratches ($X_{Enamel} = 9,87$ vs $X_{Dentine} = 6,12$), the combination of longitudinal very long and hyperlong scratches ($X_{Enamel} = 14,88$ vs $X_{Dentine} = 8,81$).

The Kruskal-Wallis Test does not support ($p > 0,05$) a significant variation between enamel and dentine for the striation width average and the ratio of broad scratches against narrow scratches.

Some of the significant differences between enamel and dentine are related with the occlusal and non-occlusal facets, in the sense that it is in the the occlusal facet were dentine is more visible in all but the last wear stage (wear stage 4; see Table 3 in Section 3.2.2). This may explain in part, the high mean values of pits, transverse scratches, and striation width average. The most important difference however, is that concerning the total amount of microfeatures, which is higher in the enamel. Even though the classic view is to consider the dentine a softer tissue and therefore, more prone to microwear imprint, it seems that enamel retrains more microfeatures.

4.3.1.4 Morphological region: crest vs valley

Before the enamel is worn off on the lingual side, crest-and-valley incisor morphology is very clear. However, due to morphological differences between crests and valleys (depending on the direction of movement, crests are more exposed while valleys are more protected), it is possible that the microwear signal is also different between these two regions.

The differentiation of morphological regions (crests and valleys) is only possible on the lingual side of the tooth, and in those teeth which have a general morphology with a typical crest-and-valley pattern, and with a wear stage that is sufficiently low (incisor wear stage 1 and 2; see Table 3 in section 3.3.2). Therefore, those microphotographs taken on specimens which did not meet these requirements were

excluded from the statistical tests. This involves mainly specimens belonging to *Potamochoerus porcus* and *Sus scrofa*.

Table 15. Microwear summary statistics and statistical tests for comparison between crest and valleys. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

[CREST VS VALLEY] (N=48)						
SUMMARY STATISTICS					STATISTICAL TESTS	
Variables/ Ratios	Crest (n=31)		Valley (n=17)		ANOVA	KRUSKAL-WALLIS
	Mean	Std. Deviation	Mean	Std. Deviation		
TMF	144,48	40,995	129,47	23,593	NO	NO
X_Lenght	150,73	46,517	196,47	27,784	YES*	YES*
X_Width	3,91	1,322	3,36	1,245	NO	NO
R_Lt.S.TS %	57,88	12,644	72,46	12,441	YES*	YES*
R_ObS.TS %	22,84	6,763	14,97	6,080	YES*	YES*
R_TrS.TS %	19,28	11,457	12,57	8,126	YES	YES
R_VSS.TS %	46,68	16,840	36,76	8,755	YES	NO
R_SS.TS %	26,02	7,005	22,36	5,576	NO	NO
R_LS.TS %	11,25	5,518	10,01	4,527	NO	NO
R_VLS.TS %	6,70	4,882	11,12	6,222	YES*	YES
R_HLS.TS %	9,35	8,496	19,75	8,619	YES*	YES*
R_Lt.HLS.TS %	8,27	8,299	22,73	11,818	YES*	YES*
R_Lt.VLS.HLS.TS %	13,83	10,978	28,09	11,242	YES*	YES*
R_TP.TMF %	44,75	15,401	35,24	11,301	YES	YES
R_SP.TP %	50,89	13,771	53,33	15,804	NO	NO
R_WP.TP %	30,80	11,843	32,06	12,409	NO	NO
R_HWP.TP %	18,31	9,011	14,61	11,829	NO	NO
R_BS.NS	,31	,188	,23	,240	NO	YES
R_P.S	1,00	,775	,60	,336	YES	YES
R_WP.HWP.SP	1,15	,754	1,04	,625	NO	NO

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

Both parametric and non-parametric tests, regarding differences in variables between crests and valleys, reveal that there are no significant differences ($p > 0,05$) in the total number of microfeatures counted, the striation width average, the proportion of short scratches, long scratches, small pits, wide pits, hyperwide pits, and the ratio of the combination of wide pits and hyperwide pits against small pits (Table 15).

Other variables show significant differences ($p < 0,05$), with higher values in valleys for striation length average ($X_{\text{Valley}} = 196,47$ vs $X_{\text{Crest}} = 150,73$), proportion of longitudinal scratches ($X_{\text{Valley}} = 72,46$ vs $X_{\text{Crest}} = 57,88$), very long scratches ($X_{\text{Valley}} = 11,12$ vs $X_{\text{Crest}} = 6,70$), hyperlong scratches ($X_{\text{Valley}} = 19,75$ vs $X_{\text{Crest}} = 9,35$), longitudinal hyperlong scratches ($X_{\text{Valley}} = 22,73$ vs $X_{\text{Crest}} = 8,27$), and the proportion of the combination of longitudinal very long and hyperlong scratches ($X_{\text{Valley}} = 28,09$ vs $X_{\text{Crest}} = 13,83$).

On the contrary, the occlusal facet shows higher significant ($p < 0,05$) mean values of the proportion of oblique scratches ($X_{\text{Crest}} = 22,84$ vs $X_{\text{Valley}} = 14,97$), transverse scratches ($X_{\text{Crest}} = 19,28$ vs $X_{\text{Valley}} = 12,57$), and the percentage of pits ($X_{\text{Crest}} = 44,75$ vs $X_{\text{Valley}} = 35,24$), which is also indicated by the ratio of pits against scratches ($X_{\text{Crest}} = 1,00$ vs $X_{\text{Valley}} = 0,60$).

While ANOVA's mean comparison for the proportion of very short scratches is significant ($p < 0,05$), with higher mean values in crests ($X_{\text{Crest}} = 46,68$) than valleys ($X_{\text{Valley}} = 36,76$), this is not supported by the Kruskal-Wallis test. On the other hand, non-parametric test supports a significant difference ($p < 0,05$) between the ranks of the ratio of broad scratches against narrow scratches, while ANOVA's result is not significant ($p > 0,05$). Mean value for this ratio is just slightly higher in the crests ($X_{\text{Crest}} = 0,31$) than valleys ($X_{\text{Valley}} = 0,23$).

Higher mean values of transverse scratches and pits in crests may be a consequence of the greater exposure of these areas to lateral and occlusal movements of the jaw. On the contrary, higher mean values of longer and longitudinal scratches in valleys may be a consequence of antero-posterior movements while rooting or exogenous particles following a longitudinal direction through the valleys.

4.3.2. Inter-tooth variability

Table 16. Microwear summary statistics and statistical tests for comparison between lingual non-occlusal facets of first and second lower incisors. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

[LINGUAL NON-OCCLUSAL FACET (I1 VS I2)] (N=90)						
SUMMARY STATISTICS					STATISTICAL TESTS	
Variables/ Ratios	I1 (n=61)		I2 (n=29)		ANOVA	KRUSKAL-WALLIS
	Mean	Std. Deviation	Mean	Std. Deviation		
TMF	121,74	45,050	142,90	62,168	NO	NO
X_Lenght	162,59	51,894	171,73	49,075	NO	NO
X_Width	3,90	1,494	3,29	1,141	NO	NO
R_LtS.TS %	60,38	17,307	55,33	15,399	NO	NO
R_ObS.TS %	20,65	9,637	20,77	7,151	NO	NO
R_TrS.TS %	18,97	13,076	23,90	12,288	NO	NO
R_VSS.TS %	44,33	18,686	41,94	16,672	NO	NO
R_SS.TS %	24,26	7,668	24,69	7,223	NO	NO
R_LS.TS %	11,31	6,180	11,13	6,570	NO	NO
R_VLS.TS %	9,31	6,754	7,32	4,671	NO	NO
R_HLS.TS %	10,79	9,411	14,92	9,516	NO	NO
R_Lt.HLS.TS %	9,85	11,086	13,60	10,148	NO	NO
R_Lt.VLS.HLS.TS %	15,25	12,974	19,02	12,281	NO	NO
R_TP.TMF %	42,93	12,387	36,70	13,804	YES	YES*
R_SP.TP %	52,69	17,282	52,46	18,792	NO	NO
R_WP.TP %	31,09	12,736	30,76	12,728	NO	NO
R_HWP.TP %	16,22	10,997	16,78	10,765	NO	NO
R_BS.NS	,31	,253	,19	,128	YES	YES
R_P.S	,85	,501	,69	,560	NO	YES*
R_WP.HWP.SP	1,12	,738	1,20	,918	NO	NO

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

The last step before the global analysis between taxa was to compare between lower first and second incisors. If both teeth give a similar microwear signal, both lower first and second lower in the fossil record can be compared with this reference data. Statistical tests were carried out on the lingual non-occlusal facet and the labial side of the teeth, because this is the potential area to compare between different taxa.

Both parametric and non-parametric tests, regarding differences in variables in the lingual non-occlusal facet between first and second lower incisors, reveal that there are no significant differences ($p > 0,05$) for almost all the variables studied (Table 16).

Only the proportion of pits ($X_{I1} = 42,93$ vs $X_{I2} = 36,70$), and the ratio of broad scratches against narrow scratches ($X_{I1} = 0,31$ vs $X_{I2} = 0,19$), show higher mean values in the first lower incisor, and significant differences ($p < 0,05$). The differences between the ratio of pits against scratches ($p < 0,01$) are highly significant according to the Kruskal-Wallis test, but this difference is rejected by the parametric test. ($p > 0,05$).

More differences could have been expected due to different wear stages between first and second incisor (due to different eruption times). The fact that there are almost no statistical differences in the lingual non-occlusal facet, allows intra- and inter-species comparison using both incisors as a unique group.

Table 17. Microwear summary statistics and statistical tests for comparison between labial sides of first and second lower incisors. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

[LABIAL SIDE (I1 VS I2)] (N=51)						
SUMMARY STATISTICS					STATISTICAL TESTS	
Variables/ Ratios	I1 (n=61)		I2 (n=29)		ANOVA	KRUSKAL-WALLIS
	Mean	Std. Deviation	Mean	Std. Deviation		
TMF	129,25	27,426	130,22	27,186	NO	NO
X_Lenght	197,66	27,075	186,37	40,561	NO	NO
X_Width	4,09	1,178	3,09	,809	YES*	YES*
R_LtS.TS %	58,68	12,195	47,30	12,924	YES*	YES*
R_Obs.TS %	23,03	6,557	27,07	6,712	YES	YES
R_TrS.TS %	18,23	9,365	25,63	10,429	YES	YES
R_VSS.TS %	31,70	7,908	34,05	13,902	NO	NO
R_SS.TS %	27,11	6,724	28,73	5,887	NO	NO
R_LS.TS %	14,68	4,385	13,91	5,103	NO	NO
R_VLS.TS %	9,86	4,180	8,90	3,729	NO	NO
R_HLS.TS %	16,65	7,561	14,41	8,904	NO	NO
R_Lt.HLS.TS %	13,41	6,331	9,83	7,221	NO	NO
R_Lt.VLS.HLS.TS %	20,42	8,232	14,30	8,113	YES	YES
R_TP.TMF %	29,84	8,402	27,00	7,885	NO	NO
R_SP.TP %	52,27	18,002	52,19	14,734	NO	NO
R_WP.TP %	30,06	12,609	33,74	12,594	NO	NO
R_HWP.TP %	17,66	11,695	14,06	8,245	NO	NO
R_BS.NS	,30	,191	,18	,114	YES*	YES*
R_P.S	,45	,175	,38	,157	NO	NO
R_WP.HWP.SP	1,20	,916	1,08	,618	NO	NO

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

Both parametric and non-parametric tests on the labial side show the same results (Table 17). First lower incisor show higher mean values of striation width average ($X_{I1} = 4,09$ vs $X_{I2} = 3,09$), proportion of longitudinal scratches ($X_{I1} = 58,68$ vs $X_{I2} = 47,30$), and ratio of broad scratches against narrow scratches ($X_{I1} = 0,30$ vs $X_{I2} = 0,18$). Differences in these three variables were highly significant ($p < 0,01$). The combination of longitudinal very large and hyperlarge scratches also present higher values in the first lower incisor ($X_{I1} = 20,42$ vs $X_{I2} = 14,30$). This difference was significant for $p < 0,05$.

Second lower incisor show higher mean values of the proportion of oblique scratches ($X_{I2} = 0,30$ vs $X_{I1} = 0,18$) and transverse scratches ($X_{I2} = 25,63$ vs $X_{I1} = 18,23$), where differences were also significant ($p < 0,05$).

The rest of the variables present no significant differences ($p > 0,05$). Due to the existing differences between some variables, the grouping of first and second lower incisors to make further intra- and inter-taxa comparisons in the labial side can add some noise to the results, which should be considered when interpreting the results.

4.3.3. Inter-taxa comparison

Statistical comparison was carried out following the same procedures as in the precedent sections, but the ANOVA was accompanied by a Tukey's HSD test, to make multiple comparisons between species.

All of the transformed data were normal in the lingual non-occlusal facet, while some few variables still were not normally distributed or had significant different variances (see Appendage I for supplementary data). Still, results obtained by both parametric and non-parametric tests are very similar for both lingual non-occlusal facet and labial side (Tables 18 and 19).

Table 18. Microwear summary statistics and statistical tests for comparison between taxa in the labial side of first and second lower incisors. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

(Continued next page)

[INTER-TAXA COMPARISON (LABIAL SIDE)] (N=51)														
SUMMARY STATISTICS													STATISTICAL TESTS	
VARIABLES /RATIOS	<i>B.babyrussa</i> (n=4)		<i>P.tajacu</i> (n=10)		<i>P.africanus</i> (n=3)		<i>P.porcus</i> (n=4)		<i>S. scrofa</i> (n=28)		<i>T.pecari</i> (n=2)		ANOVA	KRUSKAL -WALLIS
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.		
TMF	128,75	11,026	98,00	27,721	163,00	14,526	110,25	28,826	138,36	15,912	157,50	31,820	YES*	YES*
X_Lenght	184,73	15,721	205,22	40,986	170,13	25,241	198,37	17,000	197,44	25,306	98,89	24,423	YES*	NO
X_Width	3,81	,666	4,09	1,403	2,02	,493	4,93	1,509	3,58	,744	1,85	,134	YES*	YES*
R_Lt.S.TS	52,12	4,966	53,42	16,931	30,65	2,942	68,85	12,326	54,69	11,310	44,77	5,805	YES*	YES
R_ObS.TS	28,06	4,732	22,68	6,802	26,33	1,574	16,40	6,365	26,10	6,833	26,46	7,651	NO	NO
R_TrS.TS	19,83	5,171	23,90	12,914	43,02	4,450	14,75	10,125	19,15	7,744	28,78	1,846	YES*	YES
R_VSS.TS	33,30	2,793	30,07	11,197	37,52	14,922	38,46	5,806	30,04	7,461	64,72	16,928	YES*	NO
R_SS.TS	31,72	8,627	26,47	6,004	30,40	9,492	21,05	2,660	28,52	5,459	27,16	12,876	NO	NO
R_LS.TS	14,06	3,107	13,12	4,392	14,53	2,309	10,51	2,533	16,01	4,417	4,80	2,531	YES*	YES
R_VLS.TS	7,07	3,771	12,21	4,848	6,43	1,595	6,62	1,973	9,97	3,118	2,78	,735	YES*	YES
R_HLS.TS	13,86	3,059	18,12	8,700	11,13	5,693	23,36	5,270	15,47	7,847	,55	,778	YES*	YES
R_Lt.HLS.TS	9,95	3,275	14,63	5,767	2,23	1,896	22,07	4,677	11,45	5,820	,00	,000	YES*	YES*
R_Lt.VLS.HLS.TS	15,10	4,425	22,81	8,910	3,02	2,216	26,97	5,298	17,56	6,388	1,85	,495	YES*	YES*
R_TP.TMF	34,30	8,222	33,31	7,081	24,06	10,002	31,32	7,997	26,08	7,903	29,35	4,582	NO	NO
R_SP.TP	38,34	10,509	43,40	13,483	60,64	9,997	45,11	15,321	56,62	16,833	64,51	14,086	NO	YES
R_WP.TP	31,46	10,647	37,19	13,240	25,72	11,874	30,30	11,106	31,42	13,141	21,08	8,754	NO	NO
R_HWP.TP	30,20	15,812	19,41	10,626	13,64	6,134	24,59	12,785	11,97	6,929	14,41	5,332	YES	YES
R_BS.NS	,33	,145	,29	,164	,04	,015	,48	,348	,22	,103	,03	,035	YES*	YES
R_P.S	,54	,185	,51	,150	,33	,191	,47	,174	,37	,159	,42	,092	NO	NO
R_WP.HWP.SP	1,79	,879	1,49	,673	,68	,291	1,48	1,048	,97	,766	,59	,346	NO	YES

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

4.3.3.1 Labial side

The labial side of lower incisors shows no significant differences between the species ($p > 0,05$) in the proportion of oblique scratches, the percentage of pits (accordingly, the ratio pits/scratches), or the proportion of wide pits (Table 18).

Significant differences ($p < 0,05$ or $p < 0,01$; see Table x) were found in the total number of microfeatures, where *P.africanus* shows the highest mean value ($X_{P.africanus} = 163,00$), in contrast to *P.tajacu* ($X_{P.tajacu} = 98,00$); striation width average, where *P.porcus* shows the highest mean value ($X_{P.porcus} = 4,93$) and *T.pecari* the lowest ($X_{T.pecari} = 1,85$); or the proportion of longitudinal scratches, where *P.porcus* shows the highest mean value ($X_{P.porcus} = 68,85$) and *P.africanus* the lowest ($X_{P.africanus} = 30,65$). In the case of transverse scratches, *P.africanus* is the species showing the highest mean values ($X_{P.africanus} = 43,02$), while *P.porcus* shows the lowest ($X_{P.porcus} = 14,75$). Tukey's HSD Test supported highly significant differences between the two African species, and this difference should be considered a good discriminator between their rooting styles.

Concerning the proportion of large, very large and hyper large scratches, as well as the proportion of longitudinal hyper long scratches and the combination of longitudinal very large and hyper large scratches, *P.porcus*, *P.tajacu* and *S.scrofa* show high mean values along all the variables, while *T.pecari* has clearly the lowest (see Table x). The proportion of hyper wide pits also shows significant differences ($p < 0,05$), *B.babyrussa* showing the highest mean value ($X_{B.babyrussa} = 30,20$); while the mean values of the ratio of broad scratches against narrow scratches is high in *P.porcus* ($X_{P.porcus} = 1,48$), and low in *P.africanus* ($X_{P.africanus} = 0,04$) and *T.pecari* ($X_{T.pecari} = 0,03$).

Orientation may be very important to distinguish between different rooting styles from microwear patterns observed in suoid incisors. The transverse scratches exhibited by *P.africanus* in the labial side are possibly reflecting the lateral movements of the skull and jaw while rooting on hard soils. Both soil hardness and jaw lateral movements may explain the great number of microfeatures displayed in this side of the tooth. On the other hand, longitudinal scratches in *P.tajacu*, *P.porcus* and *S.scrofa* may be an indication of forces acting along the anterior-posterior axis, while digging or rooting (pushing or pulling in an orthogonal direction).

If this is the case, the great mean values for the total number of microfeatures and transverse scratches, and the lower values of longitudinal scratches, shown by *T. pecari*, are unexpected ($X_{T.pecari} = 157,50$ for TMF and $X_{T.pecari} = 28,78\%$ for TrS and $X_{T.pecari} = 44,77\%$ for LtS). The explanation to this may come from the mean value of the proportion of very small scratches, higher in *T. pecari* than in *P. africanus* ($X_{T.pecari} = 64,72\%$ and $X_{P.africanus} = 30,40\%$).

On the contrary, while ANOVA rejects the null hypothesis ($p > 0,05$) for the proportion of small pits and the ratio of wide and hyper wide pits against small pits, ranked non-parametric test found differences between taxa ($p < 0,05$). In this case, *T. pecari* shows the highest mean value for the proportion of small pits ($X_{T.pecari} = 64,51$) and accordingly, the lowest mean value for the ratio of wide and hyperwide pits against small pits ($X_{T.pecari} = 0,59$).

4.3.3.2 Lingual side

Comparisons between taxa in the lingual non-occlusal facet were significant ($p > 0,05$) for all the variables (Table 19), except for the proportion of wide pits ($p < 0,05$). Most of the differences were highly significant ($p < 0,01$). *T. pecari* show the highest frequencies of total microfeatures ($X_{T.pecari} = 186,00$), and the majority of these microfeatures are pits ($X_{T.pecari} = 57,36\%$ for the proportion of pits; $X_{T.pecari} = 1,50$ for the ratio pits/scratches). Accordingly, *T. pecari* presents the lowest mean values for striation length average and striation width average, in comparison to the high mean values of *Sus scrofa*, and *P. porcus* and *B. babyrussa* respectively. ($X_{T.pecari} = 81,08$ vs $X_{S.scrofa} = 202,63$ for striation length average; $X_{T.pecari} = 2,84$ vs $X_{P.porcus} = 4,42$ and $X_{B.babyrussa} = 4,32$ for striation width average).

Table 19. Microwear summary statistics and statistical tests for comparison between taxa in the lingual non-occlusal facet of first and second lower incisors. The first sets of ratios until the grey band are expressed as a percentage. See supplementary data in Appendix I for specific statistical test information.

(Continued next page)

[INTER-TAXA COMPARISON (LINGUAL NON-OCCLUSAL FACET)] (N=90)

SUMMARY STATISTICS													STATISTICAL TESTS	
VARIABLES /RATIOS	<i>B.babyrussa</i> (n=5)		<i>P.tajacu</i> (n=7)		<i>P.africanus</i> (n=9)		<i>P.porcus</i> (n=17)		<i>S. scrofa</i> (n=39)		<i>T.pecari</i> (n=13)		ANOVA	KRUSKAL -WALLIS
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.		
TMF	89,40	20,007	103,71	16,368	97,33	45,459	136,59	54,147	122,59	28,380	186,00	79,260	YES*	YES*
X_Lenght	170,84	36,493	176,70	11,306	163,35	32,184	140,04	42,201	202,63	25,385	81,08	20,009	YES*	YES*
X_Width	4,32	1,546	3,98	1,447	3,43	2,157	4,42	1,615	3,62	1,032	2,84	1,103	YES	YES
R_Lt.S.TS	39,83	8,729	65,51	10,974	31,61	5,367	66,98	10,433	67,06	13,031	45,50	8,149	YES*	YES*
R_Obs.TS	28,92	9,567	16,41	5,712	29,19	9,851	20,78	8,920	16,76	6,750	25,64	7,205	YES*	YES*
R_TrS.TS	31,25	14,590	18,08	7,095	39,21	9,662	12,24	7,121	16,19	11,102	28,86	9,169	YES*	YES*
R_VSS.TS	45,49	7,674	36,67	4,300	39,35	11,497	49,87	17,149	32,55	9,201	74,23	10,712	YES*	YES*
R_SS.TS	16,18	7,596	29,14	7,177	29,03	6,210	26,12	7,194	24,02	6,217	20,66	8,761	YES*	YES*
R_LS.TS	13,45	7,364	10,45	3,228	14,82	5,549	10,28	5,389	13,04	5,986	4,26	4,369	YES*	YES*
R_VLS.TS	13,37	9,192	9,97	4,253	10,46	4,894	6,61	4,646	11,01	5,481	,59	1,159	YES*	YES*
R_HLS.TS	11,51	7,468	13,77	5,026	6,34	5,493	7,12	6,974	19,38	7,529	,25	,636	YES*	YES*
R_Lt.HLS.TS	1,82	2,131	13,77	5,026	1,33	1,812	6,80	7,080	19,49	9,697	,15	,555	YES*	YES*
R_Lt.VLS.HLS.TS	5,56	2,712	21,03	5,743	4,25	3,929	13,09	8,978	26,61	9,422	,63	1,664	YES*	YES*
R_TP.TMF	53,22	15,119	36,53	8,845	36,63	11,897	47,56	9,306	32,76	7,501	57,36	10,600	YES*	YES*
R_SP.TP	61,44	17,361	33,26	5,281	65,99	26,451	56,66	10,680	49,22	15,976	55,32	17,954	YES*	YES*
R_WP.TP	27,42	9,753	41,46	11,682	25,68	20,630	27,47	7,419	32,89	12,728	29,27	9,814	NO	NO
R_HWP.TP	11,14	11,263	25,28	10,993	8,33	8,053	15,87	9,660	17,90	10,933	15,42	10,564	YES	YES
R_BS.NS	,37	,261	,28	,258	,25	,334	,42	,274	,24	,169	,16	,095	YES	YES
R_P.S	1,34	,791	,60	,232	,63	,332	,97	,357	,51	,176	1,50	,666	YES*	YES*
R_WP.HWP.SP	,74	,532	2,07	,494	,88	1,076	,85	,482	1,26	,788	1,04	,795	YES*	YES*

- NO or red color: $p > 0,05$ - YES or green color: $p < 0,05$ - * $p < 0,01$

Scratch orientation, as in the labial side, seems to be an important factor to differentiate between species. *P. africanus* mostly, but also *B. babyrussa* and *T. pecari* present higher proportions of transverse and oblique scratches ($X_{P.africanus} = 39,21\%$ and $29,19\%$; $X_{B.babyrussa} = 31,25\%$ and $28,92\%$; $X_{T.pecari} = 28,86\%$ and $25,64\%$; for transverse and oblique scratches respectively) than *S.scrofa*, *P.porcus* and *P.tajacu* ($X_{S.scrofa} = 67,06\%$; $X_{P.porcus} = 66,98\%$; $X_{P.tajacu} = 65,51\%$). The mean values for the proportion of longitudinal scratches and transverse scratches are correlated, because both are calculated in function of the total number of scratches ($R^2 = 0,742$; see Figure 27).

Again, similar to the labial side, *P. africanus* may be distinguished from *T. pecari* when considering the length of the striations. Values of very small scratches are considerably higher in *T. pecari* ($X_{T.pecari} = 74,23\%$ vs $X_{P.africanus} = 39,35\%$). Furthermore, *T. pecari*, as well as *B. babyrussa*, show higher proportions of pits, in comparison to *P. africanus* ($X_{T.pecari} = 57,36\%$ and $X_{B.babyrussa} = 53,22\%$ vs $X_{P.africanus} = 36,63\%$), suggesting different use of incisors.

Finally, if *P. tajacu* is considered among the rooters with orthogonal movements, it shows an unexpected high mean value of the ratio of wide and hyperwide pits against the total of pits, in comparison to *S.scrofa* and especially *P.porcus* ($X_{P.tajacu} = 2,07$; $X_{S.scrofa} = 1,26$; $X_{P.porcus} = 0,85$).

At this point, it is possible to distinguish three microwear patterns (which are more-or-less reflected in both lingual and labial sides), that are related to three different rooting styles. Firstly, the rooting style of *P.africanus*, characterized by a high proportion of transverse scratches and a low proportion of pits. Secondly, the rooting style of *P. tajacu*, *P. porcus* and *S. scrofa*, marked by a high proportion of longitudinal very long and hyperlong scratches (>300 micras). And finally, the rooting style of *T. pecari*, which exhibits high frequencies of transverse scratches, very small scratches and proportion of pits. *B. babyrussa* shows results different to interpret, may be due to the fact that all samples were taken from zoos, and that incisor characteristics are very different to those of their counterparts. It is important to remark that scratch orientation clearly reflects differences in incisor use between the two African species studied, *Potamochoerus* with a longitudinal signal and *Phacochoerus* with a transverse one (see Figures 28-30).

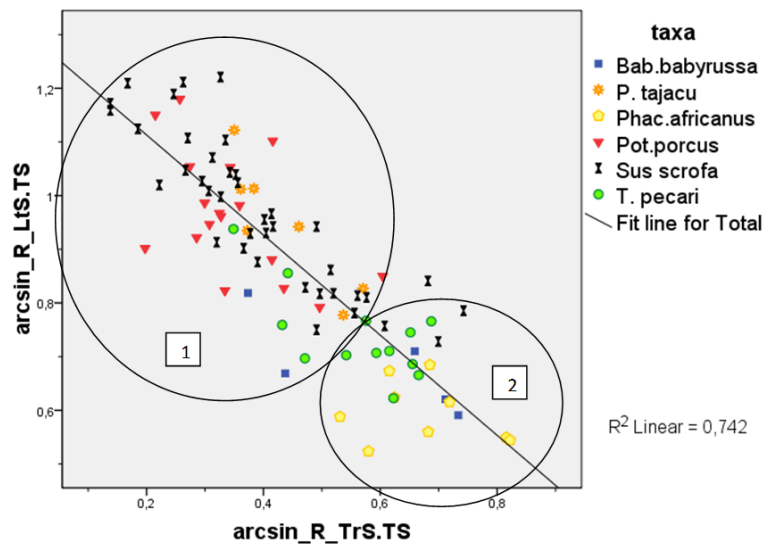


Figure 28. Bivariant graph showing transformed data and linear relationship between the ratios of longitudinal scratches, and transverse scratches in the lingual non-occlusal facet of first and second lower suoid incisors. Group 1: rooting style characterized by high proportion of longitudinal scratches, including the African species *Potamochoerus porcus*; Group 2: rooting style characterized by high proportion of transverse scratches, including the African species *Phacocheorus afrianus*.

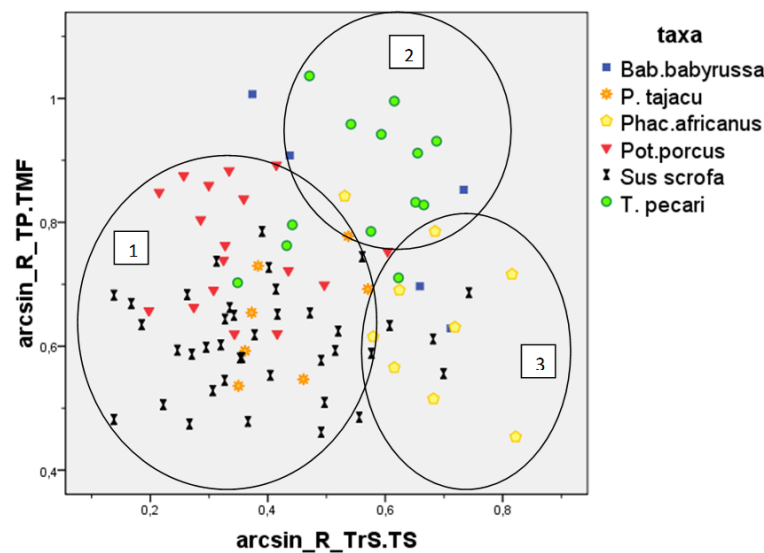


Figure 29. Bivariant graph showing transformed data between the proportion of pits, and transverse scratches in the lingual non-occlusal facet of first and second lower suoid incisors. Group 1: rooting style characterized by low proportion of transverse scratches and pits; Group 2: rooting style characterized by high proportion of transverse scratches and high proportion of pits. Group 3: rooting style characterized by high proportion of transverse scratches and low proportion of pits.

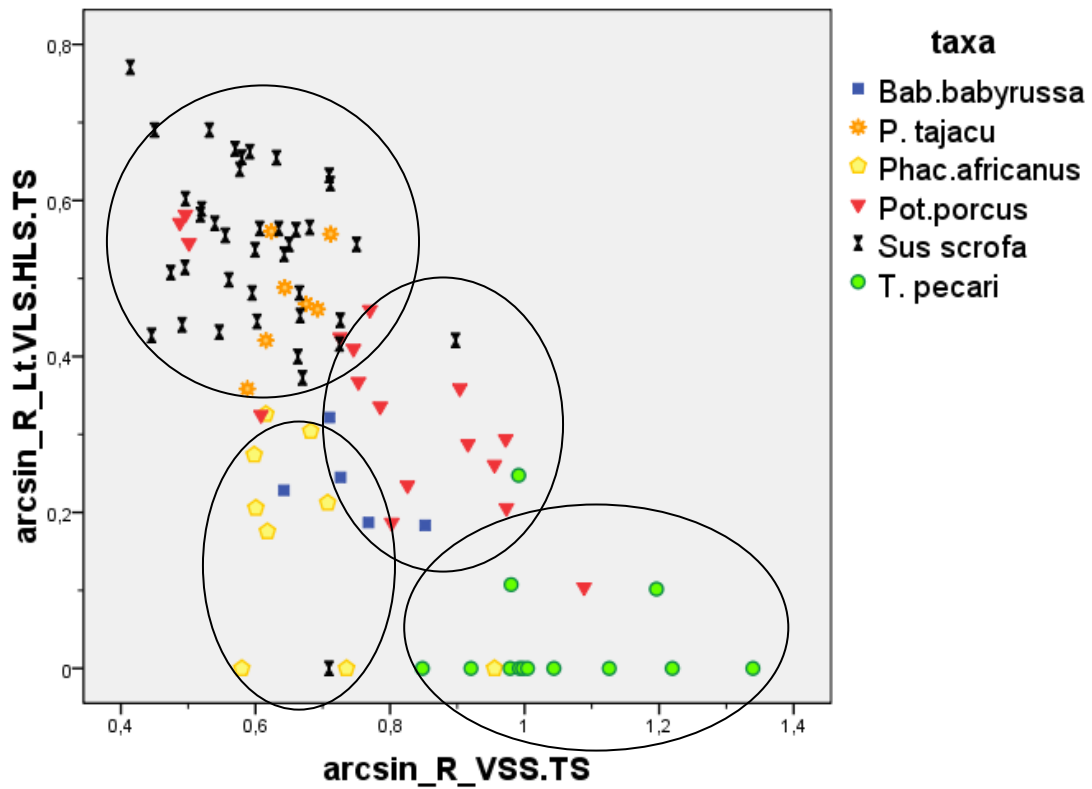


Figure 30. Bivariant graph showing transformed data between the ratios of longitudinal (very long + hyper long) scratches, and very small scratches in the lingual non-occlusal facet of first and second lower suoid incisors. The group formed by S.scrofa and P.tajacu seems different to T.pecari and the other groups. P.porcus and P.africanus, the African suids seem to form different clusters.

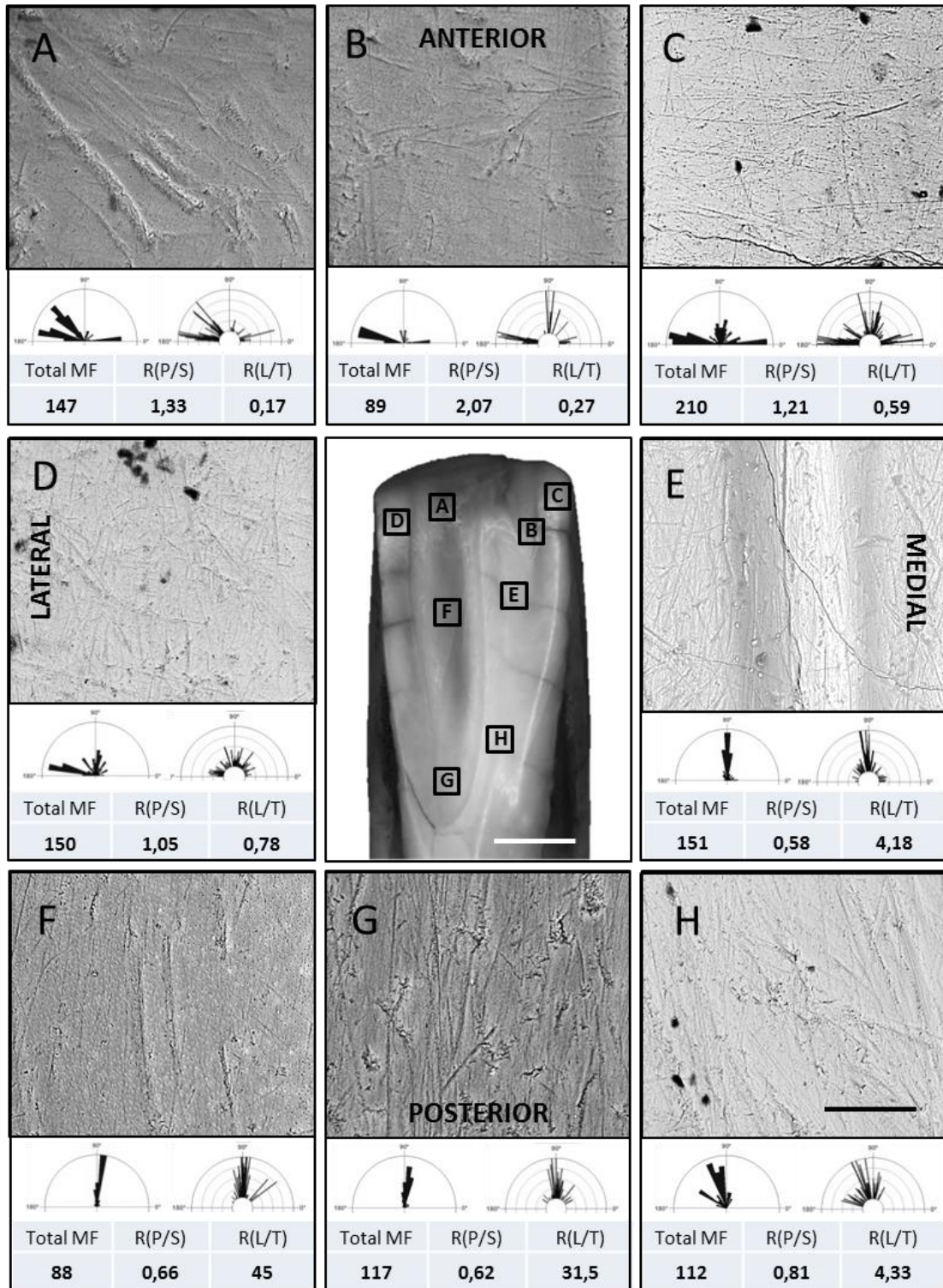


Figure 31: Lingual view of the left first lower incisor of specimen MNCN-18385 (*Sus scrofa*) and SEM images taken at different points of the lingual surface. Graphs show main orientation of scratches: at the left, a histogram; at the right, a linear-angle diagram, showing orientation and relative length of scratches. “Total MF”=Total microfeatures; “R (P/S)” = Ratio (pits / scratches); “R (L/T)” = Ratio (longitudinal scratches / transverse scratches). Images were taken at 200x. Black scale bar = 200 200 μ m. White scale bar = 3 mm.

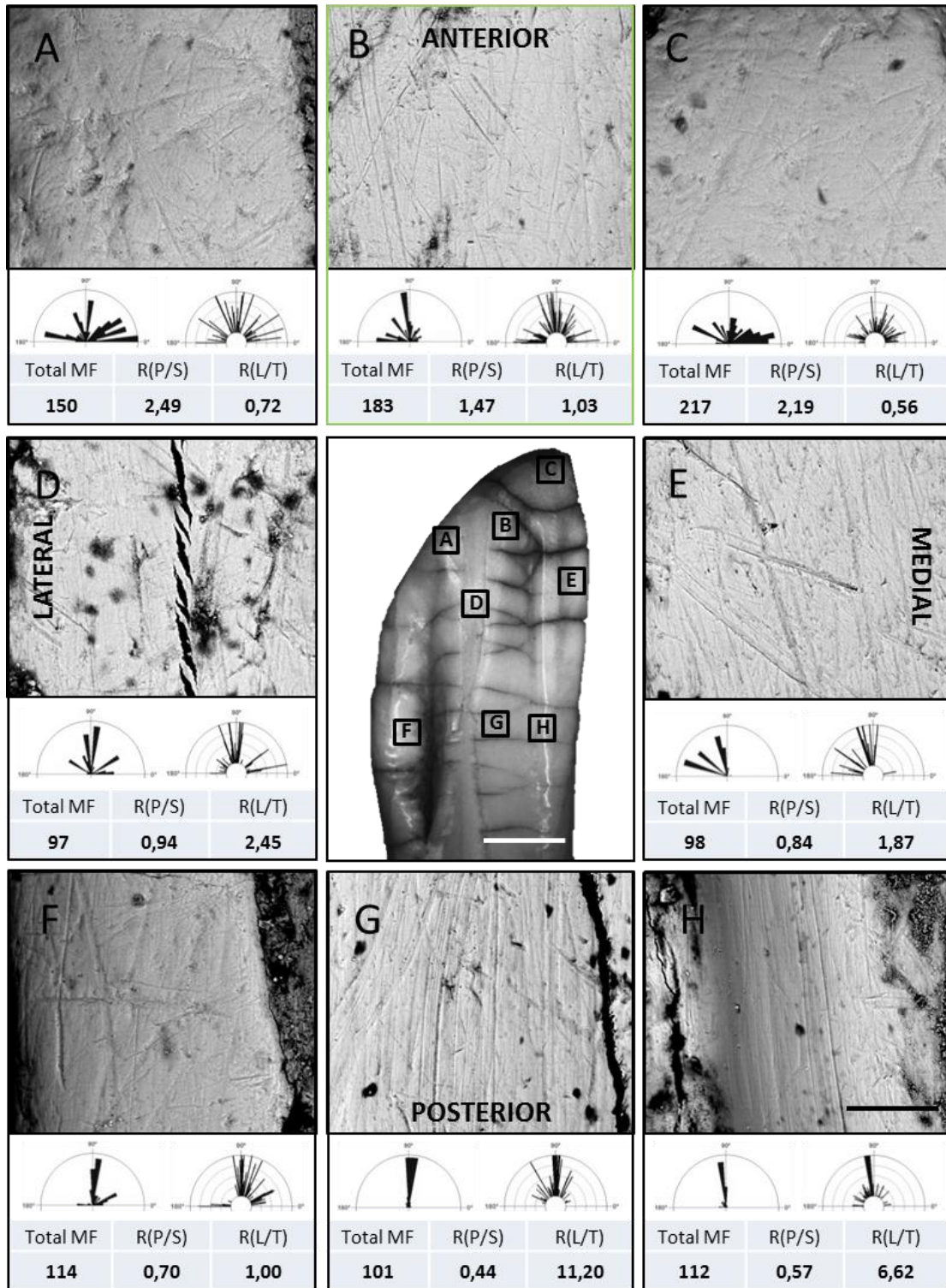


Figure 32: Lingual view of the left second lower incisor of specimen MNCN-18385 (*Sus scrofa*) and SEM images taken at different points of the lingual surface. Graphs show main orientation of scratches: at the left, a histogram; at the right, a linear-angle diagram, showing orientation and relative length of scratches. “Total MF”=Total microfeatures; “R (P/S)” = Ratio (pits / scratches); “R (L/T)” = Ratio (longitudinal scratches / transverse scratches. Images were taken at 200x. Black scale bar = 200 200 μ m. White scale bar = 3 mm.

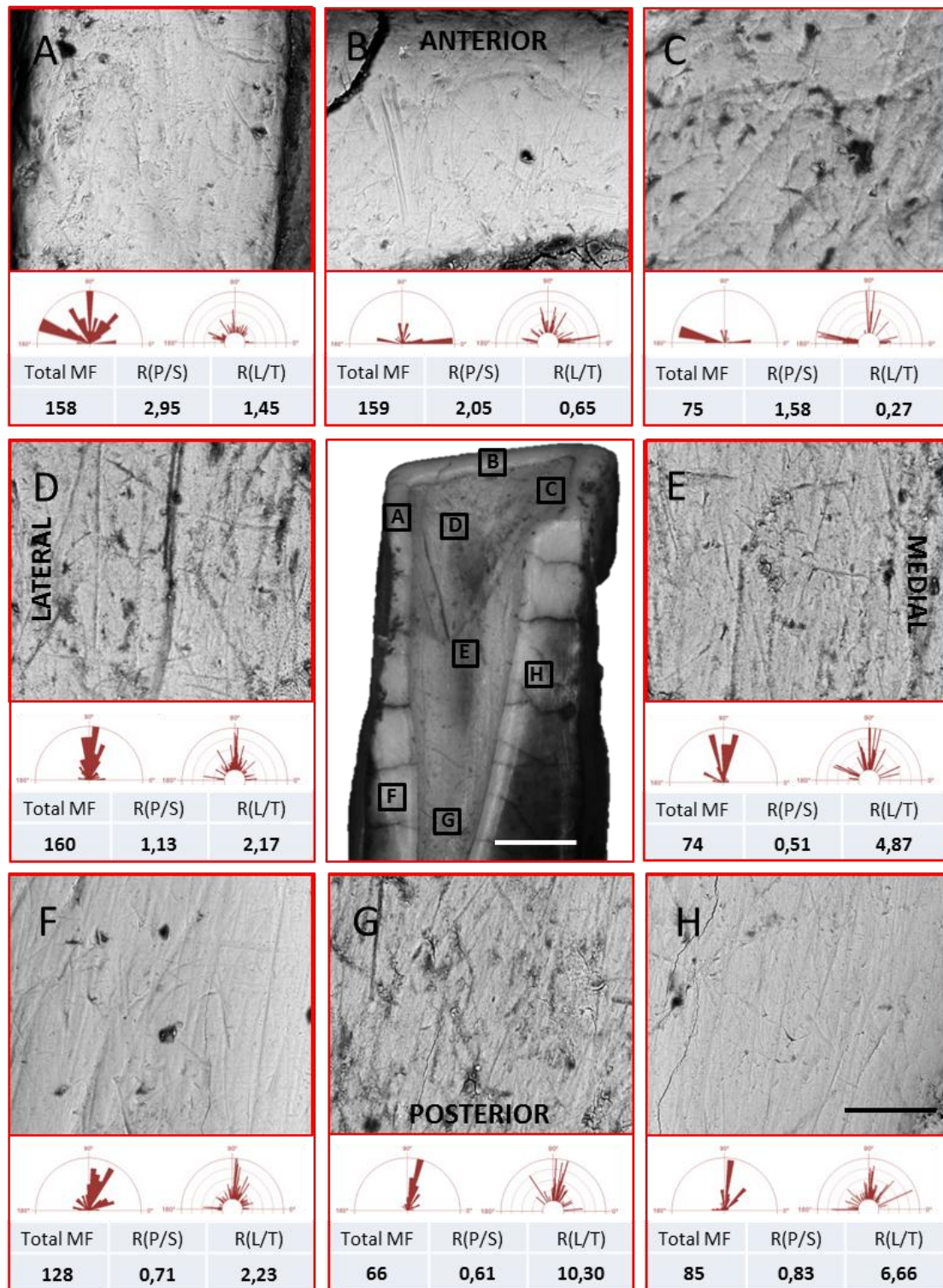


Figure 33: Lingual view of the left first lower incisor of specimen MNCN-18957 (*Potamochoerus porcus*) and SEM images taken at different points of the lingual surface. Graphs show main orientation of scratches: at the left, a histogram; at the right, a linear-angle diagram, showing orientation and relative length of scratches. “Total MF”=Total microfeatures; “R (P/S)” = Ratio (pits / scratches); “R (L/T)” = Ratio (longitudinal scratches / transverse scratches. Images were taken at 200x. Black scale bar = 200 200 μ m. White scale bar = 3 mm.

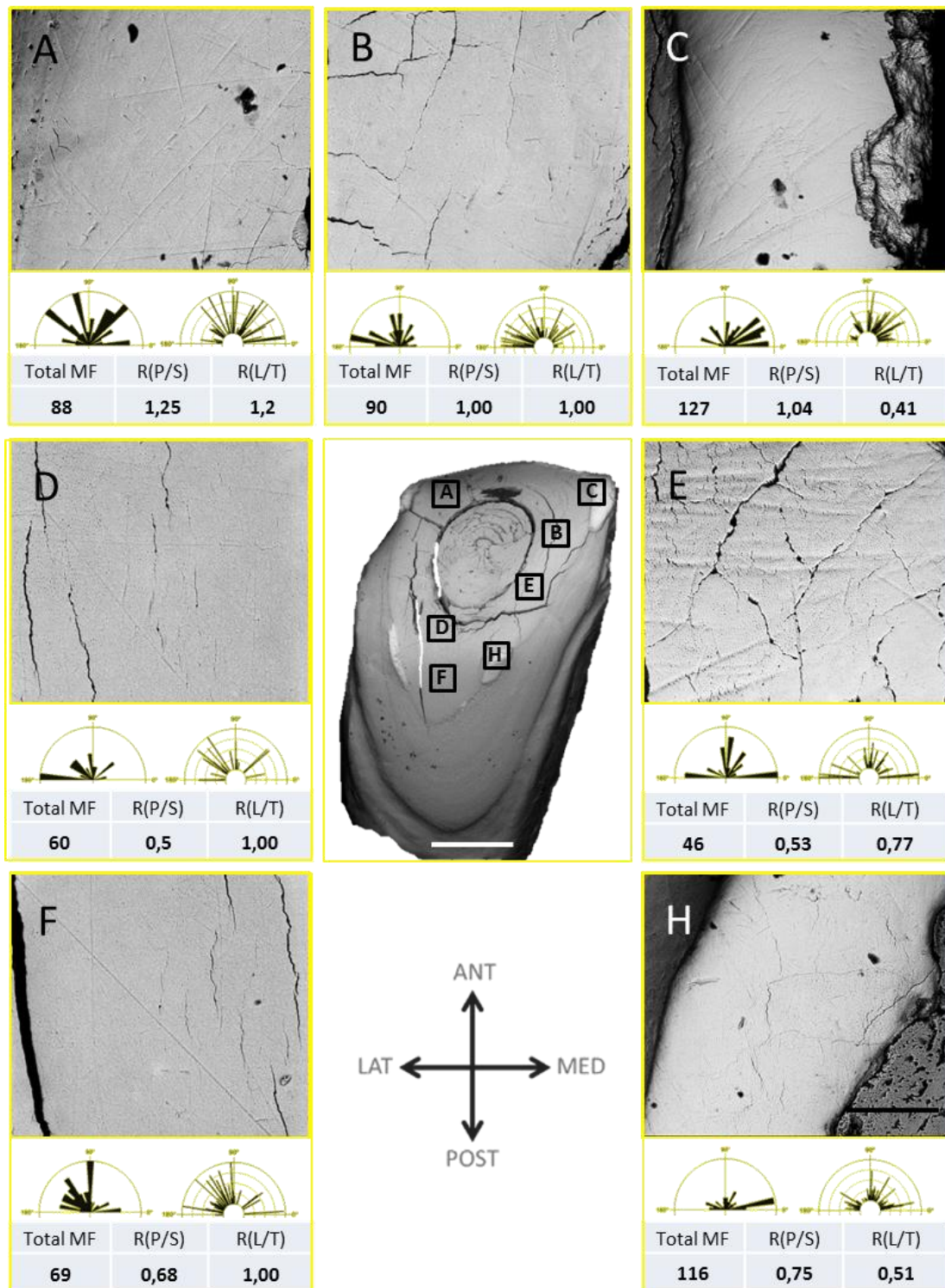


Figure 34: Lingual view of the left first lower incisor of specimen JVDM-1 (*Phacochoerus africanus*) and SEM images taken at different points of the lingual surface. Graphs show main orientation of scratches: at the left, a histogram; at the right, a linear-angle diagram, showing orientation and relative length of scratches. “Total MF”=Total microfeatures; “R (P/S)” = Ratio (pits / scratches); “R (L/T)” = Ratio (longitudinal scratches / transverse scratches. Images were taken at 200x. Black scale bar = 200 200 μ m. White scale bar = 3 mm.

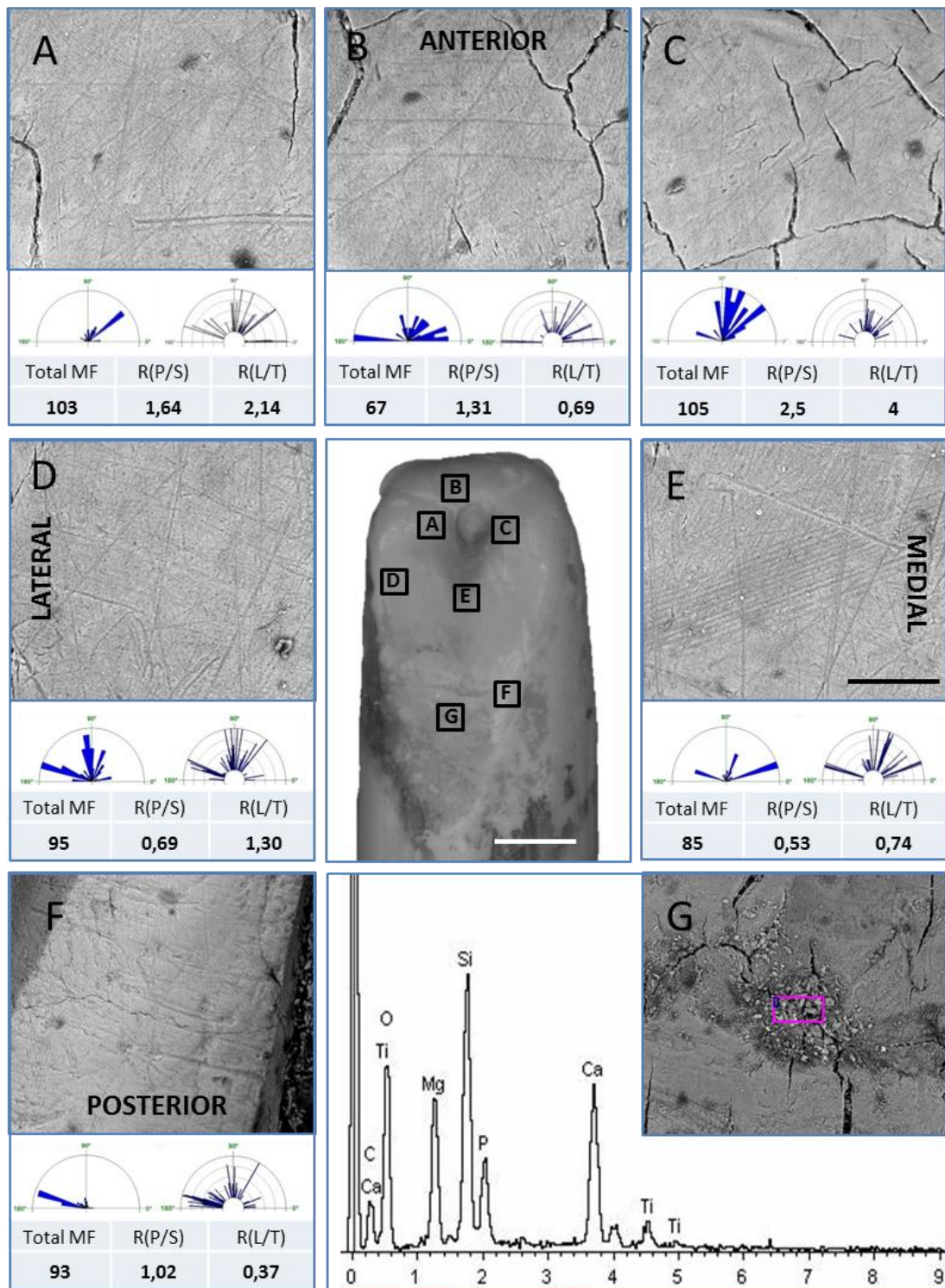


Figure 35: Lingual view of the left first lower incisor of specimen MNCN-14236 (*Babryrousa babyrussa*) and SEM images taken at different points of the lingual surface. Graphs show main orientation of scratches: at the left, a histogram; at the right, a linear-angle diagram, showing orientation and relative length of scratches. Lower right: Energy Dispersive X-ray analysis (EDX) applied to sediment deposition under pink square in image G. “Total MF”=Total microfeatures; “R (P/S)” = Ratio (pits / scratches); “R (L/T)” = Ratio (longitudinal scratches / transverse scratches). Images were taken at 200x. Black scale bar = 200 200 μm . White scale bar = 3 mm.

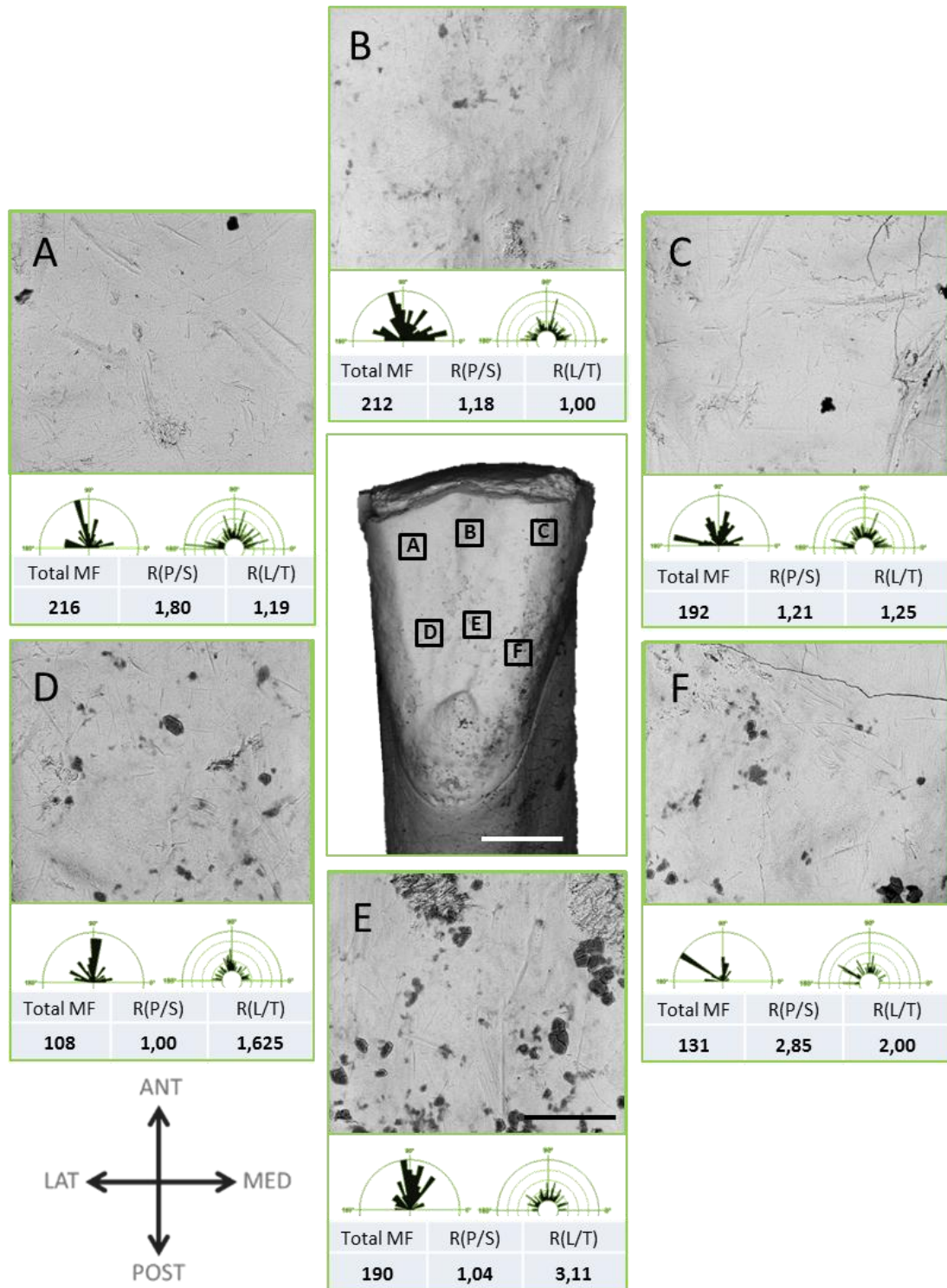


Figure 36: Lingual view of the left first lower incisor of specimen JVDM-2 (*Tayassu pecari*) and SEM images taken at different points of the lingual surface. Graphs show main orientation of scratches: at the left, a histogram; at the right, a linear-angle diagram, showing orientation and relative length of scratches. “Total MF”=Total microfeatures; “R (P/S)” = Ratio (pits / scratches); “R (L/T)” = Ratio (longitudinal scratches / transverse scratches. Images were taken at 200x. Black scale bar = 200 200 μ m. White scale bar = 3 mm.

5. Discussion

5.1. Macrowear on the incisors

The incisors used in this study presented different degrees of wear, because it was difficult to find a representative sample of recent incisors with homogenous wear, and because incisors in the fossil record have variable wear stages. As no methodology had been yet developed to classify suoid incisor wear stage, one is proposed here, that is fairly simple and applicable to most of the suoid species.

The degree of wear in the first and second lower incisor was recorded, using this novel methodology, and compared to lower molar wear, the latter classified by adapting existing methodologies based on modern *Sus scrofa* (used mainly to calculate age of the individual). Differences between wear stage in incisor and molar wear are notable in some of the species studied. In individuals of *B. babyrussa* and *S. scrofa*, and in the lower first incisor of *P. tajacu*, incisor wear stage was high compared to the molar wear stage, while equivalent wear stages were found in incisors and molars in all individuals of *P. porcus*, and lower wear stage in the incisor were found in *T. pecari* and, again, *P. tajacu*.

These differences might be explained by: 1) the wear stages defined for the molars and incisors are not comparable; 2) the species studied differ in incisor morphology, rates of eruption, or mastication biomechanics; 3) individual or specific differences in incisor use may cause different incisor wear rates compared to molar wear. If the latter assumption is true, this methodology allows inferring differential use of the incisors between individuals and/or species. Those individuals with a higher wear stage in the incisors may have used their incisors more intensively to dig or root, therefore increasing wear rate; or diet was harder or more abrasive, therefore wearing the molars more rapidly. In the case of *T. pecari*, low wear in the incisors may suggest less frequent or less powerful rooting. On the contrary, a higher wear stage in the incisors compared to that of molars in some individuals of *S. scrofa* and *Pe. tajacu*, may be an indicator of intense rooting. Variability in the comparative results for these two species may account for inter-individual differences, but also to different times of incisor eruption. These rates are apparently very similar in peccaries and *Sus scrofa* (Kirkpatrick and SOWLS, 1962 on peccaries; Matschke, 1967 on wild hogs), but data for

the time of tooth replacement on *Phacochoerus*, *Potamochoerus* and *Babyrousa* are lacking.

The fact that *B. babyrussa* has higher wear rates in the incisors can be explained by the unique characteristics of the latter in this species. As already mentioned, Babirusas have ever-growing incisors. The crown wears off very quickly and incisors continue growing to compensate wear.

A direct comparison with *Phacochoerus africanus* could not be made, because molar morphology is very different to that of other suoid species, so that it was not possible to use the same methodology to classify molar wear. Despite, *Ph. africanus* usually wears off all the dentition very quickly, including the incisors, and it is frequent to find adult individuals with only upper and lower third molars (Cumming, 1975). Therefore, wear rate in *Ph. africanus* incisors might be considered as high.

5.2. SEM descriptive analysis: Wear facet complex, mastication biomechanics and microfeature morphology

Many researchers have tried to understand the characteristics of dental microwear in different species, because it is a very valuable proxy to understand dietary patterns and ecomorphological adaptations related to mastication biomechanics. Other dental microwear studies have identified cultural (or behavioral) striations on the labial side of the anterior dentition in Middle to Late Pleistocene hominins, produced by the impact of stone tools while manipulating them (e.g. Lozano *et al.*, 2008). The majority of the research, however, has been oriented to the study of diet by analyzing microwear on molars.

In ungulates, for instance, only the study of Young and Marty (1986) and Rivals *et al.* (2010), have attempted to explore the possibilities of anterior dentition in the reconstruction of fossil diets. The conclusion of Rivals *et al.* (2010), in his own words, is that “incisors do not reveal the same dietary signal as molars”. The dietary signal in molars has allowed many researchers to assign fossil or extant species to broad dietary categories, such as grazers, browsers or mixed-feeders, or address questions about food hardness, presence of grit in the diet, or mastication characteristics (eg. Merceron *et al.*, 2004). But what does the microwear signal in incisors reveal about diet? The answer to this question is still far to be understood, due to the almost complete lack of literature

about this topic. The potential of this field is encouraging because the matter needs to be accurately assessed in many species.

Regarding the absence of microwear data, both descriptive and quantitative, and the very few mentions about macroscopic wear in incisors (e.g. Herring, 1972; Leinders, 1977; Van der Made, 1996), it became indispensable to understand the wear/facet complex (patterns of occlusion and formation of facets), and the type of microfeatures found on them. Moreover, this step was compulsory to find a homologous region, target of the microwear analysis under SEM, and assure maximum effectiveness of the posterior step-by-step quantitative procedure.

The suoid incisor wear/facet complex can be understood by differentiating two types of facets. Those which are the result of wear produced by tooth-to-tooth contact or by the impact of exogenous particles in between, and those produced mainly by activities that can be derived from mastication activities or by other actions, such as digging, rooting, or catching food (Herring, 1972). Both types of facet are distinguishable at a macroscopic level, but they also present different morphologies under SEM.

Occlusive facets present an irregular morphology, mainly parallel transverse or oblique orientated scratches, and many pits, that can reveal in some instances the microstructure of enamel and dentine. Upper and lower occlusal facets present the same characteristics, thus revealing that they have been formed mainly by occlusion of upper and lower incisors, with a reduced contribution of exogenous particles. If this is the case, the transverse or oblique scratches in the upper row should all have an opposite direction (from lateral to the medial plane) to their counterparts in the lower row (from the medial to the lateral plane), reflecting the movement of the jaw relative to the skull, a fact that have been observed in this work (for further understanding of pig mastication, see Metzger *et al.*, (2009) and the Pig Feeding project page at <http://www.xromm.org>). Therefore, jaw movements in fossils (along with all the functional and ecomorphological evolutionary implications implied), can be inferred from the orientation of these scratches on the dental surface. Most of the studies analyzing this aspect have focused on the molar or premolar facets (e.g. Leinders, 1977; Estebaranz *et al.*, 2012; Green and Resar, 2012), partly because the pattern of occlusion in the incisors may be confusing and is infra-studied. Again, much work remains to be done.

Contrary to the occlusal facets, the surface of non-occlusive facets may be very heterogeneous, with the appearance of microfeatures of different size, morphology and orientation. Among all the microfeatures observed, it is important to mention those scratches with “v”-shape and microinternal striation, which are very similar to the already mentioned cultural striations found in the buccal side of past human groups. This type of striation is very common in both labial and lingual sides of the incisors, and their number, and morphology may vary intra- and inter-species. As with humans, these striations are produced by the impact of a particle of rock or mineral against the dental surface.

The debate regarding the different implication of grit and dietary components in the formation of wear and microwear is still open (see Damuth & Janis (2011) for a complete review about this topic). Sanson *et al.* (2007) has demonstrated that some food items such as phytoliths, nuts or bones, are softer than enamel, but they have been treated in microwear studies as a major factor for microwear formation (e.g. Harmon & Rose, 1998). On the contrary, others just mention grit as a secondary agent or do not even mention it (e.g. Futuyma, 1986; Brooker *et al.*, 2008). In this work, the finding of striations clearly made by soil particles in non-occlusive facets in species that are known to dig into the soil with their incisors, is another fact to support those authors who defend the major importance of grit in wear formation (e.g. Ungar *et al.*, 1995), and the implications derived from them in questions related to evolutionary paleobiology at this respect. Janis (1988), and Damuth & Janis (2011), have argued for more than two decades that the development of hypsodonty (high crowns) in many ungulate species, as a consequence of climatic change deriving in the opening of the environment, was not solely related to diet, but mainly to the inclusion of soil particles accompanying those dietary items. If true, this assumption applies more strongly in the case of suoid incisors, because they are used actively while digging or rooting, a behavior which is unique among the large mammals.

5.3. SEM quantitative analysis

In the quantitative analysis, one matter of interest was to test for differences in the microwear signal between labial and lingual sides of teeth, because the latter is influenced by forces derived from mastication, while the former displays microfeatures

that are mainly the result of the contact with exogenous surfaces and particles. Ungar (1994) concluded that quantitative studies of individual wear features may allow to distinguish effects of diet from those of substrate use. In Ungar & Teaford (1996), it is pointed out that the potentiality of buccal and lingual microwear comparisons to reveal important information about diet, soil use, and mastication biomechanics. Results in this work indicate that the labial surface is characterized by a major presence of scratches, which are longer than the ones found in the lingual side. It is hypothesized here that these scratches are formed when the incisors are introduced into the soil to feed on underground resources. The lingual side, on the other hand, has higher pit frequencies and smaller scratches in general, especially in the occlusal facet, as it is discussed below. Scratch orientation does not differ significantly between sides, though longitudinal very long and hyper long scratches are found in greater number in the labial side. Labial facets are therefore not mutually comparable with lingual facets, thus they have to be compared as different groups in inter-taxa comparisons.

Before choosing the target point to test for microwear differences between taxa, the lingual side of at least one original (= not a cast) first lower incisor was mapped for all species except *Pe. tajacu*, by taking a series of rows of several microphotographs. The objective was to get a preliminary idea about the microwear signal at different regions of the tooth and choose the best homologous points to compare between taxa.

Graphical and quantitative data obtained in this step revealed several differences that were posteriorly tested statistically. The main variables observed at this point basically refer to the total amount of microfeatures, the relation of pits and scratches and scratch orientation. It became clear from the first moment, and not unexpectedly, that the microwear signal differs from occlusal facets to non-occlusal ones, from dentine to enamel, and from crests to valleys.

Statistical analyses have revealed that occlusal facets, apart from the transverse/oblique signal explained before, were characterized by a high number of pits in relation to the number of scratches, in comparison to non-occlusal facets. Traditionally, many pits have been regarded as a consequence of eating fruit with seeds, and many scratches as a result of eating more fibrous vegetation (e.g. Solounias and Moelleken, 1993), with higher concentration of phytoliths (MacNaughton *et al.*, 1985; Robert & Roland, 1998). According to Maas (1994), pits are formed by triturated food particles and/or contaminants, which make compression fractures on occlusal surfaces

during the power stroke of mastication, a fact that has been observed in groups with different diets (e.g. Strait, 1993), or by experimental work on dental microdamage (e.g. Peters, 1982). Occlusal facets show significant higher mean values of striation width average and a major presence of very small scratches, compared to the non-occlusal facets. Wide scratches and very small scratches may be formed as secondary products of the formation of pits due to the prolongation of the power stroke.

Differences between microphotographs taken at dentine or enamel are mainly referred to the total number of microfeatures observed, being considerably higher in the enamel. This fact is supported by the literature, which predicts that when dental surfaces are pressed against an abrasive object, the enamel is much more likely to suffer microfeatures than dentine (Lucas, 2004). Results also indicate higher pit frequencies in dentine surfaces, as well as a more transverse scratch orientation signal and wider scratches, in comparison to enamel, that presents a more longitudinal scratch orientation signal, with a high number of very long and hyper long longitudinal scratches, but also a higher frequency of very small scratches. Because statistical comparison between enamel and dentine did not differentiate occlusal and non-occlusal facets, and dentine is more prone to be present in the occlusal facet, results may be conditioned by this fact, and may be explained by following the same rules explained before for facet microwear signal variability. This means that results are also influenced by the incisor wear stage. Schmidt (2010) has reported higher pitting values in teeth with higher macrowear scores. As a result, inter-taxa comparison between incisors with different wear stages may be problematic. The ideal situation would be to compare individuals with the same wear stage, but nor the extant samples nor the fossil specimens in the fossil record allow this.

Other features in the lingual side of suoid incisors have also proven to be significantly different at the microscopic level; these are crests and valleys. As explained somewhere at the introduction of this work, the lingual size of the incisor is an irregular surface that, in a simple way, can be described as one of crests and valleys. Crests are more exposed to wear, while valleys are protected by crests (at least from lateral movements). This variability is translated into different microwear signals, which mainly refer to the length and orientation of scratches, and pit proportion. Crests have less and smaller scratches, with more oblique and transverse orientation, and higher pit frequencies. In valleys, exogenous particles tend to go through the end of the valley

following a longitudinal direction while the animal is digging or eating. In fact, the number of longitudinal very long and hyper long scratches is considerably higher in valleys.

Finally, before carrying out the comparison between species, possible differences between first and second lower incisors were tested statistically. No significant variability was found, except for the proportion of pits, which was higher in the second incisor. Surprisingly, this result fits with that obtained by Rivals *et al.* (2010) in horse incisors, showing a significant increase in the number of pits for I1 to I3, that they related to the orientation of the teeth in the incisor row. Though suoid and equid incisors do not display the same orientation, differences caused by variability in the proportion of shearing versus compression forces while chewing may account for this result.

5.3.1. Inter-taxa variability

5.3.1.1. Labial side

Quantitative data revealed several differences between species in the labial side of first and second lower incisors. The most important difference is related to scratch orientation, which is mainly transverse in *Ph. africanus*, while more longitudinal in the rest of species. This is especially evident if the two African species are compared, because differences are striking. Accordingly, *Po. porcus* also presents a very high percentage of longitudinal very long and hyper long scratches, thus reinforcing the idea that the rooting style of this suid involves antero-posterior movements of the incisors into the ground. However, there is also a clear signal of transversely orientated scratches on the labial side of *Ph. africanus*, which reflects the lateral movements of the head while rooting. The total amount of microfeatures is also higher in *Ph. africanus* than *Po. porcus*, while the ratio of broad scratches against narrow scratches is considerably lower in *Ph. africanus*. This might be due to the fact that *Ph. africanus* tends to dig in the harder soil of the savannah, which may leave more visible microfeatures, while *Po. porcus* is doing so in the softer grounds of moist forests. The wider scratches in *Po. porcus* might have been formed by hard mineral particles in this soil, like quartz. This tendency is also observed in *Pe. tajuca* and *S. scrofa*, two species also related to more covered habitats than *Ph. africanus*.

T. pecari has a very different pattern, basically when looking to the proportion of long, very long and hyperlong scratches, but especially because of the absence of longitudinal hyperlong scratches and the few longitudinal (very long + hyper long) scratches. On the contrary, the labial side exhibits a great number of microfeatures, mainly conformed by very small scratches with an intermediate scratch orientation signal between *Ph. africanus* and the rest of species. Probably, *T. pecari* is a less intensive rooter than the other suoid species studied, even though it has been reported as having intense rooting activity (Oliver, 1993). On the contrary, Sicuro & Oliveira (2002) found it a much less capable rooter than feral *Sus scrofa*. While more individuals need to be studied in order to confirm these results, it is clear that the variation in the microwear signal between species and/or individuals may be great, and it may be a consequence of the modification of feeding and rooting habits depending on the environmental conditions, which is another proof of the great adaptability of the group. Furthermore, *Pe. tajacu* shows a pattern of longitudinal and very long to hyperlong scratches, very similar to that of *S. scrofa* and *Po. porcus*, indicating similar rooting habits. The inferred differences in rooting habits might explain why the populations of *T. pecari* are declining, while *Pe. tajacu* is extending its range to the southern regions of North America (Keuroghlian *et al.*, 2013)

B. Babyrussa shows an intermediate microwear signal between *T. pecari*, *Ph. africanus* and the rest of the species. All microfeatures belonging to this species were taken on the dentine of ever-growing incisors in captive individuals, thus results should be considered with caution.

5.3.1.2. Lingual side

In the non-occlusal facets of the lingual side of first and second lower incisors, all of the variables presented significant differences, except for the proportion of wide pits against small pits. Again, some key differences occur in scratch orientation and length, but also scratch width and number of pits. *Ph. africanus* is also the species to present scratches with a major transverse and/or oblique orientation, thus indicating lateral-medial movements while feeding or rooting, in comparison to the more longitudinal signal shown by *Po. porcus*, *S. scrofa*, *Pe. tajacu*, and in to a lesser extent, *T. pecari* and *B. babyrussa*. This difference is remarked by the low proportion of

longitudinal (very long + hyperlong) scratches in *Ph. africanus*, though in this case comparable to *T. pecari* and *B. babyrussa*. But differently from *Ph. africanus*, both *T. pecari* and *B. babyrussa* show higher pit proportion, and *T. pecari* again shows a strikingly high proportion of very small scratches, and very low mean values in general for scratch width and length.

Ph. africanus is also characterized by low proportion of hyperwide pits. These pits are likely to be created by grabbing food or pulling food items, or by pushing action into the soil. Both diet and/or rooting style may influence this signal in seed predators and intense rooters, such as *Po. porcus*, *S. scrofa* or *Pe. tajacu*, but also *T. pecari* and *B. babyrussa*. Similarly to what happened at the labial side, scratch width average and the ratio of broad scratches against narrow scratches is considerably lower in *Ph. africanus* if compared to the other African suid, *Po. porcus*, though this time presenting similar values to *S. scrofa* and *Pe. Tajacu*.

5.4. Relating microwear signal to rooting behavior

The results obtained in this work have demonstrated that there are differences in the microwear signal in the incisors of different suoid species. This variability responds to different incisor activities, which are most probably related to the habitual feeding behaviour displayed by suoids, rooting. There is little specific information about the extent to which different species root as a part of their feeding repertoire, the manner in which they do it, or the deepness they reach when digging holes. Sims (2005) on *Sus scrofa*, Sicuro & Oliveria (2002) on peccaries and *Sus scrofa*, and Cumming (1975) and Ewer (1958) on *Phacochoerus* are probably the most important reports about this topic.

Until more literature is available, however, it is possible to relate the existing information about rooting, to the microwear signal found on the incisors. On this basis, three main rooting styles are proposed in this study: 1) “Low rooting intensity”, indicated by a high proportion of very small scratches, displayed by *Tayassu pecari*; 2) “Longitudinal rooting”, recognized mainly by hyperlong longitudinal scratches, displayed by *Potamochoerus porcus*, *Sus scrofa* and *Peccari tajacu*; 3) “Transverse rooting” for rhizomes, recognized by transversely directed microfeatures, displayed by *Phacochoerus africanus* (Table 20).

Table 20. Summary of different microwear signals and rooting styles within species. (Low/Medium/High are orientative categories)

	Microwear signal				Rooting style	Food item target	Depth	Incisor activity
	Total Number of Microfeatures	Scratches (Length / Orientation)	Scratches (Width)	% Pits				
<i>T. pecari</i>	Labial: High Lingual: High	Very small (no predominant orientation)	Labial: Low Lingual: Low	High	Low intensity	Varied	Shallow (7-8 cm)	Grabbing + pulling
<i>Pe.tajacu</i>	Labial: Low Lingual: Medium	Hyper long longitudinal	Labial: Medium Lingual: Medium	Low	Longitudinal	Varied	Shallow (7-8 cm)	Grabbing + pulling
<i>Po.porcus</i>	Labial: Low Lingual: Medium	Hyper long longitudinal	Lab: High Ling: High	Medium	Longitudinal	Varied	Deep	Grabbing + pulling
<i>S.scrofa</i>	Labial: Medium Lingual: Medium	Hyper long longitudinal	Lab: Medium Ling: Medium	Low	Longitudinal	Varied	Deep (24-30 cm)	Grabbing + pulling
<i>Ph.africanus</i>	Lab: High Ling: Low	Transverse / oblique	Lab: Low Ling: Med	Low	Transverse	Rhizomes	Shallow	Reject unwanted material
<i>B.babyrousa</i>	Lab: Med Ling: Low	?	Lab: Med Ling: High	High	?	?	?	?

5.5 Implications of different microwear signal on suoid incisors in the reconstruction of past suoid rooting styles and the environmental causes that shaped both suid and human evolution

It has been discussed that both lingual and labial sides of the lower incisors allow us to distinguish the different microwear signals, and that this differences may account for different rooting styles. The presence of scratches clearly produced by hard mineral contact (those very similar to cultural striations) have been accounted for all the species. Because the formation of these type of scratches implies the contact with hard mineral particles, it may be assumed that either these scratches were formed by grit accompanying the food, or more likely by rooting, fundamentally when they are found on the labial side, or on non-occlusal facets in the lingual side. Rooting implies a variety of activities, like pushing teeth into the soil, grabbing food items and pulling. Therefore, the microfeatures reflected in the incisors are a consequence of this type of actions. If this is true, it means that the method is applicable to fossil or past suoid specimens, thus allowing inferences about their rooting styles.

The habit to root allows the Suoidea to efficiently exploit underground resources, for which they do not have competition from other large mammals. These resources are very important in climates with a marked seasonality. Cold or dry seasons tend to limit the availability of fruit and leaves to part of the year. In seasonal environments, migrating species tend to make up most of the biomass. Suoidea resolve seasonal food scarcity by rooting for subsurface resources, which depending on the environments may consist of grass rhizomes, various types of geophytes, earthworms, other invertebrates or small vertebrates. Rooting habits are therefore an essential adaptation to Suoidea in habitats with marked seasonality. Living species of african suids have rooting styles that differ from those of other Suoidea living elsewhere. Most of the living African suids belong to groups that were diverse and evolved during several millions of years in Africa. Therefore it is expected that, the increasing wet-dry seasonality in the Late Miocene and Plio-Pleistocene of East Africa (DeMenocal, 1995, 2004), molded the evolution of the rooting habits of these suids. These same climatic and environmental changes are believed to have had a great impact on human evolution.

As a consequence, many species of large mammals, like bovids or equids, had to migrate. But other large mammals, such as suids and humans in East Africa, adapted to this climatic changes differently. The former, among other adaptations, may have evolved different rooting styles that allow them to exploit the underground resources and the latter, by developing complex cultural and social skills, promoted by a bipedal locomotion, big brains and hand dexterity, among others (Larsen, 2010).

If it is possible to track the evolution of different rooting styles of suid species in East Africa along time, we would have a wider picture of the extrinsic factors that impelled both suid and human evolutionary paths. Figure 37 compares the human and suid phylogenies with evidence of climatic change in East Africa derived from studies of carbon stable isotopes of soil paleocarbonates, and oxygen stable isotopes. DeMenocal (2004) argues that important climatic and environmental changes in East Africa coincide, or caused, important evolutionary jumps in hominin evolution. For instance, approximately 2.6 to 3.0 million years ago, climate became drier, cooler and more seasonal (Shackleton *et al.*, 1990; Mix *et al.*, 1995; DeMenocal, 1995; 2004) and open environments with C4 grasses spread, leading to a reduction in arboreal cover (Cerling *et al.*, 1977; Cerling and Hay, 1988; Cerling, 1992; Wynn, 2000; Cerling *et al.*, 2011). This is when the australopithecines radiated and the genus *Paranthropus* and *Homo* appeared in the fossil record. Simultaneously, important events in the evolution of the Suidae happened, like the extinction of the genus *Sivachoerus*, the appearance of the genus *Notochoerus*, and perhaps most important, the appearance and posterior radiation of the hyper specialized genus of grazers, *Metridchoerus* (Cooke, 1976, 1978, 1985; Harris & White, 1979; White & Harris, 1977).

The major trends in the evolution of the suid dentition involve the reduction of the anterior dentition and the increase in length and hypsodonty of the posterior dentition. This was derived to an extreme in the clade *Metridchoerus*. Representatives of this genus experienced a drastical posterior enlargement of the third molar and a notorious increase in hypsodonty (e.g. Harris & White, 1979), as an adaptation to grazing. Carbon stable isotope analyses have revealed a positive correlation between the increase of the third molar length in African fossil suids and a diet based mainly in plants C4 (Cerling *et al.*, 2005). Species that became grazers in a C4 dominated landscape, are expected to have adapted their rooting style to the resources in the soils under these landscapes. Was there indeed a drastic change in the rooting style of

different species? When did it happen? Did it precede other changes in the dentition? Did it happen simultaneous to or after known environmental or climatic change and was it related?

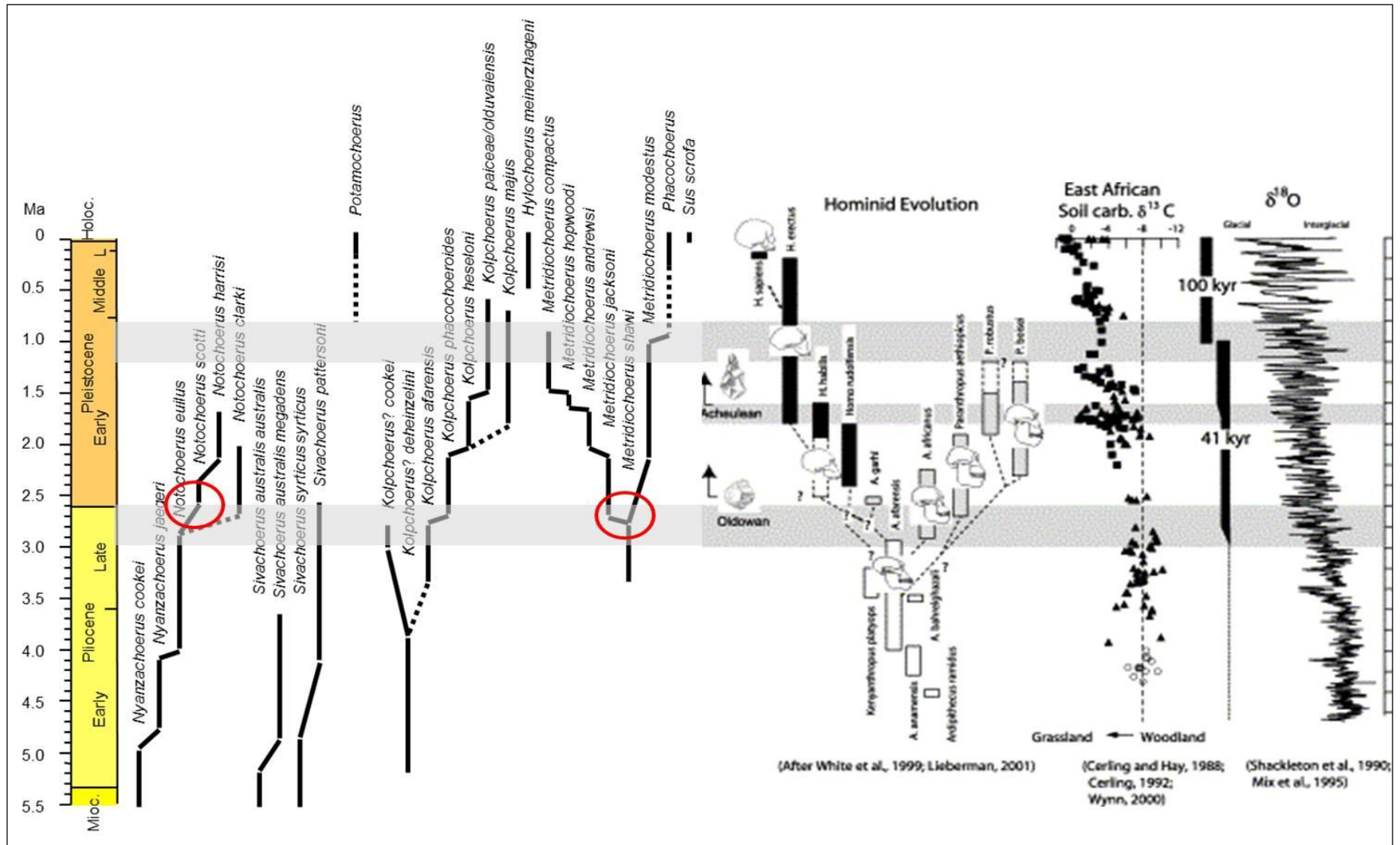
Cranial and dental adaptations to rooting are more developed in Suidae, than in Tayassuidae (Sicuro & Oliveira, 2011; Van der Made, 2010). Within the Suidae, there is a progressive dental adaptation to rooting, in which *Potamochoerus* is fairly and *Sus scrofa* much advanced (Van der Made, 2010), while the dentitions of the remaining African suids suggest highly modified rooting styles.

Phacochoerus, studied in this work, is the closest extant relative of the fossil *Metridiochoerus*. Was the typical rooting style of *Phacochoerus*, as evidenced by the microwear signal, already present in the earliest *Metridiochoerus*, or did it evolve later, and at what time? The *Nyanzochoeurs-Notochoerus* lineage had the same evolutionary tendencies as *Metridiochoerus* and presumably became a grazer likewise. Did it change its rooting style in the same way? The fossil *Kolpochoerus* is related to the living *Hylochoerus*. How and when did its rooting style change?

Many of these questions can now be addressed by using the methodology and data presented in this work. Future research will allow not only to gain further understanding of suoid evolution all over the world, but to explore the connection of adaptive responses of this group and environmental and climate change, especially in East Africa, where suids are one of the most abundant groups of large mammals associated to fossil hominin sites. Further contribution may shed light to the importance of climatic change in the evolution of hominins, and explain some of the most important causes that drove the evolution of early hominins.

Figure 37. Evolution of the Suidae compared to a hominid phylogeny, and climatic data derived from the analysis of carbon and oxygen stable isotopes. Grey bands indicate periods of important climatic and evolutionary change in both groups. (Adapted from DeMenocal, 2004; and Van der Made, in press)

(Continued next page)



5.6. Further considerations: other potential uses and limitations.

The main objective of this work was to elaborate a methodology that will allow analysis of incisor microwear in fossil suids related to fossil hominin sites, mainly of East Africa, in order to derive conclusions about rooting styles and environmental change related to the evolution of these styles. However, the methodology may have further applications, and at the same time, potential limitations.

The most important consideration in this respect is that the microfeatures observed in the incisors were produced in a short period before the animal died. Teaford & Oyen (1989) demonstrated that microwear turnover in primates could be of the order of days, hours or even minutes, so that all of the microfeatures present at a certain time could have been replaced by less than a month. Because feeding behavior may vary along the lifespan of an individual, or along the year, so does the microwear signal reflected in the dentition. Therefore, general assumptions derived from microwear studies about diet should be carefully considered. This is especially true for marked seasonal species that modify their feeding behavior depending on the availability of food resources (Teaford & Robinson, 1989), as it is the case of suoids. Seasonal variations in the mode of feeding have been reported for all the species studied in this work, *Ph. africanus* (Cumming, 1975; Leus & MacDonald, 1997), *Po. porcus* (Jones, 1984), *Sus scrofa* (Rosell, 2001; Giménez-Anaya *et al.*, 2008), *Pe. tajacu* (Keuroghlian *et al.*, 2004), *T. pecari* (Altrichter *et al.*, 2001; López *et al.*, 2006) and *B. babyrussa* (Patry *et al.*, 1995).

While seasonal variations in feeding behaviors may be a complication in dental microwear analyses, especially when doing general adaptationist assumptions, it may also be a potential tool to detect this seasonality. It may serve to know the extent to what an environment was seasonal, but also to know the season of the year in which that particular individual died. This may be of use in archaeological contexts, because it may be possible to detect hunting and husbandry practices, an idea already applied by Vanpoucke *et al.* (2009).

5.7. Future work

After more than 50 years of dental microwear research, the possibilities of this technique are still very encouraging. The spare point of this field is the analysis of microwear texture, by the application of multi-fractal 3D reconstruction with the use of confocal microscopy (e.g. Scott *et al.*, 2005, 2006). However, this work has shown that traditional methodologies based on light microscopy or SEM, can still contribute to the fields of Paleoanthropology and Paleontology. Anyway, the three types of microscopy give different data, so that they must be considered as complementary.

As this is the first study to analyze microfeatures on suid incisors, much work is still to be done to obtain a higher resolution of the matter and improve the robustness of the conclusions. Future work may be resumed as follows:

- Wear stage. Control for possible variability between different wear stages.
- More representative samples, increasing the number of individuals in order to obtain more significant results after statistical analysis.
- Other species. Include the other extant suid species inhabiting Africa, *Hylochoerus meinertzhageni*.
- Upper dentition. Study upper dentition quantitatively to understand differences in microwear with the lower dentition.
- Seasonality. As it has been mentioned before, suoid incisors may reveal seasonal differences and husbandry practices in archaeological contexts. A first step may be looking to a identified skeletal collection of wild hogs (because it is possible at least in the Iberian Peninsula), and compare between those individuals who died in the dry season or in the wet season.
- Molars. Compare the microwear signal in incisors to that of molars in same individuals, to look for possible differences.
- New techniques. Explore the possibility of applying texture microwear analysis to the study of suoid incisors and molars, as a complementary tool to other analyses.
- Fossils. Finally and most important, apply this methodology to suid fossil incisors, mainly those recovered from fossil hominin sites in East Africa.

6. Conclusions

- The suoid incisor wear stage recording methodology developed in this work is fairly easy to apply. Intra-individual comparison between incisor wear stage and molar wear stage may be useful to identify intense or low rooting habits, if the incisor wear stage is higher than the molar wear stage, respectively.
- The microscopic descriptive exploration of the suoid incisors has revealed differences in different regions, like that of occlusal and non-occlusal facets. The finding of scratches with an identical morphology to those known as “cultural striations” suggests that grit is a major factor in the production of microfeatures in suoid incisors, both while masticating or rooting.
- Significant quantitative differences have been found between the labial and lingual side of lower incisors. The former has a lower pits/scratches ratio, with longer scratches, and a higher proportion of longitudinal (very large + hyperlarge) scratches, than the latter, basically reflecting differences related to masticatory movements. Important fractures may be found at the labial side, with the very visible exposure of enamel and/or dentine microstructure, due to forcefull impacts.
- Lingual occlusal facets were significantly different to non-occlusal regions and/or facets. Occlusal surfaces are characterized by a relatively homogenous surface with a high frequency of transverse and/or oblique scratches and a high proportion of pits, which may expose enamel and/or dentine microstructure. On the contrary, non-occlusal regions and/or facets are characterized by a heterogenous surface with longer and more longitudinally-orientated scratches.
- Enamel surfaces present more total microfeatures than dentine, and longer and more longitudinally-orientated scratches, which mainly respond to the structural, mechanical and physical properties of both composites, but may also account to differences is wear stage (enamel at occlusal facets is worn off more rapidly).
- In the lingual non-occlusal region, valleys had more scratches than crests, and these were larger and more longitudinally-orientated. Probably it is due to the fact that crests are more exposed to masticatory movements occurring in the mouth, and/or

lateral movements involved in wrenching, while valleys are protected from lateral movements and tend to register only longitudinal scratches derived from pulling food items or pushing into the soil.

- No important differences were found between first and second lower incisors, though pits were significantly higher in the second incisor, probably due to differences in masticatory forces caused by the different orientation of first and second incisors, which is congruent with already published data in horse incisors.
- Three main rooting styles are characterized in this study: 1) **low rooting intensity**, indicated by a high proportion of very small scratches, displayed by *Tayassu pecari*; 2) **longitudinal rooting**, recognized mainly by hyperlong longitudinal scratches, displayed by *Potamochoerus porcus*, *Sus scrofa* and *Peccari tajacu*; 3) **transverse rooting** for rhizomes, recognized by transversely directed microfeatures, displayed by *Phacochoerus africanus*.
- The application of the incisor microwear methodology proposed in this work to fossil suid species, mainly in fossil hominin sites in East Africa, may shed light on the relative importance of climatic and environmental change in the evolutionary patterns of both suids and hominins. The aim is to understand the possible changes in “rooting styles” and track for possible environmental and climatic changes that were very important in Human Evolution.
- This work opens a new line of research where much work is still to be done. Possible limitations referred to seasonality may also be the potential of this technique, not only in paleontology and paleoanthropology, but also in the reconstruction of husbandry practices related to pigs.

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APPENDAGE I

- Supplementary data -

- LABIAL VS LINGUAL SIDE -

Table 1. Summary statistics of the microfeature counts on the lingual and occlusal sides of the lower suid incisors.

SEM: LINGUAL SIDE VARIABLES (n=145)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	133,79	49,170	2417,711	38	352	98,50	126,00	158,50
TS	67,19	24,525	601,490	20	164	50,00	65,00	81,00
LtS	35,42	19,518	380,968	2	89	18,50	33,00	50,50
ObS	14,90	7,460	55,649	1	39	9,00	14,00	18,50
TrS	16,87	12,059	145,420	1	88	8,00	14,00	24,00
VSS	31,53	17,319	299,931	5	94	19,00	28,00	39,50
SS	16,81	7,804	60,907	1	49	11,00	17,00	21,50
LS	6,94	4,755	22,614	0	32	4,00	6,00	9,00
VLS	5,03	4,411	19,458	0	27	1,50	4,00	8,00
HLS	6,89	7,325	53,654	0	32	,50	4,00	12,00
Lt_HLS	5,91	8,461	71,582	0	59	,00	2,00	8,00
Lt_VLS.HLS	8,70	9,917	98,352	0	39	1,00	5,00	14,50
BS	12,93	7,278	52,967	0	43	8,00	12,00	17,00
NS	54,26	23,872	569,889	8	158	38,00	50,00	65,50
TP	66,59	39,374	1550,299	16	220	35,50	54,00	88,50
SP	36,68	26,279	690,582	6	159	17,00	32,00	47,50
WP	19,66	13,160	173,184	0	69	10,00	16,00	26,00
HWP	10,26	8,441	71,247	0	49	4,00	9,00	13,00
X_Length	154,11	51,625	2665,134	36	291	111,16	165,55	193,01
X_Width	3,95	1,472	2,168	1	9	2,84	3,78	4,77

Table 2. Summary statistics of the microfeature ratios on the lingual and occlusal sides of the lower suid incisors. The ratios above the grey band are expressed as a percentage.

SEM: LINGUAL SIDE RATIOS (n=145)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_TS.TMF	52,44	15,072	227,173	20	81	40,62	52,63	64,90
R_LtS.TS	51,03	18,787	352,962	8	88	35,00	50,70	65,44
R_ObS.TS	22,84	9,807	96,175	1	47	16,87	22,08	27,63
R_TrS.TS	26,13	15,791	249,353	2	76	12,33	23,81	37,38
R_VSS.TS	46,86	17,675	312,415	10	95	33,33	42,61	60,32
R_SS.TS	24,95	8,028	64,441	4	49	19,68	24,24	29,79
R_LS.TS	10,39	5,971	35,657	0	30	6,79	10,00	14,43
R_VLS.TS	7,46	6,003	36,037	0	28	2,84	6,25	11,18
R_HLS.TS	10,34	10,827	117,222	0	60	,56	7,32	15,63
R_Lt.HLS.TS	7,92	10,144	102,909	0	60	,00	3,13	12,45
R_Lt.VLS.HLS.TS	11,85	12,045	145,087	0	49	1,59	7,14	19,73
R_TP.TMF	47,56	15,072	227,173	19	80	35,10	47,37	59,38
R_SP.TP	53,85	17,012	289,414	21	100	40,32	54,10	66,15
R_WP.TP	30,13	12,336	152,187	0	65	21,15	28,17	38,62
R_HWP.TP	16,01	10,255	105,157	0	48	8,43	14,29	22,12
R_BS.NS	,29	,230	,053	0	2	,14	,23	,40
R_P.S	1,11	,757	,574	0	4	,54	,90	1,46
R_WP.HWP.SP	1,08	,764	,584	0	4	,51	,85	1,48

Table 3. Summary statistics of the microfeature counts on the labial side of the lower suid incisors.

SEM: LABIAL SIDE VARIABLES (n=51)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	129,69	27,048	731,620	70	192	116,00	135,00	146,00
TS	93,27	24,558	603,083	49	142	73,00	92,00	111,00
LtS	48,73	14,296	204,363	16	79	38,00	47,00	60,00
ObS	23,80	10,224	104,521	6	48	15,00	24,00	31,00
TrS	20,71	13,008	169,212	1	58	12,00	17,00	27,00
VSS	31,63	16,569	274,518	6	102	22,00	29,00	39,00
SS	26,25	9,643	92,994	7	45	18,00	25,00	33,00
LS	13,39	5,720	32,723	4	25	9,00	14,00	17,00
VLS	8,43	3,489	12,170	3	19	6,00	8,00	11,00
HLS	13,57	6,610	43,690	0	28	9,00	13,00	18,00
Lt_HLS	9,96	5,253	27,598	0	25	7,00	9,00	14,00
Lt_VLS.HLS	15,04	6,400	40,958	1	34	12,00	15,00	19,00
BS	15,84	7,154	51,175	0	32	11,00	15,00	21,00
NS	77,43	26,850	720,930	34	130	56,00	75,00	94,00
TP	36,41	11,557	133,567	15	63	29,00	34,00	46,00
SP	19,10	9,096	82,730	6	44	12,00	17,00	25,00
WP	11,65	5,688	32,353	0	24	7,00	11,00	17,00
HWP	5,67	3,445	11,867	0	15	3,00	5,00	8,00
X_Length	192,57	33,940	1151,919	82	272	175,88	193,86	208,07
X_Width	3,64	1,136	1,290	2	7	2,92	3,68	4,26

Table 4. Summary statistics of the microfeature ratios on the labial side of the lower suid incisors. The ratios above the grey band are expressed as a percentage.

SEM: LABIAL SIDE RATIOS (n=51)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_LtS.TS	53,55	13,656	186,487	25	82	44,23	55,74	62,14
R_ObS.TS	24,85	6,868	47,166	9	44	20,59	25,21	27,93
R_TrS.TS	21,57	10,443	109,046	2	48	14,13	18,03	28,17
R_VSS.TS	32,76	10,963	120,196	9	77	26,58	33,33	36,36
R_SS.TS	27,84	6,351	40,333	13	41	23,61	28,24	32,20
R_LS.TS	14,33	4,690	21,993	3	24	11,25	13,64	18,02
R_VLS.TS	9,43	3,973	15,784	2	19	6,15	9,71	12,20
R_HLS.TS	15,64	8,186	67,018	0	35	9,78	14,75	22,22
R_Lt.HLS.TS	11,79	6,915	47,813	0	28	6,73	10,71	16,85
R_Lt.VLS.HLS.TS	17,66	8,661	75,011	1	38	12,61	18,07	23,17
R_TP.TMF	28,56	8,217	67,519	11	45	22,66	27,08	35,59
R_SP.TP	52,24	16,447	270,519	23	93	38,71	52,63	63,16
R_WP.TP	31,72	12,612	159,055	0	55	21,74	29,31	41,67
R_HWP.TP	16,04	10,346	107,040	0	54	9,38	12,90	21,74
R_BS.NS	,25	,171	,029	0	1	,15	,21	,33
R_P.S	,42	,168	,028	0	1	,29	,37	,55
R_WP.HWP.SP	1,14	,790	,624	0	3	,58	,90	1,58

Table 5. Normality tests for data regarding the different variables on the lingual and labial sides.

VARIABLES/ RATIOS	SIDE	Kolmogorov-Smirnov ^a			Shapiro-Wilkinson		
		Statistic	df	Sig.	Statistic	df	Sig.
TMF	Lingual	.096	145	.002	.937	145	<0.0001
	Labial	.122	51	.055	.964	51	.123
X_Length	Lingual	.091	145	.005	.984	145	.085
	Labial	.108	51	.192	.955	51	.051
X_Width	Lingual	.072	145	.060	.955	145	<0.0001
	Labial	.085	51	.200*	.957	51	.060
R_LtS.TS	Lingual	.074	145	.047	.981	145	.042
	Labial	.074	51	.200*	.980	51	.553
R_ObS.TS	Lingual	.089	145	.007	.972	145	.004
	Labial	.120	51	.062	.975	51	.347
R_TrS.TS	Lingual	.091	145	.005	.952	145	<0.0001
	Labial	.142	51	.011	.955	51	.050
R_VSS.TS	Lingual	.113	145	<0.0001	.972	145	.005
	Labial	.149	51	.006	.910	51	.001
R_SS.TS	Lingual	.043	145	.200*	.995	145	.892
	Labial	.060	51	.200*	.986	51	.796
R_LS.TS	Lingual	.061	145	.200*	.980	145	.033
	Labial	.071	51	.200*	.989	51	.929
R_VLS.TS	Lingual	.107	145	<0.0001	.932	145	<0.0001
	Labial	.068	51	.200*	.981	51	.572
R_HLS.TS	Lingual	.170	145	<0.0001	.861	145	<0.0001
	Labial	.074	51	.200*	.979	51	.504
R_Lt.HLS.TS	Lingual	.217	145	<0.0001	.784	145	<0.0001
	Labial	.074	51	.200*	.978	51	.470
R_Lt.VLS.HLS.TS	Lingual	.163	145	<0.0001	.869	145	<0.0001
	Labial	.074	51	.200*	.981	51	.591
R_TP.TMF	Lingual	.065	145	.200*	.978	145	.022
	Labial	.085	51	.200*	.981	51	.575
R_SP.TP	Lingual	.058	145	.200*	.985	145	.113
	Labial	.094	51	.200*	.981	51	.568
R_WP.TP	Lingual	.083	145	.016	.986	145	.140
	Labial	.095	51	.200*	.964	51	.128
R_HWP.TP	Lingual	.097	145	.002	.958	145	<0.0001
	Labial	.135	51	.021	.910	51	.001
R_BS.NS	Lingual	.144	145	<0.0001	.832	145	<0.0001
	Labial	.154	51	.004	.891	51	<0.0001
R_P.S	Lingual	.145	145	<0.0001	.865	145	<0.0001
	Labial	.125	51	.044	.966	51	.155
R_WP.HWP.SP	Lingual	.140	145	<0.0001	.900	145	<0.0001
	Labial	.167	51	.001	.891	51	<0.0001

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 6. Results of the statistical tests for differences between the lingual and labial sides of the suoid incisors.

[LINGUAL VS LABIAL] STATISTICAL TESTS							
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS	
	Levene's Test		ANOVA			Kruskal-Wallis Test	
	F	Sig.		Mean Square	F	Sig.	Chi-Square
TMF	14,398	<0,0001	634,214	,320	,572	,048	,826
X_Length	21,805	<0,0001	55802,905	24,527	<0,0001	22,249	<0,0001
X_Width	4,355	,038	3,651	1,880	,172	1,015	,314
R_LtS.TS	9,049	,003	239,523	,773	,381	,963	,326
R_ObS.TS	6,712	,010	152,825	1,829	,178	4,529	,033
R_TrS.TS	12,176	,001	784,326	3,679	,057	1,926	,165
R_VSS.TS	22,195	<0,0001	7497,375	28,521	<0,0001	27,919	<0,0001
R_SS.TS	2,683	,103	313,861	5,390	,021	6,278	,012
R_LS.TS	2,625	,107	586,019	18,236	<0,0001	19,108	<0,0001
R_VLS.TS	9,664	,002	146,939	4,768	,030	8,233	,004
R_HLS.TS	4,233	,041	1058,969	10,155	,002	16,104	<0,0001
R_Lt.HLS.TS	6,384	,012	566,030	6,381	,012	15,951	<0,0001
R_Lt.VLS.HLS.TS	12,685	<0,0001	1272,218	10,015	,002	14,204	<0,0001
R_TP.TMF	23,348	<0,0001	13623,541	73,235	<0,0001	57,302	<0,0001
R_SP.TP	,142	,707	98,454	,346	,557	,274	,600
R_WP.TP	,137	,712	95,192	,618	,433	,794	,373
R_HWP.TP	,031	,860	,024	<0,0001	,988	,032	,858
R_BS.NS	3,032	,083	,072	1,548	,215	,754	,385
R_P.S	42,163	<0,0001	18,029	41,621	<0,0001	56,982	<0,0001
R_WP.HWP.SP	,055	,814	,145	,243	,622	,279	,597

- ENAMEL VS DENTINE SURFACE -

Table 7. Summary statistics of the microfeature counts on the enamel surface of the lower suoid incisors.

SEM: ENAMEL SURFACE VARIABLES (n=147)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	141,77	44,522	1982,206	66	352	108,00	136,00	164,00
TS	80,95	26,144	683,504	32	164	60,00	79,00	98,00
LtS	43,30	18,190	330,869	9	89	31,00	42,00	54,00
ObS	18,75	9,084	82,518	1	48	13,00	17,00	25,00
TrS	18,88	13,368	178,697	1	88	9,00	16,00	27,00
VSS	33,99	17,571	308,753	6	102	22,00	30,00	42,00
SS	21,63	9,003	81,058	3	49	15,00	20,00	27,00
LS	9,41	6,058	36,696	0	32	5,00	8,00	12,00
VLS	6,47	4,660	21,717	0	27	3,00	7,00	10,00
HLS	9,45	8,069	65,112	0	32	2,00	8,00	15,00
Lt_HLS	8,07	8,383	70,283	0	59	1,00	7,00	13,00
Lt_VLS.HLS	12,02	9,784	95,732	0	39	2,00	12,00	19,00
BS	14,25	7,345	53,943	0	43	9,00	13,00	19,00
NS	66,69	26,751	715,611	21	158	46,00	63,00	85,00
TP	60,82	39,739	1579,174	15	220	32,00	47,00	85,00
SP	33,24	26,562	705,556	6	159	14,00	25,00	43,00
WP	18,25	12,094	146,272	0	69	9,00	16,00	24,00
HWP	9,33	7,826	61,249	0	49	4,00	8,00	12,00
X_Length	164,39	50,543	2554,634	36	272	124,31	176,14	198,98
X_Width	3,75	1,333	1,777	1	9	2,82	3,61	4,58

Table 8. Summary statistics of the microfeature ratios on the enamel surface of the lower suid incisors. The ratios above the grey band are expressed as a percentage.

SEM: ENAMEL SURFACE RATIOS (n=147)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_LtS.TS	53,58	16,527	273,157	13	88	41,18	54,17	65,43
R_ObS.TS	23,25	8,338	69,515	1	47	17,82	23,71	27,47
R_TrS.TS	23,16	13,325	177,564	2	60	12,16	20,00	31,48
R_VSS.TS	42,49	17,722	314,086	9	95	30,00	37,61	51,72
R_SS.TS	26,75	7,177	51,512	5	41	21,88	27,27	32,00
R_LS.TS	11,39	5,635	31,754	0	25	7,79	11,48	14,81
R_VLS.TS	7,91	5,380	28,943	0	27	3,51	7,94	11,24
R_HLS.TS	11,46	9,521	90,655	0	35	2,35	10,17	18,18
R_Lt.HLS.TS	9,87	9,790	95,844	0	60	,83	8,16	16,05
R_Lt.VLS.HLS.TS	14,88	11,807	139,397	0	49	2,96	14,41	23,61
R_TP.TMF	40,76	16,250	264,079	11	80	27,03	37,88	51,91
R_SP.TP	52,61	15,895	252,640	23	93	38,85	52,94	63,24
R_WP.TP	31,11	12,029	144,702	0	65	22,06	28,57	39,62
R_HWP.TP	16,29	9,877	97,547	0	54	9,52	14,12	21,88
R_LtS.TrS	4,32	6,268	39,292	0	54	1,35	2,65	5,38
R_BS.NS	,26	,189	,036	0	1	,13	,22	,35
R_P.S	,87	,718	,515	0	4	,37	,61	1,08
R_WP.HWP.SP	1,11	,731	,535	0	3	,58	,89	1,57

Table 9. Summary statistics of the microfeature counts on the enamel surface of the lower suoid incisors.

SEM: DENTINE SURFACE VARIABLES (n=49)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	105,57	31,561	996,083	38	167	87,50	103,00	125,50
TS	53,08	17,145	293,952	20	85	39,50	52,00	67,00
LtS	25,63	15,798	249,571	2	63	13,50	20,00	38,50
ObS	12,61	7,640	58,367	1	39	7,00	12,00	16,50
TrS	14,84	8,250	68,056	1	32	8,50	13,00	19,50
VSS	24,27	13,202	174,282	5	62	14,00	20,00	33,50
SS	12,18	5,911	34,945	1	28	8,00	11,00	17,00
LS	6,22	3,907	15,261	0	16	4,00	5,00	9,00
VLS	4,24	3,212	10,314	0	13	2,00	4,00	6,00
HLS	6,16	5,935	35,223	0	20	1,00	5,00	9,00
Lt_HLS	3,65	5,262	27,690	0	20	,00	1,00	6,00
Lt_VLS.HLS	5,33	6,622	43,849	0	30	1,00	3,00	8,50
BS	12,00	7,136	50,917	0	29	7,00	10,00	16,50
NS	41,08	14,272	203,702	8	66	31,00	41,00	53,00
TP	52,49	25,486	649,547	16	119	31,50	47,00	72,50
SP	28,67	15,451	238,724	6	72	14,50	27,00	40,50
WP	15,55	12,380	153,253	0	66	7,50	12,00	19,00
HWP	8,27	7,449	55,491	0	31	2,50	7,00	12,00
X_Length	163,29	50,859	2586,602	70	291	120,19	165,96	196,78
X_Width	4,23	1,532	2,348	2	9	3,23	3,92	5,12

Table 10. Summary statistics of the microfeature ratios on the enamel surface of the lower suid incisors. The ratios above the grey band are expressed as a percentage.

SEM: DENTINE SURFACE RATIOS (n=49)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_LtS.TS	46,01	19,583	383,488	8	88	33,33	40,00	59,32
R_ObS.TS	23,70	11,369	129,244	3	46	16,29	22,22	31,48
R_TrS.TS	30,29	17,291	298,968	2	76	16,28	30,00	42,54
R_VSS.TS	45,28	16,042	257,339	10	85	32,99	44,07	58,15
R_SS.TS	22,58	8,481	71,924	4	49	15,84	22,67	26,67
R_LS.TS	11,51	6,745	45,491	0	30	6,92	10,00	16,45
R_VLS.TS	8,13	6,288	39,540	0	28	4,05	6,25	12,60
R_HLS.TS	12,49	12,922	166,988	0	60	2,66	10,20	19,33
R_Lt.HLS.TS	6,12	8,248	68,031	0	40	,00	2,50	10,69
R_Lt.VLS.HLS.TS	8,81	9,361	87,623	0	41	1,62	5,41	15,27
R_TP.TMF	48,21	13,781	189,907	23	80	35,85	47,93	58,17
R_SP.TP	55,91	19,372	375,288	21	100	41,43	57,98	71,50
R_WP.TP	28,87	13,426	180,262	0	65	19,44	28,05	37,98
R_HWP.TP	15,22	11,375	129,398	0	43	6,35	12,64	23,43
R_LtS.TrS	4,22	8,298	68,850	0	45	,79	1,30	3,84
R_BS.NS	,34	,278	,077	0	2	,18	,29	,41
R_P.S	1,11	,718	,516	0	4	,56	,92	1,39
R_WP.HWP.SP	1,06	,882	,777	0	4	,40	,72	1,42

Table 11. Normality tests for data regarding the different variables on the enamel and dentine surfaces.

VARIABLES/ RATIOS	SURFACE TYPE	Kolmogorov-Smirnov ^a			Shapiro-Wilkinson		
		Statistic	df	Sig.	Statistic	df	Sig.
TMF	Enamel	.119	147	<0.0001	.923	147	<0.0001
	Dentine	.097	49	.200*	.980	49	.552
X_Length	Enamel	.136	147	<0.0001	.956	147	<0.0001
	Dentine	.126	49	.050	.971	49	.259
X_Width	Enamel	.087	147	.008	.959	147	<0.0001
	Dentine	.133	49	.030	.945	49	.024
R_LtS.TS	Enamel	.055	147	.200*	.988	147	.242
	Dentine	.131	49	.035	.962	49	.114
R_ObS.TS	Enamel	.082	147	.017	.988	147	.265
	Dentine	.172	49	.001	.946	49	.026
R_TrS.TS	Enamel	.112	147	<0.0001	.942	147	<0.0001
	Dentine	.073	49	.200*	.967	49	.176
R_VSS.TS	Enamel	.145	147	<0.0001	.926	147	<0.0001
	Dentine	.095	49	.200*	.985	49	.763
R_SS.TS	Enamel	.038	147	.200*	.991	147	.440
	Dentine	.090	49	.200*	.970	49	.251
R_LS.TS	Enamel	.041	147	.200*	.989	147	.289
	Dentine	.176	49	.001	.960	49	.099
R_VLS.TS	Enamel	.071	147	.070	.966	147	.001
	Dentine	.134	49	.029	.921	49	.003
R_HLS.TS	Enamel	.114	147	<0.0001	.930	147	<0.0001
	Dentine	.167	49	.002	.852	49	<0.0001
R_Lt.HLS.TS	Enamel	.157	147	<0.0001	.871	147	<0.0001
	Dentine	.229	49	<0.0001	.751	49	<0.0001
R_Lt.VLS.HLS.TS	Enamel	.117	147	<0.0001	.937	147	<0.0001
	Dentine	.175	49	.001	.846	49	<0.0001
R_TP.TMF	Enamel	.081	147	.019	.960	147	<0.0001
	Dentine	.124	49	.059	.967	49	.184
R_SP.TP	Enamel	.067	147	.200*	.982	147	.050
	Dentine	.053	49	.200*	.984	49	.741
R_WP.TP	Enamel	.087	147	.009	.984	147	.093
	Dentine	.094	49	.200*	.982	49	.638
R_HWP.TP	Enamel	.113	147	<0.0001	.943	147	<0.0001
	Dentine	.120	49	.073	.940	49	.015
R_BS.NS	Enamel	.162	147	<0.0001	.878	147	<0.0001
	Dentine	.171	49	.001	.796	49	<0.0001
R_P.S	Enamel	.184	147	<0.0001	.799	147	<0.0001
	Dentine	.164	49	.002	.843	49	<0.0001
R_WP.HWP.SP	Enamel	.148	147	<0.0001	.905	147	<0.0001
	Dentine	.161	49	.003	.867	49	<0.0001

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 12. Results of the statistical tests for the differences between the enamel and dentine surfaces of the suoid incisors.

[ENAMEL VS DENTINE] STATISTICAL TESTS							
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS	
	Levene's Test		ANOVA			Kruskal-Wallis Test	
	F	Sig.	Mean Square	F	Sig.	Chi-Square	Sig.
TMF	2,739	,100	48151,430	27,702	<0,0001	25,285	<0,0001
X_Length	,001	,979	44,622	,017	,895	,385	,535
X_Width	,551	,459	8,142	4,243	,041	3,480	,062
R_LtS.TS	2,807	,095	2102,021	6,996	,009	6,774	,009
R_ObS.TS	6,021	,015	7,500	,089	,766	,199	,655
R_TrS.TS	4,430	,037	1868,577	9,001	,003	7,119	,008
R_VSS.TS	,209	,648	286,163	,954	,330	2,234	,135
R_SS.TS	,304	,582	636,980	11,262	,001	11,537	,001
R_LS.TS	2,633	,106	,558	,016	,900	,139	,710
R_VLS.TS	,762	,384	1,805	,057	,811	,058	,810
R_HLS.TS	2,845	,093	38,895	,355	,552	,005	,945
R_Lt.HLS.TS	3,083	,081	516,966	5,811	,017	6,226	,013
R_Lt.VLS.HLS.TS	7,567	,007	1357,451	10,723	,001	9,354	,002
R_TP.TMF	1,788	,183	2041,431	8,308	,004	9,404	,002
R_SP.TP	3,489	,063	400,752	1,416	,235	,998	,318
R_WP.TP	,225	,636	183,792	1,197	,275	1,346	,246
R_HWP.TP	2,860	,092	41,653	,395	,530	,896	,344
R_BS.NS	3,309	,070	,207	4,493	,035	3,444	,063
R_P.S	,012	,912	2,054	3,984	,047	9,387	,002
R_WP.HWP.SP	1,376	,242	,075	,126	,722	,998	,318

- OCCLUSAL VS NON-OCCLUSAL FACET -

Table 13. Summary statistics of the microfeature counts on the occlusal facet of the suoid lower and upper incisors.

SEM: OCCLUSAL FACET VARIABLES (n=52)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	143,40	42,849	1836,049	38	241	113,00	145,50	166,50
TS	58,08	18,471	341,170	20	96	48,25	56,00	71,00
LtS	22,65	12,702	161,329	2	57	14,00	20,00	29,00
ObS	15,31	7,589	57,590	1	39	10,00	15,00	20,75
TrS	20,10	10,323	106,559	5	49	11,25	19,00	28,75
VSS	30,62	13,640	186,045	5	62	21,25	29,00	39,00
SS	15,29	7,204	51,896	1	37	9,25	15,50	20,00
LS	5,52	3,393	11,509	0	13	3,25	5,00	7,00
VLS	3,25	3,022	9,132	0	13	1,00	3,00	4,75
HLS	3,40	4,517	20,402	0	20	,00	2,00	5,00
Lt_HLS	1,54	3,103	9,626	0	20	,00	,50	2,00
Lt_VLS.HLS	2,56	2,873	8,252	0	10	,00	1,50	4,00
BS	12,33	6,138	37,675	1	29	8,00	11,00	15,00
NS	45,75	17,437	304,034	8	87	34,25	46,00	54,75
TP	85,33	33,493	1121,754	18	173	60,50	84,50	109,00
SP	46,83	21,917	480,342	10	125	32,00	42,00	64,00
WP	24,85	15,022	225,662	3	69	13,25	23,00	34,50
HWP	13,65	10,013	100,270	0	46	5,25	12,00	20,75
X_Length	134,35	47,803	2285,095	56	291	106,37	125,59	166,90
X_Width	4,33	1,527	2,333	2	9	3,23	4,10	5,10

Table 14. Summary statistics of the microfeature ratios on the occlusal facet of the lower and upper suid incisors. The ratios above the grey band are expressed as a percentage.

SEM: OCCLUSAL FACET RATIOS (n=52)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_LtS.TS	38,21	14,945	223,355	8	75	28,65	35,97	50,53
R_ObS.TS	26,13	10,204	104,129	3	47	19,18	23,77	33,33
R_TrS.TS	35,64	16,049	257,565	8	76	22,76	33,63	46,82
R_VSS.TS	52,43	16,248	263,982	10	87	40,45	56,35	61,14
R_SS.TS	25,80	8,732	76,246	4	49	21,97	24,43	31,83
R_LS.TS	9,15	5,211	27,157	0	20	6,28	9,11	12,85
R_VLS.TS	5,49	5,223	27,283	0	25	1,56	4,80	8,12
R_HLS.TS	7,13	12,030	144,720	0	60	,00	2,76	9,14
R_Lt.HLS.TS	2,71	6,017	36,200	0	40	,00	,53	3,05
R_Lt.VLS.HLS.TS	4,08	4,533	20,548	0	19	,00	2,59	6,75
R_TP.TMF	58,39	10,852	117,760	33	80	50,58	58,70	67,39
R_SP.TP	56,21	15,880	252,159	21	94	46,32	58,30	69,30
R_WP.TP	28,39	11,559	133,621	4	65	19,86	27,30	35,86
R_HWP.TP	15,40	9,490	90,054	0	43	8,09	13,21	20,96
R_BS.NS	,32	,239	,057	0	2	,18	,28	,42
R_P.S	1,59	,757	,573	0	4	1,02	1,42	2,07
R_WP.HWP.SP	,96	,700	,490	0	4	,44	,72	1,16

Table 15. Summary statistics of the microfeature counts on the non-occlusal facet of the suoid incisors.

SEM: NON-OCCLUSAL FACET VARIABLES (n=93)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	128,41	51,816	2684,918	46	352	94,00	115,00	147,50
TS	72,29	26,060	679,100	29	164	53,50	70,00	87,00
LtS	42,56	19,059	363,227	9	89	28,50	41,00	54,00
ObS	14,67	7,418	55,029	1	34	9,00	14,00	18,00
TrS	15,06	12,624	159,365	1	88	7,00	12,00	19,00
VSS	32,04	19,120	365,585	9	94	18,00	28,00	40,50
SS	17,66	8,033	64,532	3	49	11,50	17,00	23,50
LS	7,73	5,219	27,242	0	32	4,00	7,00	10,00
VLS	6,02	4,755	22,608	0	27	2,00	6,00	8,00
HLS	8,84	7,872	61,963	0	32	2,00	7,00	15,50
Lt_HLS	8,35	9,480	89,862	0	59	,00	6,00	14,00
Lt_VLS.HLS	12,13	10,778	116,157	0	39	2,00	10,00	19,00
BS	13,27	7,855	61,699	0	43	8,00	12,00	18,50
NS	59,02	25,683	659,608	15	158	40,50	56,00	72,50
TP	56,12	38,671	1495,432	16	220	31,00	45,00	66,00
SP	31,00	26,904	723,826	6	159	13,00	23,00	39,00
WP	16,76	11,059	122,291	0	54	8,00	15,00	21,00
HWP	8,35	6,764	45,753	0	49	4,00	7,00	11,00
X_Length	165,16	50,604	2560,717	36	265	124,20	173,75	203,28
X_Width	3,74	1,405	1,973	1	8	2,74	3,59	4,60

Table 16. Summary statistics of the microfeature ratios on the non-occlusal facet of the lower and upper suid incisors. The ratios above the grey band are expressed as a percentage.

SEM: NON-OCCLUSAL RATIOS (n=93)								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_LtS.TS	58,19	16,850	283,922	25	88	45,14	57,58	71,94
R_ObS.TS	20,99	9,124	83,253	1	46	14,55	20,22	25,32
R_TrS.TS	20,81	12,956	167,854	2	54	10,33	17,54	30,63
R_VSS.TS	43,74	17,758	315,331	16	95	31,26	39,60	54,17
R_SS.TS	24,48	7,614	57,968	5	41	18,90	24,24	29,66
R_LS.TS	11,08	6,277	39,406	0	30	6,94	10,10	15,43
R_VLS.TS	8,55	6,154	37,876	0	28	3,63	8,33	13,03
R_HLS.TS	12,14	9,704	94,169	0	33	2,59	11,76	20,00
R_Lt.HLS.TS	10,83	10,822	117,113	0	60	,00	10,10	17,73
R_Lt.VLS.HLS.TS	16,20	12,748	162,514	0	49	3,84	16,67	27,35
R_TP.TMF	41,51	13,678	187,083	19	80	31,27	39,77	50,00
R_SP.TP	52,53	17,559	308,310	22	100	38,87	52,63	63,96
R_WP.TP	31,11	12,707	161,463	0	65	22,01	29,90	40,62
R_HWP.TP	16,36	10,693	114,335	0	48	9,04	14,63	23,09
R_BS.NS	,28	,225	,051	0	1	,13	,21	,36
R_P.S	,84	,616	,379	0	4	,46	,66	1,00
R_WP.HWP.SP	1,15	,793	,629	0	4	,57	,90	1,57

Table 17. Normality tests for data regarding different variables on the occlusal and non-occlusal facets.

VARIABLES/ RATIOS	FACET	Kolmogorov-Smirnov ^a			Shapiro-Wilkinson		
		Statistic	df	Sig.	Statistic	df	Sig.
TMF	occlusal	.087	52	.200*	.978	52	.461
	non-	.153	93	.000	.886	93	.000
X_Length	occlusal	.149	52	.005	.916	52	.001
	non-	.148	93	.000	.948	93	.001
X_Width	occlusal	.088	52	.200*	.947	52	.021
	non-	.099	93	.025	.955	93	.003
R_LtS.TS	occlusal	.090	52	.200*	.978	52	.426
	non-	.069	93	.200*	.973	93	.051
R_ObS.TS	occlusal	.104	52	.200*	.968	52	.173
	non-	.083	93	.128	.975	93	.067
R_TrS.TS	occlusal	.073	52	.200*	.969	52	.191
	non-	.129	93	.001	.938	93	.000
R_VSS.TS	occlusal	.114	52	.088	.978	52	.453
	non-	.137	93	.000	.931	93	.000
R_SS.TS	occlusal	.096	52	.200*	.983	52	.659
	non-	.043	93	.200*	.994	93	.955
R_LS.TS	occlusal	.090	52	.200*	.966	52	.140
	non-	.068	93	.200*	.980	93	.155
R_VLS.TS	occlusal	.147	52	.007	.871	52	.000
	non-	.082	93	.144	.952	93	.002
R_HLS.TS	occlusal	.277	52	.000	.622	52	.000
	non-	.106	93	.012	.930	93	.000
R_Lt.HLS.TS	occlusal	.326	52	.000	.461	52	.000
	non-	.158	93	.000	.868	93	.000
R_Lt.VLS.HLS.TS	occlusal	.184	52	.000	.842	52	.000
	non-	.111	93	.007	.935	93	.000
R_TP.TMF	occlusal	.078	52	.200*	.983	52	.657
	non-	.095	93	.037	.962	93	.009
R_SP.TP	occlusal	.069	52	.200*	.985	52	.730
	non-	.053	93	.200*	.976	93	.086
R_WP.TP	occlusal	.103	52	.200*	.961	52	.088
	non-	.071	93	.200*	.990	93	.739
R_HWP.TP	occlusal	.109	52	.176	.965	52	.124
	non-	.144	93	.000	.951	93	.001
R_BS.NS	occlusal	.173	52	.000	.719	52	.000
	non-	.183	93	.000	.853	93	.000
R_P.S	occlusal	.138	52	.014	.921	52	.002
	non-	.185	93	.000	.768	93	.000
R_WP.HWP.SP	occlusal	.155	52	.000	.951	52	.000
	non-	.141	93	.000	.920	93	.000

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 18. Table x. Results of the statistical tests for differences between the occlusal and non-occlusal facets of the suoid incisors.

[OCCLUSAL VS NON-OCCLUSAL FACET] STATISTICAL TESTS								
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS		
	Levene's Test			ANOVA		Kruskal-Wallis Test		
	F	Sig.		Mean Square	F	Sig.	Chi-Square	Sig.
TMF	1,009	,317		7499,380	3,148	,078	7,006	,008
X_Length	1,165	,282		31653,446	12,855	,000	14,795	,000
X_Width	,123	,726		11,697	5,566	,020	5,542	,019
R_Lt.S.TS	2,271	,134		13314,485	50,756	,000	36,877	,000
R_Ob.S.TS	1,363	,245		879,380	9,696	,002	8,174	,004
R_Tr.S.TS	3,054	,083		7328,378	36,670	,000	28,021	,000
R_VSS.TS	,319	,573		2514,272	8,465	,004	10,038	,002
R_SS.TS	,434	,511		57,891	,898	,345	,666	,414
R_LS.TS	2,578	,111		124,182	3,544	,062	2,553	,110
R_VLS.TS	2,963	,087		313,227	9,186	,003	10,034	,002
R_HLS.TS	,266	,607		835,720	7,449	,007	15,025	,000
R_Lt.HLS.TS	26,359	,000		2198,341	24,909	,000	24,364	,000
R_Lt.VLS.HLS.TS	61,642	,000		4893,397	43,737	,000	30,535	,000
R_TP.TMF	2,170	,143		9495,532	58,485	,000	43,320	,000
R_SP.TP	,568	,452		451,058	1,565	,213	2,094	,148
R_WP.TP	1,094	,297		245,658	1,621	,205	2,017	,156
R_HWP.TP	,422	,517		30,962	,293	,589	,206	,650
R_BS.NS	,199	,656		,052	,981	,324	43,378	,103
R_P.S	5,416	,021		18,539	41,368	,000	2,088	,000
R_WP.HWP.SP	2,235	,137		1,188	2,049	,155	7,006	,148

- CREST VS VALLEY -

Table 19. Summary statistics of the microfeature counts on the crest of the suoid lower incisors.

SEM: CREST VARIABLES (n=31)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	144,48	40,995	1680,591	,680	-,394	87	233	111,00	140,00	181,00
TS	78,52	27,912	779,058	,321	-,424	32	141	55,00	81,00	95,00
LtS	46,13	19,980	399,183	,367	-,111	13	89	32,00	46,00	56,00
ObS	17,48	7,681	58,991	,849	-,288	7	34	12,00	16,00	23,00
TrS	14,90	10,666	113,757	1,695	2,833	4	49	8,00	11,00	19,00
VSS	36,29	19,540	381,813	1,163	,194	15	82	23,00	29,00	50,00
SS	20,13	7,982	63,716	,267	-,457	6	36	14,00	19,00	25,00
LS	8,68	5,199	27,026	,910	,901	0	23	5,00	7,00	12,00
VLS	5,61	4,842	23,445	1,227	1,152	0	19	2,00	4,00	8,00
HLS	7,81	7,190	51,695	,590	-1,104	0	22	1,00	5,00	16,00
Lt_HLS	6,94	7,047	49,662	,811	-,661	0	22	1,00	5,00	13,00
Lt_VLS.HLS	11,71	10,244	104,946	,805	-,095	0	36	2,00	10,00	18,00
BS	16,39	8,531	72,778	1,083	1,803	4	43	9,00	16,00	20,00
NS	62,13	26,557	705,249	,702	,467	23	137	38,00	63,00	81,00
TP	65,97	31,229	975,232	,532	-,616	19	138	43,00	54,00	86,00
SP	35,68	22,845	521,892	,794	-,126	9	92	20,00	29,00	52,00
WP	18,97	9,250	85,566	,850	,019	4	39	13,00	16,00	21,00
HWP	11,32	6,882	47,359	1,010	,958	1	30	5,00	11,00	14,00
X_Length	150,73	46,517	2163,861	-,143	-1,111	61	223	111,78	148,67	193,71
X_Width	3,91	1,322	1,748	1,241	2,691	2	8	3,03	3,64	4,62

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 20. Summary statistics of the microfeature ratios on the crest of the lower suid incisors.

The ratios above the grey band are expressed as a percentage.

SEM: CREST RATIOS (n=31)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	57,88	12,644	159,879	-,398	,281	31	86	50,67	57,58	66,22
R_ObS.TS	22,84	6,763	45,733	,170	,312	8	38	18,18	22,03	27,47
R_TrS.TS	19,28	11,457	131,258	1,381	1,916	6	52	10,32	16,36	22,70
R_VSS.TS	46,68	16,840	283,585	,370	-,861	21	78	32,10	44,07	61,73
R_SS.TS	26,02	7,005	49,068	,174	-,795	15	39	20,22	25,53	30,86
R_LS.TS	11,25	5,518	30,445	-,175	-,452	0	23	7,27	12,96	15,25
R_VLS.TS	6,70	4,882	23,830	,895	,764	0	21	3,16	5,56	10,10
R_HLS.TS	9,35	8,496	72,186	,843	,234	0	33	1,72	7,69	15,28
R_Lt.HLS.TS	8,27	8,299	68,870	1,077	1,017	0	33	,83	6,78	12,77
R_Lt.VLS.HLS.TS	13,83	10,978	120,509	,551	-,573	0	38	3,70	12,35	21,43
R_TP.TMF	44,75	15,401	237,203	,407	-,487	20	77	32,09	43,68	55,25
R_SP.TP	50,89	13,771	189,648	-,220	-,245	22	80	43,75	52,63	61,70
R_WP.TP	30,80	11,843	140,247	,846	,827	14	65	21,95	29,55	39,62
R_HWP.TP	18,31	9,011	81,206	,454	-,097	2	38	12,32	16,67	22,92
R_BS.NS	,31	,188	,035	1,152	1,210	0	1	,19	,26	,40
R_P.S	1,00	,775	,601	1,894	3,695	0	3	,47	,78	1,23
R_WP.HWP.SP	1,15	,754	,569	1,664	2,789	0	4	,62	,90	1,29

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 21. Summary statistics of the microfeature counts in the valley of the suoid lower incisors.

SEM: VALLEY VARIABLES (n=17)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	129,47	23,593	556,640	-,255	-1,171	91	167	109,00	135,00	149,50
TS	82,82	17,479	305,529	,519	-1,028	59	115	69,50	77,00	100,00
LtS	59,12	12,917	166,860	1,100	,650	41	89	50,50	55,00	65,00
ObS	12,71	6,253	39,096	,112	,057	1	26	8,50	13,00	17,00
TrS	11,00	8,839	78,125	1,450	1,572	2	32	5,00	8,00	14,50
VSS	30,65	10,185	103,743	,069	-,421	11	49	24,00	29,00	40,50
SS	18,29	4,858	23,596	,409	-,887	11	27	14,50	17,00	23,00
LS	7,94	3,051	9,309	-,386	-,919	2	12	5,50	8,00	10,50
VLS	9,35	5,798	33,618	1,546	5,088	0	27	6,50	9,00	11,50
HLS	16,59	8,522	72,632	-,330	-,312	0	32	9,50	19,00	22,00
Lt_HLS	19,59	12,495	156,132	1,976	5,926	3	59	11,00	19,00	22,00
Lt_VLS.HLS	23,35	10,758	115,743	-,586	-,210	0	39	16,00	23,00	32,00
BS	12,59	7,649	58,507	1,183	1,820	2	33	7,00	10,00	17,50
NS	70,24	21,206	449,691	,050	-,785	33	107	54,00	69,00	87,00
TP	46,65	20,347	413,993	,850	-,132	21	89	31,00	41,00	60,00
SP	25,06	13,631	185,809	1,203	1,411	7	59	16,00	21,00	32,50
WP	15,12	8,580	73,610	,470	-,219	2	34	8,50	15,00	21,00
HWP	6,47	4,679	21,890	,289	-,966	0	15	2,50	6,00	11,00
X_Length	196,47	27,784	771,924	,600	1,301	146	265	177,52	195,47	211,42
X_Width	3,36	1,245	1,549	1,394	2,895	2	7	2,58	2,85	4,30

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 22. Summary statistics of the microfeature ratios in the valley of the lower suid incisors.
The ratios above the grey band are expressed as a percentage.

SEM: VALLEY RATIOS (n=17)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.TS	72,46	12,441	154,781	-,566	-,739	50	88	64,11	74,31	83,65
R_ObS.TS	14,97	6,080	36,967	-,469	,520	1	26	12,82	14,86	18,69
R_TrS.TS	12,57	8,126	66,037	,977	,293	2	30	6,60	11,27	15,72
R_VSS.TS	36,76	8,755	76,642	-,745	,248	16	48	31,45	37,61	43,34
R_SS.TS	22,36	5,576	31,089	1,508	2,150	17	38	18,73	20,27	25,61
R_LS.TS	10,01	4,527	20,498	,215	-,653	3	19	6,30	9,17	13,58
R_VLS.TS	11,12	6,222	38,718	,876	1,971	0	27	8,16	9,43	14,95
R_HLS.TS	19,75	8,619	74,287	-,890	,332	0	31	14,57	21,78	26,22
R_Lt.HLS.TS	22,73	11,818	139,674	1,806	5,649	5	60	15,32	20,78	27,30
R_Lt.VLS.HLS.TS	28,09	11,242	126,376	-,722	1,510	0	49	22,67	28,57	36,00
R_TP.TMF	35,24	11,301	127,709	,733	-,011	21	59	26,15	34,19	42,46
R_SP.TP	53,33	15,804	249,759	,664	,552	28	90	41,67	52,50	61,39
R_WP.TP	32,06	12,409	153,991	-,365	-,433	7	50	23,77	35,09	43,31
R_HWP.TP	14,61	11,829	139,918	1,375	2,874	0	48	6,65	13,33	21,11
R_BS.NS	,23	,240	,058	2,394	6,491	0	1	,08	,14	,31
R_P.S	,60	,336	,113	1,492	1,882	0	1	,36	,52	,74
R_WP.HWP.SP	1,04	,625	,390	,921	,912	0	3	,64	,90	1,44

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 23. Normality tests for data regarding different variables on crests and in valleys.

VARIABLES/ RATIOS	REGION	Kolmogorov-Smirnov ^a			Shapiro-Wilkinson		
		Statistic	df	Sig.	Statistic	df	Sig.
TMF	Crest	.153	31	.063	.932	31	.051
	Vallev	.170	17	.200*	.942	17	.341
X_Length	Crest	.132	31	.178	.951	31	.165
	Vallev	.151	17	.200*	.969	17	.793
X_Width	Crest	.135	31	.157	.918	31	.021
	Vallev	.224	17	.024	.871	17	.022
R_Lt.S.TS	Crest	.131	31	.191	.958	31	.257
	Vallev	.119	17	.200*	.925	17	.181
R_ObS.TS	Crest	.110	31	.200*	.980	31	.819
	Vallev	.170	17	.200*	.965	17	.729
R_TrS.TS	Crest	.157	31	.050	.865	31	.001
	Vallev	.194	17	.090	.899	17	.066
R_VSS.TS	Crest	.109	31	.200*	.953	31	.190
	Vallev	.153	17	.200*	.946	17	.402
R_SS.TS	Crest	.058	31	.200*	.966	31	.414
	Vallev	.229	17	.018	.842	17	.008
R_LS.TS	Crest	.138	31	.139	.973	31	.618
	Vallev	.139	17	.200*	.965	17	.732
R_VLS.TS	Crest	.141	31	.117	.934	31	.058
	Vallev	.193	17	.091	.931	17	.222
R_HLS.TS	Crest	.139	31	.133	.910	31	.013
	Vallev	.151	17	.200*	.930	17	.222
R_Lt.HLS.TS	Crest	.160	31	.043	.883	31	.003
	Vallev	.186	17	.120	.846	17	.009
R_Lt.VLS.HLS.TS	Crest	.133	31	.172	.937	31	.066
	Vallev	.179	17	.153	.955	17	.542
R_TP.TMF	Crest	.112	31	.200*	.970	31	.518
	Vallev	.123	17	.200*	.931	17	.230
R_SP.TP	Crest	.093	31	.200*	.984	31	.903
	Vallev	.170	17	.200*	.954	17	.515
R_WP.TP	Crest	.107	31	.200*	.948	31	.137
	Vallev	.126	17	.200*	.956	17	.556
R_HWP.TP	Crest	.107	31	.200*	.962	31	.332
	Vallev	.131	17	.200*	.901	17	.070
R_BS.NS	Crest	.195	31	.004	.904	31	.009
	Vallev	.253	17	.005	.722	17	.000
R_P.S	Crest	.178	31	.014	.792	31	.000
	Vallev	.169	17	.200*	.836	17	.007
R_WP.HWP.SP	Crest	.205	31	.002	.835	31	.000
	Vallev	.199	17	.071	.927	17	.198

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 24. Results of the statistical tests for differences between crests and valleys.

[CREST VS VALLEY] STATISTICAL TESTS							
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS	
	Levene's		ANOVA			Kruskal-Wallis	
	F	Sig.	Mean Square	F	Sig.	Chi-Square	Sig.
TMF	3,651	,062	2474,689	1,919	,173	,569	,450
X_Length	9,599	,003	22968,513	13,674	,001	9,043	,003
X_Width	,013	,908	3,358	2,000	,164	3,558	,059
R_Lt.TS	,001	,978	2333,213	14,757	,000	10,807	,001
R_ObS.TS	,387	,537	678,757	15,902	,000	12,501	,000
R_TrS.TS	1,841	,181	495,040	4,560	,038	4,463	,035
R_VSS.TS	8,121	,007	1082,149	5,114	,029	3,599	,058
R_SS.TS	1,534	,222	147,001	3,433	,070	3,437	,064
R_LS.TS	1,439	,236	16,790	,622	,434	,447	,504
R_VLS.TS	,318	,576	214,807	7,405	,009	6,258	,012
R_HLS.TS	,016	,901	1187,437	16,285	,000	11,997	,001
R_Lt.HLS.TS	,393	,534	2294,549	24,541	,000	17,544	,000
R_Lt.VLS.HLS.TS	,403	,528	2230,556	18,201	,000	13,046	,000
R_TP.TMF	2,467	,123	993,393	4,989	,030	4,509	,034
R_SP.TP	,022	,884	65,454	,311	,580	,134	,714
R_WP.TP	,208	,651	17,466	,120	,730	,461	,497
R_HWP.TP	,706	,405	150,240	1,478	,230	2,409	,121
R_BS.NS	,207	,652	,071	1,634	,208	4,841	,028
R_P.S	5,036	,030	1,804	4,183	,047	4,464	,035
R_WP.HWP.SP	,306	,583	,141	,278	,601	,142	,706

- NON-OCCLUSAL LINGUAL FACET (I1 vs I2) –

Table 25. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first lower incisors.

SEM: LINGUAL NON-OCCLUSAL FACET (I1) VARIABLES (n=61)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	121,74	45,050	2029,463	,886	,010	46	233	90,00	108,00	147,50
TS	67,51	23,416	548,321	,561	-,027	29	126	50,00	66,00	81,00
LtS	42,00	20,131	405,267	,411	-,131	9	89	28,50	40,00	54,50
ObS	13,28	6,763	45,738	,840	,768	1	33	8,00	13,00	16,50
TrS	12,23	9,276	86,046	1,366	1,359	1	40	6,00	10,00	16,50
VSS	30,85	19,966	398,628	1,342	1,067	9	84	16,00	26,00	40,00
SS	16,11	6,706	44,970	,516	,483	3	36	11,00	16,00	19,00
LS	7,08	3,942	15,543	,573	,211	0	18	4,50	7,00	10,00
VLS	6,18	5,214	27,184	1,391	3,242	0	27	2,00	6,00	8,50
HLS	7,28	7,121	50,704	,988	-,019	0	27	1,00	5,00	11,50
Lt_HLS	7,25	9,679	93,689	2,938	12,760	0	59	,00	5,00	9,00
Lt_VLS.HLS	10,79	10,498	110,204	1,052	,306	0	37	2,00	10,00	15,50
BS	14,03	8,792	77,299	,906	,990	0	43	8,00	12,00	19,00
NS	53,48	21,539	463,920	,516	-,519	15	101	38,00	50,00	66,00
TP	54,23	29,943	896,580	1,030	,551	16	139	30,50	46,00	69,50
SP	28,92	18,878	356,377	1,027	,477	7	82	13,00	24,00	41,50
WP	16,89	10,531	110,903	,684	-,105	0	45	8,00	15,00	22,50
HWP	8,43	7,258	52,682	3,089	15,828	0	49	4,00	8,00	11,00
X_Length	162,59	51,894	2693,024	-,313	-,870	58	265	112,70	169,51	203,28
X_Width	3,90	1,494	2,232	,936	,715	2	8	2,78	3,61	4,77

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 26. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first lower incisors. The ratios above the grey band are expressed as a percentage.

SEM: LINGUAL NON-OCCLUSAL FACET (I1) RATIOS (n=61)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.TS	60,38	17,307	299,549	-,276	-,826	25	88	48,10	62,64	72,91
R_Obs.TS	20,65	9,637	92,866	,501	,273	1	45	13,75	19,70	25,32
R_TrS.TS	18,97	13,076	170,980	,812	-,439	2	53	9,32	14,46	29,40
R_VSS.TS	44,33	18,686	349,149	,607	-,585	16	88	29,85	39,06	61,42
R_SS.TS	24,26	7,668	58,792	,084	-,473	8	41	17,88	24,32	29,36
R_LS.TS	11,31	6,180	38,190	,551	,571	0	30	7,11	10,26	15,47
R_VLS.TS	9,31	6,754	45,621	,517	-,034	0	28	3,76	9,09	13,88
R_HLS.TS	10,79	9,411	88,564	,632	-,667	0	33	2,21	8,00	15,63
R_Lt.HLS.TS	9,85	11,086	122,895	1,911	5,588	0	60	,00	7,69	14,61
R_Lt.VLS.HLS.TS	15,25	12,974	168,315	,598	-,603	0	49	3,81	12,90	26,20
R_TP.TMF	42,93	12,387	153,447	,281	-,216	20	74	33,77	41,41	51,48
R_SP.TP	52,69	17,282	298,665	,479	-,135	26	100	39,14	52,63	63,33
R_WP.TP	31,09	12,736	162,214	,161	,004	0	65	22,01	30,56	40,62
R_HWP.TP	16,22	10,997	120,928	,701	,107	0	48	9,14	14,63	22,74
R_BS.NS	,31	,253	,064	1,248	,921	0	1	,13	,23	,42
R_P.S	,85	,501	,251	1,805	4,451	0	3	,51	,71	1,06
R_WP.HWP.SP	1,12	,738	,545	,785	-,254	0	3	,58	,90	1,56

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 27. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the second lower incisors.

SEM: LINGUAL NON-OCCLUSAL FACET (I2) VARIABLES (n=29)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	142,90	62,168	3864,882	2,027	4,349	68	352	107,00	117,00	151,50
TS	85,52	26,687	712,187	1,207	1,915	40	164	70,00	81,00	95,50
LtS	46,28	15,457	238,921	,164	-,129	17	81	34,00	48,00	54,00
ObS	17,83	8,094	65,505	,281	-,547	3	34	10,50	17,00	24,00
TrS	21,41	16,657	277,466	2,455	8,540	2	88	10,00	19,00	29,50
VSS	35,72	17,659	311,850	1,520	2,859	12	94	23,00	31,00	45,00
SS	21,45	9,284	86,185	,618	1,689	3	49	15,50	22,00	26,50
LS	9,66	6,940	48,163	1,360	2,765	0	32	4,50	9,00	12,00
VLS	6,10	3,764	14,167	-,250	-,834	0	13	3,00	7,00	8,50
HLS	12,59	8,437	71,180	-,008	-,502	0	32	4,50	13,00	18,50
Lt_HLS	11,41	8,744	76,466	,159	-,642	0	32	1,50	13,00	18,50
Lt_VLS.HLS	15,90	10,838	117,453	-,062	-,815	0	39	4,50	18,00	23,50
BS	11,97	5,704	32,534	,274	-,436	1	25	7,50	12,00	16,00
NS	73,55	28,199	795,185	1,393	2,202	33	158	56,00	66,00	81,00
TP	57,38	51,476	2649,744	2,453	5,064	25	220	31,50	41,00	47,50
SP	33,79	38,430	1476,884	2,258	4,372	7	159	13,00	21,00	33,00
WP	15,76	11,615	134,904	2,075	4,442	4	54	8,50	13,00	17,00
HWP	7,83	5,587	31,219	1,709	4,788	1	28	3,50	6,00	11,00
X_Length	171,73	49,075	2408,382	-1,350	1,249	36	240	167,31	188,46	201,20
X_Width	3,29	1,141	1,302	,344	-,436	1	6	2,32	3,00	4,28

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 28. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the second lower incisors. The ratios above the grey band are expressed as a percentage.

SEM: LINGUAL NON-OCCLUSAL FACET (I2) RATIOS (n=29)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	55,33	15,399	237,141	,157	-,829	27	81	42,52	52,83	68,51
R_Ob.S.TS	20,77	7,151	51,131	-,134	,199	4	35	15,06	20,24	24,57
R_Tr.S.TS	23,90	12,288	150,995	,446	-,271	3	54	12,70	22,70	32,96
R_VSS.TS	41,94	16,672	277,946	1,649	2,796	22	95	31,63	38,20	44,02
R_SS.TS	24,69	7,223	52,175	-,157	,878	5	41	20,00	23,94	29,76
R_LS.TS	11,13	6,570	43,159	,274	-,503	0	25	5,95	10,00	15,53
R_VLS.TS	7,32	4,671	21,814	-,065	-,655	0	16	3,83	8,24	10,50
R_HLS.TS	14,92	9,516	90,553	-,231	-,877	0	31	7,36	16,05	21,93
R_Lt.HLS.TS	13,60	10,148	102,973	-,052	-1,184	0	31	2,17	15,48	20,48
R_Lt.VLS.HLS.TS	19,02	12,281	150,828	-,363	-1,147	0	38	6,57	21,43	28,51
R_TP.TMF	36,70	13,804	190,544	1,314	,947	19	70	27,31	33,61	40,68
R_SP.TP	52,46	18,792	353,133	,183	-,904	22	87	36,42	52,50	69,17
R_WP.TP	30,76	12,728	162,006	,266	-,557	9	56	21,88	28,13	41,31
R_HWP.TP	16,78	10,765	115,881	,599	-,683	3	40	6,98	13,53	25,00
R_BS.NS	,19	,128	,016	1,125	1,274	0	1	,10	,16	,26
R_P.S	,69	,560	,313	2,030	3,160	0	2	,38	,51	,69
R_WP.HWP.SP	1,20	,918	,843	1,083	,484	0	4	,44	,90	1,75

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 29. Normality tests for the data regarding the different variables on the lingual non-occlusal facet between the first and second lower incisors.

VARIABLES/ RATIOS	REGION	Kolmogorov-Smirnov ^a			Shapiro-Wilkinson		
		Statistic	df	Sig.	Statistic	df	Sig.
TMF	I1	.161	61	.000	.917	61	.001
	I2	.232	29	.000	.773	29	.000
X_Length	I1	.113	61	.051	.960	61	.045
	I2	.247	29	.000	.845	29	.001
X_Width	I1	.131	61	.011	.939	61	.004
	I2	.141	29	.146	.974	29	.679
R_LtS.TS	I1	.081	61	.200*	.964	61	.071
	I2	.146	29	.117	.951	29	.196
R_ObS.TS	I1	.080	61	.200*	.974	61	.220
	I2	.085	29	.200*	.979	29	.807
R_TrS.TS	I1	.169	61	.000	.903	61	.000
	I2	.110	29	.200*	.971	29	.580
R_VSS.TS	I1	.119	61	.031	.940	61	.005
	I2	.242	29	.000	.830	29	.000
R_SS.TS	I1	.059	61	.200*	.991	61	.941
	I2	.132	29	.200*	.969	29	.545
R_LS.TS	I1	.076	61	.200*	.975	61	.243
	I2	.085	29	.200*	.973	29	.633
R_VLS.TS	I1	.084	61	.200*	.950	61	.015
	I2	.103	29	.200*	.952	29	.202
R_HLS.TS	I1	.128	61	.015	.913	61	.000
	I2	.114	29	.200*	.942	29	.116
R_Lt.HLS.TS	I1	.187	61	.000	.814	61	.000
	I2	.172	29	.028	.915	29	.023
R_Lt.VLS.HLS.TS	I1	.120	61	.029	.924	61	.001
	I2	.133	29	.200*	.912	29	.019
R_TP.TMF	I1	.063	61	.200*	.983	61	.580
	I2	.214	29	.001	.846	29	.001
R_SP.TP	I1	.060	61	.200*	.968	61	.113
	I2	.090	29	.200*	.965	29	.441
R_WP.TP	I1	.062	61	.200*	.993	61	.978
	I2	.109	29	.200*	.972	29	.610
R_HWP.TP	I1	.161	61	.000	.942	61	.006
	I2	.136	29	.183	.931	29	.059
R_BS.NS	I1	.177	61	.000	.871	61	.000
	I2	.131	29	.200*	.912	29	.020
R_P.S	I1	.158	61	.001	.849	61	.000
	I2	.298	29	.000	.681	29	.000
R_WP.HWP.SP	I1	.135	61	.008	.927	61	.001
	I2	.163	29	.047	.892	29	.006

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 30. Results of the statistical tests for differences in lingual non-occlusal facets between the first and second lower incisors.

[LINGUAL NON-OCCLUSAL FACET (I1 vs I2)] STATISTICAL TESTS								
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS		
	Levene's Test			ANOVA		Kruskal-Wallis Test		
	F	Sig.		Mean Square	F	Sig.	Chi-Square	Sig.
TMF	,845	,361		8799,729	3,367	,070	3,842	,050
X_Length	1,264	,264		1642,184	,631	,429	,822	,365
X_Width	1,514	,222		7,491	3,870	,052	3,148	,076
R_Lt.S.TS	,514	,475		501,664	1,794	,184	2,180	,140
R_Ob.S.TS	2,800	,098		,266	,003	,954	,135	,714
R_Tr.S.TS	,276	,601		478,621	2,907	,092	3,807	,051
R_VSS.TS	2,653	,107		112,156	,344	,559	,132	,717
R_SS.TS	,300	,585		3,586	,063	,802	,108	,743
R_LS.TS	,206	,651		,652	,016	,898	,007	,931
R_VLS.TS	5,210	,025		77,260	2,031	,158	1,422	,233
R_HLS.TS	,002	,965		335,138	3,757	,056	3,530	,060
R_Lt.HLS.TS	,070	,792		276,486	2,372	,127	3,695	,055
R_Lt.VLS.HLS.TS	,205	,652		279,985	1,720	,193	1,940	,164
R_TP.TMF	,019	,890		762,776	4,616	,034	7,233	,007
R_SP.TP	,307	,581		1,032	,003	,955	,001	,972
R_WP.TP	,029	,864		2,163	,013	,908	,019	,890
R_HWP.TP	,248	,619		6,191	,052	,820	,000	,997
R_BS.NS	10,363	,002		,300	6,155	,015	4,756	,029
R_P.S	,043	,836		,499	1,841	,178	7,142	,008
R_WP.HWP.SP	1,210	,274		,123	,193	,662	,001	,972

- LABIAL SIDE (I1 vs I2) -

Table 31. Summary statistics of the microfeature counts on the labial side of the first lower incisors.

SEM: LABIAL (I1) VARIABLES (n=28)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	129,25	27,426	752,194	,150	-,095	85	192	107,75	134,50	143,25
TS	90,96	23,202	538,332	,213	-,604	52	140	74,50	87,50	109,25
LtS	52,21	13,726	188,397	,132	-,459	23	79	42,25	50,50	65,50
ObS	21,64	9,658	93,275	,466	-,358	6	45	14,00	19,50	29,75
TrS	17,04	10,953	119,962	1,706	3,729	1	52	11,00	14,00	21,00
VSS	29,29	12,159	147,841	1,206	2,149	13	67	20,25	29,00	33,75
SS	25,32	10,485	109,930	,243	-,963	7	45	15,50	24,00	33,00
LS	13,43	5,514	30,402	,725	-,148	5	25	9,25	11,50	16,75
VLS	8,54	3,283	10,776	,905	3,001	3	19	7,25	8,00	10,00
HLS	14,39	6,124	37,507	,795	,290	4	28	10,50	13,00	19,50
Lt_HLS	11,36	4,604	21,201	,753	1,749	2	25	8,00	11,00	14,00
Lt_VLS.HLS	17,29	5,887	34,656	,038	2,682	2	34	15,00	17,50	20,75
BS	18,21	6,669	44,471	-,085	-,250	4	32	13,25	18,50	23,75
NS	72,75	25,982	675,083	,472	-,321	34	129	53,25	70,50	89,50
TP	38,29	13,012	169,323	,280	-,885	15	63	29,00	34,50	49,50
SP	20,39	10,758	115,729	,613	-,610	6	44	12,00	17,50	27,75
WP	11,64	5,914	34,979	-,002	-,723	0	24	6,50	11,00	17,00
HWP	6,25	3,638	13,231	,738	-,020	2	15	3,00	5,50	9,00
X_Length	197,66	27,075	733,075	-,157	1,139	124	253	185,32	195,43	216,26
X_Width	4,09	1,178	1,389	,496	1,130	2	7	3,45	4,11	4,59

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 32. Summary statistics of the microfeature ratios on the labial side of the first lower incisors. The ratios above the grey band are expressed as a percentage.

SEM: LABIAL SIDE (I1) RATIOS (n=28)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.TS	58,68	12,195	148,714	-,669	1,452	25	82	53,82	59,22	63,44
R_Obs.TS	23,03	6,557	42,999	,312	-,260	11	38	16,82	24,08	26,23
R_TrS.TS	18,23	9,365	87,712	1,023	1,230	2	40	11,78	17,61	22,68
R_VSS.TS	31,70	7,908	62,532	,655	,429	16	52	26,32	29,88	35,54
R_SS.TS	27,11	6,724	45,216	-,380	-,339	13	39	22,96	28,06	31,88
R_LS.TS	14,68	4,385	19,225	,518	-,613	8	24	12,22	13,36	18,46
R_VLS.TS	9,86	4,180	17,468	,521	-,186	3	19	6,27	9,86	12,60
R_HLS.TS	16,65	7,561	57,163	,707	-,053	3	34	10,79	14,78	21,95
R_Lt.HLS.TS	13,41	6,331	40,078	,687	,350	2	28	9,33	12,28	17,28
R_Lt.VLS.HLS.TS	20,42	8,232	67,762	,063	,658	2	38	15,70	19,99	24,70
R_TP.TMF	29,84	8,402	70,592	-,191	-,582	11	45	23,90	28,58	37,73
R_SP.TP	52,27	18,002	324,059	,114	-,484	23	93	38,71	52,79	66,35
R_WP.TP	30,06	12,609	158,991	,082	-,038	0	52	21,15	28,81	37,88
R_HWP.TP	17,66	11,695	136,781	1,295	1,722	5	54	9,16	12,81	25,32
R_BS.NS	,30	,191	,036	1,484	3,436	0	1	,18	,27	,38
R_P.S	,45	,175	,030	,244	-,760	0	1	,31	,40	,61
R_WP.HWP.SP	1,20	,916	,838	1,160	,387	0	3	,51	,90	1,58

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 33. Summary statistics of the microfeature counts on the labial side of the second lower incisors.

SEM: LABIAL SIDE (I2) VARIABLES (n=23)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	130,22	27,186	739,087	-,569	,159	70	180	121,00	135,00	147,00
TS	96,09	26,361	694,901	-,167	-,673	49	142	72,00	98,00	119,00
LtS	44,48	14,103	198,897	,167	-,198	16	72	34,00	44,00	54,00
ObS	26,43	10,483	109,893	,224	-,028	6	48	20,00	28,00	31,00
TrS	25,17	14,118	199,332	,977	,489	9	58	13,00	21,00	32,00
VSS	34,48	20,664	426,988	1,549	4,202	6	102	23,00	35,00	43,00
SS	27,39	8,601	73,976	-,075	-,737	13	44	23,00	26,00	33,00
LS	13,35	6,087	37,055	-,090	-1,234	4	23	8,00	14,00	20,00
VLS	8,30	3,795	14,403	,147	-1,275	3	15	5,00	8,00	11,00
HLS	12,57	7,166	51,348	,287	-,523	0	27	8,00	12,00	18,00
Lt_HLS	8,26	5,586	31,202	,422	-,360	0	21	4,00	8,00	13,00
Lt_VLS.HLS	12,30	6,026	36,312	-,270	,035	1	25	9,00	13,00	16,00
BS	12,96	6,772	45,862	,185	-,369	0	27	9,00	12,00	18,00
NS	83,13	27,352	748,119	,038	-,834	37	130	56,00	83,00	98,00
TP	34,13	9,265	85,846	,143	-1,030	19	50	28,00	32,00	43,00
SP	17,52	6,423	41,261	,995	,898	9	35	12,00	17,00	23,00
WP	11,65	5,532	30,601	,399	-,665	3	23	7,00	11,00	16,00
HWP	4,96	3,126	9,771	,533	,031	0	12	3,00	4,00	7,00
X_Length	186,37	40,561	1645,205	-,384	1,562	82	272	166,24	189,61	205,10
X_Width	3,09	,809	,655	-,283	-,686	2	4	2,45	3,16	3,71

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 34. Summary statistics of the microfeature ratios on the labial side of the second lower incisors. The ratios above the grey band are expressed as a percentage.

SEM: LABIAL SIDE (I2) RATIOS (n=23)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	47,30	12,924	167,026	,566	-,186	28	77	38,03	46,85	56,36
R_Ob.S.TS	27,07	6,712	45,049	,090	2,727	9	44	24,72	26,53	29,81
R_Tr.S.TS	25,63	10,429	108,769	,334	-,627	10	48	14,71	27,27	31,48
R_VSS.TS	34,05	13,902	193,279	1,108	3,345	9	77	26,80	34,45	37,76
R_SS.TS	28,73	5,887	34,658	,033	-,444	18	41	23,61	28,89	33,33
R_LS.TS	13,91	5,103	26,045	-,353	-,393	3	22	10,20	14,79	17,65
R_VLS.TS	8,90	3,729	13,908	,051	-,539	2	16	6,00	9,26	11,11
R_HLS.TS	14,41	8,904	79,287	,306	-,463	0	35	6,72	14,75	22,22
R_Lt.HLS.TS	9,83	7,221	52,146	,359	-,917	0	25	4,12	9,00	16,33
R_Lt.VLS.HLS.TS	14,30	8,113	65,827	,029	-,526	1	31	9,28	13,13	19,10
R_TP.TMF	27,00	7,885	62,178	,250	-,716	14	43	20,78	26,11	32,59
R_SP.TP	52,19	14,734	217,102	,238	-,822	31	78	37,93	52,38	61,90
R_WP.TP	33,74	12,594	158,608	,119	-1,114	15	55	26,00	31,25	46,51
R_HWP.TP	14,06	8,245	67,974	,631	1,445	0	37	9,52	12,90	18,60
R_BS.NS	,18	,114	,013	,588	,570	0	0	,08	,17	,24
R_P.S	,38	,157	,025	,650	-,220	0	1	,26	,35	,48
R_WP.HWP.SP	1,08	,618	,381	,592	-,862	0	2	,62	,91	1,64

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 35. Normality tests for data regarding different variables on the lingual non-occlusal facet between the first and second lower incisors.

VARIABLES/ RATIOS	REGION	Kolmogorov-Smirnov ^a			Shapiro-Wilkinson		
		Statistic	df	Sig.	Statistic	df	Sig.
TMF	I1	.161	61	.000	.917	61	.001
	I2	.232	29	.000	.773	29	.000
X_Length	I1	.113	61	.051	.960	61	.045
	I2	.247	29	.000	.845	29	.001
X_Width	I1	.131	61	.011	.939	61	.004
	I2	.141	29	.146	.974	29	.679
R_LtS.TS	I1	.081	61	.200*	.964	61	.071
	I2	.146	29	.117	.951	29	.196
R_ObS.TS	I1	.080	61	.200*	.974	61	.220
	I2	.085	29	.200*	.979	29	.807
R_TrS.TS	I1	.169	61	.000	.903	61	.000
	I2	.110	29	.200*	.971	29	.580
R_VSS.TS	I1	.119	61	.031	.940	61	.005
	I2	.242	29	.000	.830	29	.000
R_SS.TS	I1	.059	61	.200*	.991	61	.941
	I2	.132	29	.200*	.969	29	.545
R_LS.TS	I1	.076	61	.200*	.975	61	.243
	I2	.085	29	.200*	.973	29	.633
R_VLS.TS	I1	.084	61	.200*	.950	61	.015
	I2	.103	29	.200*	.952	29	.202
R_HLS.TS	I1	.128	61	.015	.913	61	.000
	I2	.114	29	.200*	.942	29	.116
R_Lt.HLS.TS	I1	.187	61	.000	.814	61	.000
	I2	.172	29	.028	.915	29	.023
R_Lt.VLS.HLS.TS	I1	.120	61	.029	.924	61	.001
	I2	.133	29	.200*	.912	29	.019
R_TP.TMF	I1	.063	61	.200*	.983	61	.580
	I2	.214	29	.001	.846	29	.001
R_SP.TP	I1	.060	61	.200*	.968	61	.113
	I2	.090	29	.200*	.965	29	.441
R_WP.TP	I1	.062	61	.200*	.993	61	.978
	I2	.109	29	.200*	.972	29	.610
R_HWP.TP	I1	.161	61	.000	.942	61	.006
	I2	.136	29	.183	.931	29	.059
R_BS.NS	I1	.177	61	.000	.871	61	.000
	I2	.131	29	.200*	.912	29	.020
R_P.S	I1	.158	61	.001	.849	61	.000
	I2	.298	29	.000	.681	29	.000
R_WP.HWP.SP	I1	.135	61	.008	.927	61	.001
	I2	.163	29	.047	.892	29	.006

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 36. Results of the statistical tests for the differences in the lingual non-occlusal facets between first and second lower incisors.

[LINGUAL NON-OCCLUSAL FACET (I1 vs I2)] STATISTICAL TESTS (N = 51)								
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS		
	Levene's Test			ANOVA		Kruskal-Wallis Test		
	F	Sig.		Mean Square	F	Sig.	Chi-Square	Sig.
TMF	,058	,810		11,817	,016	,900	,056	,813
X_Length	2,393	,128		1608,431	1,408	,241	1,514	,219
X_Width	1,386	,245		12,572	11,867	,001	10,479	,001
R_Lt.S.TS	,511	,478		1634,480	10,415	,002	9,347	,002
R_Ob.S.TS	,449	,506		206,263	4,696	,035	5,872	,015
R_Tr.S.TS	1,080	,304		691,175	7,113	,010	6,056	,014
R_VSS.TS	1,547	,219		69,296	,572	,453	,809	,369
R_SS.TS	,241	,626		33,318	,823	,369	,517	,472
R_LS.TS	,305	,583		7,576	,340	,563	,043	,835
R_VLS.TS	,101	,752		11,592	,730	,397	,379	,538
R_HLS.TS	1,235	,272		63,156	,941	,337	1,045	,307
R_Lt.HLS.TS	1,458	,233		161,359	3,547	,066	3,234	,072
R_Lt.VLS.HLS.TS	,104	,749		472,776	7,068	,011	6,628	,010
R_TP.TMF	,157	,694		102,047	1,527	,222	1,910	,167
R_SP.TP	1,200	,279		,077	,000	,987	,004	,947
R_WP.TP	,084	,774		170,622	1,074	,305	,843	,359
R_HWP.TP	3,260	,077		163,458	1,544	,220	,312	,576
R_BS.NS	2,751	,104		,189	7,297	,009	7,088	,008
R_P.S	,633	,430		,046	1,663	,203	1,937	,164
R_WP.HWP.SP	2,408	,127		,177	,280	,599	,002	,962

- LABIAL SIDE INTER-TAXA ANALYSIS -

Table 37. Summary statistics of the microfeature counts on the labial side of the first and second lower incisors in *Babyroussa babyroussa*.

SEM: <i>Babyroussa babyroussa</i> LABIAL SIDE VARIABLES (n=4)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	128,75	11,026	121,583	,186	-4,253	118	141	118,75	128,00	139,50
TS	84,25	9,032	81,583	-1,072	,133	72	92	74,75	86,50	91,50
LtS	44,00	6,782	46,000	-1,795	3,390	34	49	37,00	46,50	48,50
ObS	23,75	5,679	32,250	1,659	2,615	20	32	20,00	21,50	29,75
TrS	16,50	3,697	13,667	,475	-2,716	13	21	13,25	16,00	20,25
VSS	28,00	3,367	11,333	,000	-,161	24	32	24,75	28,00	31,25
SS	27,25	9,878	97,583	,077	-4,045	17	38	18,00	27,00	36,75
LS	11,75	2,500	6,250	,560	,928	9	15	9,50	11,50	14,25
VLS	5,75	2,754	7,583	,323	-3,033	3	9	3,25	5,50	8,50
HLS	11,50	1,732	3,000	-1,540	2,889	9	13	9,75	12,00	12,75
Lt_HLS	8,25	2,500	6,250	-,560	,928	5	11	5,75	8,50	10,50
Lt_VLS.HLS	12,50	3,109	9,667	-1,597	2,704	8	15	9,25	13,50	14,75
BS	19,75	5,377	28,917	-,574	-1,714	13	25	14,25	20,50	24,50
NS	64,50	13,279	176,333	-,338	-3,630	49	77	51,25	66,00	76,25
TP	44,50	12,610	159,000	-,646	,707	28	58	31,75	46,00	55,75
SP	18,00	8,869	78,667	-,482	-1,700	7	27	9,00	19,00	26,00
WP	14,25	6,021	36,250	-1,071	1,169	6	20	8,00	15,50	19,25
HWP	12,25	3,096	9,583	-1,138	,758	8	15	9,00	13,00	14,75
X_Length	184,73	15,721	247,162	-,380	-3,637	166	199	168,97	186,85	198,37
X_Width	3,81	,666	,444	-,541	-1,939	3	4	3,13	3,90	4,40

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 38. Summary statistics of the microfeature ratios on the labial side of the first and second lower incisors of *Babyroussa babyroussa*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Babyroussa babyroussa</i> LABIAL SIDE RATIOS (n=4)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	52,12	4,966	24,659	1,158	2,266	47	59	48,19	51,10	57,06
R_Ob.S.TS	28,06	4,732	22,389	1,427	1,985	24	35	24,47	26,67	33,03
R_Tr.S.TS	19,83	5,171	26,743	-,148	-4,192	14	25	14,82	20,10	24,58
R_VSS.TS	33,30	2,793	7,800	-1,387	1,613	29	36	30,35	34,14	35,41
R_SS.TS	31,72	8,627	74,422	,210	-4,444	24	41	24,03	30,99	40,14
R_LS.TS	14,06	3,107	9,656	-,844	-1,240	10	17	10,81	14,78	16,58
R_VLS.TS	7,07	3,771	14,223	-,008	-5,098	3	11	3,55	7,08	10,56
R_HLS.TS	13,86	3,059	9,354	-,933	-,167	10	17	10,67	14,50	16,42
R_Lt.HLS.TS	9,95	3,275	10,727	-1,212	,566	5	13	6,48	10,93	12,43
R_Lt.VLS.HLS.TS	15,10	4,425	19,585	-1,611	2,406	9	18	10,42	16,81	18,07
R_TP.TMF	34,30	8,222	67,605	-,768	-1,701	24	41	25,76	36,18	40,97
R_SP.TP	38,34	10,509	110,430	-,706	-2,064	25	47	27,47	40,72	46,84
R_WP.TP	31,46	10,647	113,359	1,310	2,469	21	47	23,22	28,94	42,21
R_HWP.TP	30,20	15,812	250,015	1,820	3,501	19	54	19,99	24,31	46,30
R_BS.NS	,33	,145	,021	-,132	-4,533	0	0	,19	,33	,46
R_P.S	,54	,185	,034	-,594	-2,579	0	1	,35	,58	,70
R_WP.HWP.SP	1,79	,879	,772	1,219	,562	1	3	1,13	1,51	2,72

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 39. Summary statistics of the microfeature counts on the labial side of the first and second lower incisors in *Pecari tajacu*.

SEM: <i>Pecari tajacu</i> LABIAL SIDE VARIABLES (n=10)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	98,00	27,721	768,444	2,463	6,999	70	172	85,75	89,50	101,00
TS	66,10	24,205	585,878	2,453	6,403	49	130	53,50	56,00	71,00
LtS	33,80	10,850	117,733	-,192	-,932	16	50	23,00	33,50	42,50
ObS	15,80	10,789	116,400	2,581	7,590	6	45	10,25	14,00	16,00
TrS	16,50	13,640	186,056	2,254	5,920	4	52	8,50	12,50	20,25
VSS	21,90	17,458	304,767	2,251	5,630	6	67	12,50	15,50	25,50
SS	17,70	8,070	65,122	1,577	3,613	7	37	13,00	16,00	19,50
LS	8,40	3,134	9,822	,484	-,454	4	14	6,50	7,50	11,25
VLS	7,50	2,273	5,167	-,142	-,884	4	11	5,00	8,00	9,25
HLS	10,60	3,836	14,711	-,267	-,151	4	17	7,50	12,00	13,00
Lt_HLS	8,70	3,302	10,900	-,666	,545	2	13	6,75	8,50	12,00
Lt_VLS.HLS	13,50	5,126	26,278	-1,067	2,385	2	21	11,50	14,50	16,50
BS	12,70	4,877	23,789	,328	,824	4	21	10,75	12,00	15,50
NS	53,40	27,342	747,600	2,497	6,640	34	126	40,00	43,50	59,00
TP	31,90	7,593	57,656	-,488	-,455	19	42	27,00	32,00	39,25
SP	13,80	6,215	38,622	2,355	5,934	9	30	10,00	12,00	14,25
WP	12,10	5,607	31,433	,237	-1,577	4	20	8,00	10,00	17,50
HWP	6,00	3,266	10,667	,167	-1,416	2	11	2,75	6,00	8,50
X_Length	205,21	40,986	1679,840	-,357	,871	124	272	180,63	204,08	235,45
X_Width	4,09	1,403	1,967	,277	1,193	2	7	3,26	4,12	4,80

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 40. Summary statistics of the microfeature ratios on the labial side of the first and second lower incisors of *Pecari tajacu*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Pecari tajacu</i> LABIAL SIDE RATIOS (n=10)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	53,42	16,931	286,670	-,299	-,903	25	76	40,11	56,05	66,95
R_ObS.TS	22,68	6,802	46,269	-,065	,094	11	35	18,32	23,26	26,72
R_TrS.TS	23,90	12,914	166,775	,390	-1,702	7	41	14,22	17,77	40,10
R_VSS.TS	30,07	11,197	125,373	,449	,420	12	52	22,20	28,06	37,58
R_SS.TS	26,47	6,004	36,052	-,811	1,913	13	35	23,36	26,90	29,68
R_LS.TS	13,12	4,392	19,288	,583	1,045	6	22	10,63	12,50	15,62
R_VLS.TS	12,21	4,848	23,505	,198	-1,721	6	19	7,33	11,37	16,76
R_HLS.TS	18,12	8,700	75,696	,210	,785	3	35	13,37	17,01	23,36
R_Lt.HLS.TS	14,63	5,767	33,254	-1,231	2,516	2	23	12,01	15,67	17,87
R_Lt.VLS.HLS.TS	22,81	8,910	79,381	-1,333	4,130	2	37	21,21	24,01	27,01
R_TP.TMF	33,31	7,081	50,139	-,950	,444	19	43	28,61	35,64	38,36
R_SP.TP	43,40	13,483	181,783	,999	,404	31	71	31,95	39,05	52,71
R_WP.TP	37,19	13,240	175,300	,087	-1,957	21	55	23,74	36,29	50,38
R_HWP.TP	19,41	10,626	112,916	,287	-1,093	5	35	9,41	19,01	28,36
R_BS.NS	,29	,164	,027	,693	1,036	0	1	,20	,26	,37
R_P.S	,51	,150	,023	-,547	-,041	0	1	,40	,55	,62
R_WP.HWP.SP	1,49	,673	,453	-,280	-1,521	0	2	,90	1,56	2,13

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 41. Summary statistics of the microfeature counts on the labial side of the first and second lower incisors in *Phacochoerus africanus*.

SEM: <i>Phacochoerus africanus</i> LABIAL SIDE VARIABLES (n=3)*									
Variables	Mean	Std. Deviation	Variance	Sk	Min	Max	Percentiles		
							25	50 (Median)	75
TMF	163,00	14,526	211,000	-,308	148	177	148,00	164,00	177,00
TS	123,00	10,817	117,000	1,152	114	135	114,00	120,00	135,00
LtS	37,67	4,509	20,333	-,331	33	42	33,00	38,00	42,00
ObS	32,33	2,517	6,333	,586	30	35	30,00	32,00	35,00
TrS	53,00	7,810	61,000	-1,700	44	58	44,00	57,00	58,00
VSS	46,33	18,556	344,333	-,401	27	64	27,00	48,00	64,00
SS	37,33	11,547	133,333	-1,732	24	44	24,00	44,00	44,00
LS	18,00	4,359	19,000	1,630	15	23	15,00	16,00	23,00
VLS	8,00	2,646	7,000	1,458	6	11	6,00	7,00	11,00
HLS	13,33	5,859	34,333	1,508	9	20	9,00	11,00	20,00
Lt_HLS	2,67	2,082	4,333	1,293	1	5	1,00	2,00	5,00
Lt_VLS.HLS	3,67	2,517	6,333	-,586	1	6	1,00	4,00	6,00
BS	5,00	1,000	1,000	,000	4	6	4,00	5,00	6,00
NS	118,00	11,136	124,000	,782	108	130	108,00	116,00	130,00
TP	40,00	19,925	397,000	1,727	28	63	28,00	29,00	63,00
SP	25,33	16,289	265,333	1,615	14	44	14,00	18,00	44,00
WP	9,67	4,163	17,333	-1,293	5	13	5,00	11,00	13,00
HWP	5,00	1,732	3,000	-1,732	3	6	3,00	6,00	6,00
X_Length	170,13	25,241	637,092	,705	147	197	147,16	166,07	197,15
X_Width	2,02	,493	,243	1,652	2	3	1,69	1,79	2,59

* Kurtosis was not possible to calculate due to small sample.

Std.Dev. Standard Deviation

Sk. Skewness

Min. Minimum

Max. Maximum

Table 42. Summary statistics of the microfeature ratios on the labial side of the first and second lower incisors of *Phacochoerus africanus*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Phacochoerus africanus</i> LABIAL SIDE RATIOS (n=3)*									
Variables	Mean	Std. Dev.	Variance	Sk	Min	Max	Percentiles		
							25	50 (Median)	75
R_Lt.TS	30,65	2,942	8,658	-,691	28	33	27,50	31,11	33,33
R_Obs.TS	26,33	1,574	2,478	1,077	25	28	25,00	25,93	28,07
R_TrS.TS	43,02	4,450	19,805	,061	39	48	38,60	42,96	47,50
R_VSS.TS	37,52	14,922	222,672	,582	24	53	23,68	35,56	53,33
R_SS.TS	30,40	9,492	90,098	-,984	20	39	20,00	32,59	38,60
R_LS.TS	14,53	2,309	5,331	,906	13	17	12,50	14,04	17,04
R_VLS.TS	6,43	1,595	2,544	,791	5	8	5,00	6,14	8,15
R_HLS.TS	11,13	5,693	32,411	1,364	7	18	6,67	9,17	17,54
R_Lt.HLS.TS	2,23	1,896	3,594	1,506	1	4	,83	1,48	4,39
R_Lt.VLS.HLS.TS	3,02	2,216	4,909	,115	1	5	,83	2,96	5,26
R_TP.TMF	24,06	10,002	100,032	1,702	18	36	17,68	18,92	35,59
R_SP.TP	60,64	9,997	99,947	-,632	50	70	50,00	62,07	69,84
R_WP.TP	25,72	11,874	140,982	1,575	17	39	17,24	20,63	39,29
R_HWP.TP	13,64	6,134	37,631	1,659	10	21	9,52	10,71	20,69
R_BS.NS	,04	,015	,000	,935	0	0	,03	,04	,06
R_P.S	,33	,191	,036	1,711	0	1	,21	,23	,55
R_WP.HWP.SP	,68	,291	,085	1,019	0	1	,43	,61	1,00

* Kurtosis was not possible to calculate due to small sample.

Std.Dev. Standard Deviation

Sk. Skewness

Min. Minimum

Max. Maximum

Table 43. Summary statistics of the microfeature counts on the labial side of the first and second lower incisors in *Potamochoerus porcus*.

SEM: <i>Potamochoerus porcus</i> LABIAL SIDE VARIABLES (n=4)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	110,25	28,826	830,917	,572	-2,445	84	146	85,50	105,50	139,75
TS	74,25	12,997	168,917	1,590	2,336	65	93	65,25	69,50	88,00
LtS	50,25	5,909	34,917	-1,298	1,098	42	55	44,00	52,00	54,75
ObS	12,25	5,058	25,583	-,261	-,101	6	18	7,25	12,50	17,00
TrS	11,75	9,570	91,583	,439	,780	1	24	3,00	11,00	21,25
VSS	28,50	5,916	35,000	-,193	-4,629	22	34	22,75	29,00	33,75
SS	15,75	4,272	18,250	1,728	2,919	13	22	13,00	14,00	20,25
LS	8,00	3,162	10,000	,632	-1,700	5	12	5,25	7,50	11,25
VLS	5,00	2,160	4,667	1,190	1,500	3	8	3,25	4,50	7,25
HLS	17,00	2,582	6,667	,000	-1,200	14	20	14,50	17,00	19,50
Lt_HLS	16,00	1,633	2,667	,000	1,500	14	18	14,50	16,00	17,50
Lt_VLS.HLS	19,75	3,403	11,583	-1,199	1,979	15	23	16,25	20,50	22,50
BS	21,75	9,811	96,250	-,653	,101	9	32	11,75	23,00	30,50
NS	52,50	16,381	268,333	,328	,148	34	73	37,25	51,50	68,75
TP	36,00	16,990	288,667	,000	-5,159	19	53	20,25	36,00	51,75
SP	17,50	12,450	155,000	,580	-2,284	6	33	6,75	15,50	30,25
WP	11,25	6,238	38,917	-,880	-,458	3	17	4,75	12,50	16,50
HWP	7,25	1,708	2,917	-,753	,343	5	9	5,50	7,50	8,75
X_Length	198,37	17,000	289,009	,053	,496	178	219	182,14	198,21	214,77
X_Width	4,93	1,509	2,277	1,054	-,247	4	7	3,76	4,50	6,52

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 44. Summary statistics of the microfeature ratios on the labial side of the first and second lower incisors of *Potamochoerus porcus*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Potamochoerus porcus</i> LABIAL SIDE RATIOS (n=4)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_LtS.TS	68,85	12,326	151,924	,120	-5,146	58	82	57,93	68,03	80,60
R_ObS.TS	16,40	6,365	40,511	,495	1,326	9	25	10,69	15,86	22,66
R_TrS.TS	14,75	10,125	102,510	-,599	,990	2	26	4,60	15,83	23,81
R_VSS.TS	38,46	5,806	33,711	1,271	1,504	33	47	33,87	36,97	44,55
R_SS.TS	21,05	2,660	7,078	-,448	-2,470	18	24	18,36	21,37	23,43
R_LS.TS	10,51	2,533	6,416	-,311	-3,784	8	13	7,99	10,78	12,76
R_VLS.TS	6,62	1,973	3,893	-,592	-1,110	4	9	4,60	6,88	8,37
R_HLS.TS	23,36	5,270	27,768	,903	-1,032	19	30	19,22	21,99	28,88
R_Lt.HLS.TS	22,07	4,677	21,870	,118	-3,703	17	27	17,70	21,90	26,61
R_Lt.VLS.HLS.TS	26,97	5,298	28,065	-,476	-2,985	21	32	21,60	27,75	31,56
R_TP.TMF	31,32	7,997	63,945	-,066	-3,985	23	40	23,63	31,49	38,83
R_SP.TP	45,11	15,321	234,720	-,572	1,635	25	62	30,21	46,60	58,54
R_WP.TP	30,30	11,106	123,344	-,707	,022	16	42	18,92	31,86	40,11
R_HWP.TP	24,59	12,785	163,460	-,374	-3,230	9	37	11,76	26,04	35,96
R_BS.NS	,48	,348	,121	,881	-,471	0	1	,19	,41	,84
R_P.S	,47	,174	,030	,088	-4,000	0	1	,31	,46	,64
R_WP.HWP.SP	1,48	1,048	1,098	1,637	3,071	1	3	,74	1,15	2,55

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 45. Summary statistics of the microfeature counts on the labial side of the first and second lower incisors in *Sus scrofa*.

SEM: <i>Sus scrofa</i> LABIAL SIDE VARIABLES (n=28)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	138,36	15,912	253,201	1,227	4,227	105	192	130,00	136,50	146,25
TS	102,46	17,362	301,443	,505	,015	73	142	89,00	101,50	116,25
LtS	55,54	12,883	165,962	,052	-1,064	33	79	46,00	53,50	67,50
ObS	27,07	9,141	83,550	,443	,171	11	48	21,25	26,50	31,00
TrS	19,79	9,102	82,841	,685	-,444	7	40	12,25	17,50	27,75
VSS	31,39	10,966	120,247	-,084	-,580	8	51	22,25	30,50	39,00
SS	29,32	7,674	58,893	-,273	-,021	12	45	24,00	30,00	34,50
LS	16,29	4,883	23,841	,110	-,857	8	25	11,75	16,00	20,75
VLS	10,07	3,288	10,810	,430	1,085	3	19	8,00	10,00	12,00
HLS	15,39	7,115	50,618	,416	-1,083	5	28	9,00	13,50	21,50
Lt_HLS	11,29	4,965	24,656	,802	,912	4	25	8,00	10,50	14,75
Lt_VLS.HLS	17,43	5,124	26,254	1,220	2,866	9	34	13,50	17,00	19,75
BS	17,64	5,697	32,460	-,003	-,344	5	28	14,00	17,50	21,75
NS	84,82	18,952	359,189	,438	,054	53	129	73,00	83,50	96,25
TP	35,89	11,123	123,729	,435	-,413	15	59	29,00	33,00	45,25
SP	19,96	8,271	68,406	,901	,360	8	41	13,50	17,50	25,75
WP	11,54	6,119	37,443	,222	-,559	0	24	6,00	11,50	16,00
HWP	4,39	2,833	8,025	,747	,100	0	11	2,00	4,00	6,00
X_Length	197,44	25,306	640,407	,719	-,029	158	254	178,42	193,65	216,31
X_Width	3,58	,744	,554	,174	-,451	2	5	3,00	3,68	4,22

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 46. Summary statistics of the microfeature ratios on the labial side of the first and second lower incisors of *Sus scrofa*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Sus scrofa</i> LABIAL SIDE RATIOS (n=28)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	54,69	11,310	127,918	-,309	-,492	32	76	45,28	57,08	62,02
R_Ob.S.TS	26,10	6,833	46,686	,654	,788	15	44	22,72	25,23	29,58
R_Tr.S.TS	19,15	7,744	59,966	,524	-,667	8	36	12,17	17,76	24,75
R_VSS.TS	30,04	7,461	55,662	-,671	1,200	9	44	25,86	29,54	35,75
R_SS.TS	28,52	5,459	29,805	-1,052	1,132	13	37	25,62	29,92	31,96
R_LS.TS	16,01	4,417	19,512	-,052	-,899	8	24	12,40	15,75	20,00
R_VLS.TS	9,97	3,118	9,723	-,223	-,213	3	16	7,28	10,17	12,28
R_HLS.TS	15,47	7,847	61,583	,743	-,281	5	34	9,30	13,50	21,90
R_Lt.HLS.TS	11,45	5,820	33,869	1,090	1,244	4	28	7,13	10,35	13,83
R_Lt.VLS.HLS.TS	17,56	6,388	40,807	1,411	2,955	9	38	13,03	17,06	20,55
R_TP.TMF	26,08	7,903	62,450	,404	,262	11	45	21,06	25,33	30,51
R_SP.TP	56,62	16,833	283,346	-,084	-,239	23	93	41,49	58,97	66,67
R_WP.TP	31,42	13,141	172,673	-,108	-,220	0	53	22,08	30,52	43,12
R_HWP.TP	11,97	6,929	48,012	,632	,457	0	29	6,92	11,13	16,18
R_BS.NS	,22	,103	,011	,603	,209	0	0	,15	,21	,30
R_P.S	,37	,159	,025	1,051	1,308	0	1	,27	,34	,44
R_WP.HWP.SP	,97	,766	,586	1,732	3,207	0	3	,50	,70	1,43

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 47. Summary statistics of the microfeature counts on the labial side of the first and second lower incisors in *Tayassu pecari*.

SEM: <i>Tayassu pecari</i> LABIAL SIDE VARIABLES (n=2)*								
Variables	Mean	Std. Deviation	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
TMF	186,00	79,260	6282,167	87	352	108,50	190,00	227,50
TS	74,69	25,464	648,397	34	132	55,50	77,00	90,00
LtS	33,85	11,768	138,474	14	53	26,50	37,00	39,50
ObS	18,31	5,964	35,564	9	30	13,50	17,00	23,00
TrS	22,54	12,467	155,436	7	49	13,00	20,00	31,50
VSS	55,69	21,013	441,564	24	94	37,00	54,00	71,50
SS	15,62	8,312	69,090	3	30	9,00	14,00	23,50
LS	2,77	2,587	6,692	0	8	,50	2,00	5,00
VLS	,46	,776	,603	0	2	,00	,00	1,00
HLS	,15	,376	,141	0	1	,00	,00	,00
Lt_HLS	,08	,277	,077	0	1	,00	,00	,00
Lt_VLS.HLS	,38	,870	,756	0	3	,00	,00	,50
BS	9,23	4,126	17,026	1	17	7,50	9,00	12,00
NS	65,46	24,244	587,769	30	118	43,00	66,00	81,00
TP	111,31	58,917	3471,231	37	220	53,00	105,00	149,50
SP	65,85	45,813	2098,808	11	159	31,50	54,00	102,50
WP	30,31	13,913	193,564	8	54	17,50	30,00	42,50
HWP	15,15	12,536	157,141	5	49	6,50	11,00	20,50
X_Length	81,08	20,009	400,364	36	107	68,07	83,78	97,82
X_Width	2,84	1,103	1,217	1	6	2,30	2,63	3,16

* Kurtosis and skewness was not possible to calculate due to small sample.

Std.Dev. Standard Deviation

Min. Minimum

Max. Maximum

Table 48. Summary statistics of the microfeature ratios on the labial side of the first and second lower incisors of *Tayassu pecari*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Tayassu pecari</i> LABIAL SIDE RATIOS (n=2)*								
Variables	Mean	Std. Dev.	Variance	Min	Max	Percentiles		
						25	50 (Median)	75
R_Lt.S.TS	44,77	5,805	33,702	41	49	40,66	44,77	48,87
R_ObS.TS	26,46	7,651	58,536	21	32	21,05	26,46	31,87
R_TrS.TS	28,78	1,846	3,406	27	30	27,47	28,78	30,08
R_VSS.TS	64,72	16,928	286,562	53	77	52,75	64,72	76,69
R_SS.TS	27,16	12,876	165,802	18	36	18,05	27,16	36,26
R_LS.TS	4,80	2,531	6,408	3	7	3,01	4,80	6,59
R_VLS.TS	2,78	,735	,541	2	3	2,26	2,78	3,30
R_HLS.TS	,55	,778	,605	0	1	,00	,55	1,10
R_Lt.HLS.TS	,00	,000	,000	0	0	,00	,00	,00
R_Lt.VLS.HLS.TS	1,85	,495	,245	2	2	1,50	1,85	2,20
R_TP.TMF	29,35	4,582	20,995	26	33	26,11	29,35	32,59
R_SP.TP	64,51	14,086	198,403	55	74	54,55	64,51	74,47
R_WP.TP	21,08	8,754	76,632	15	27	14,89	21,08	27,27
R_HWP.TP	14,41	5,332	28,426	11	18	10,64	14,41	18,18
R_BS.NS	,03	,035	,001	0	0	,00	,03	,05
R_P.S	,42	,092	,008	0	0	,35	,42	,48
R_WP.HWP.SP	,59	,346	,120	0	1	,34	,59	,83

* Kurtosis and skewness was not possible to calculate due to small sample.

Std.Dev. Standard Deviation

Min. Minimum

Max. Maximum

Table 49. Normality tests for data regarding transformed variables on the labial side of the first and second lower incisors between taxa.

		Tests of Normality					
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	taxa	Statistic	df	Sig.	Statistic	df	Sig.
sqrt_TMF	Bab.babyrussa	,258	4	.	,902	4	,439
	P. tajacu	,261	10	,052	,748	10	,003
	Phac.africanus	,200	3	.	,995	3	,862
	Pot.porcus	,257	4	.	,918	4	,528
	Sus scrofa	,140	28	,170	,926	28	,049
log10_X_Length	Bab.babyrussa	,274	4	.	,893	4	,398
	P. tajacu	,167	10	,200*	,935	10	,496
	Phac.africanus	,212	3	.	,990	3	,810
	Pot.porcus	,168	4	.	,997	4	,990
	Sus scrofa	,151	28	,103	,960	28	,341
log10_X_Width	Bab.babyrussa	,235	4	.	,937	4	,637
	P. tajacu	,167	10	,200*	,934	10	,490
	Phac.africanus	,340	3	.	,849	3	,238
	Pot.porcus	,274	4	.	,884	4	,354
	Sus scrofa	,124	28	,200*	,969	28	,543
arcsin_R_LtS.TS	Bab.babyrussa	,331	4	.	,892	4	,392
	P. tajacu	,150	10	,200*	,964	10	,829
	Phac.africanus	,232	3	.	,979	3	,725
	Pot.porcus	,285	4	.	,853	4	,236
	Sus scrofa	,118	28	,200*	,972	28	,643
arcsin_R_ObS.TS	Bab.babyrussa	,266	4	.	,893	4	,397
	P. tajacu	,193	10	,200*	,960	10	,788
	Phac.africanus	,266	3	.	,953	3	,581
	Pot.porcus	,210	4	.	,982	4	,911
	Sus scrofa	,130	28	,200*	,959	28	,335
arcsin_R_TrS.TS	Bab.babyrussa	,254	4	.	,911	4	,489
	P. tajacu	,249	10	,080	,881	10	,133
	Phac.africanus	,176	3	.	1,000	3	,985
	Pot.porcus	,280	4	.	,919	4	,534
	Sus scrofa	,100	28	,200*	,966	28	,468
arcsin_R_VSS.TS	Bab.babyrussa	,258	4	.	,876	4	,322
	P. tajacu	,124	10	,200*	,992	10	,998
	Phac.africanus	,208	3	.	,992	3	,826
	Pot.porcus	,246	4	.	,916	4	,514
	Sus scrofa	,118	28	,200*	,928	28	,055
arcsin_R_SS.TS	Bab.babyrussa	,270	4	.	,884	4	,355
	P. tajacu	,206	10	,200*	,903	10	,236
	Phac.africanus	,267	3	.	,951	3	,575

	Pot.porcus	,238	4	.	,941	4	,663
	Sus scrofa	,162	28	,059	,905	28	,015
arcsin_R_LS.TS	Bab.babyrussa	,263	4	.	,890	4	,383
	P. tajacu	,164	10	,200*	,966	10	,853
	Phac.africanus	,243	3	.	,972	3	,681
	Pot.porcus	,265	4	.	,905	4	,457
	Sus scrofa	,124	28	,200*	,967	28	,503
arcsin_R_VLS.TS	Bab.babyrussa	,267	4	.	,874	4	,314
	P. tajacu	,179	10	,200*	,917	10	,329
	Phac.africanus	,225	3	.	,984	3	,756
	Pot.porcus	,213	4	.	,953	4	,735
	Sus scrofa	,140	28	,167	,963	28	,413
arcsin_R_HLS.TS	Bab.babyrussa	,223	4	.	,924	4	,561
	P. tajacu	,184	10	,200*	,963	10	,825
	Phac.africanus	,282	3	.	,935	3	,508
	Pot.porcus	,279	4	.	,873	4	,311
	Sus scrofa	,121	28	,200*	,963	28	,403
arcsin_R_Lt.HLS.TS	Bab.babyrussa	,252	4	.	,853	4	,236
	P. tajacu	,237	10	,118	,806	10	,017
	Phac.africanus	,289	3	.	,927	3	,476
	Pot.porcus	,227	4	.	,934	4	,619
	Sus scrofa	,118	28	,200*	,965	28	,463
arcsin_R_Lt.VLS.HLS.TS	Bab.babyrussa	,309	4	.	,786	4	,079
	P. tajacu	,320	10	,005	,734	10	,002
	Phac.africanus	,210	3	.	,991	3	,818
	Pot.porcus	,264	4	.	,909	4	,477
	Sus scrofa	,109	28	,200*	,939	28	,105
arcsin_R_TP.TMF	Bab.babyrussa	,273	4	.	,883	4	,353
	P. tajacu	,213	10	,200*	,913	10	,305
	Phac.africanus	,360	3	.	,808	3	,134
	Pot.porcus	,237	4	.	,926	4	,570
	Sus scrofa	,094	28	,200*	,986	28	,968
arcsin_R_SP.TP	Bab.babyrussa	,281	4	.	,874	4	,314
	P. tajacu	,213	10	,200*	,855	10	,067
	Phac.africanus	,218	3	.	,987	3	,786
	Pot.porcus	,274	4	.	,946	4	,691
	Sus scrofa	,085	28	,200*	,982	28	,891
arcsin_R_WP.TP	Bab.babyrussa	,320	4	.	,901	4	,435
	P. tajacu	,208	10	,200*	,879	10	,127
	Phac.africanus	,325	3	.	,876	3	,312
	Pot.porcus	,199	4	.	,959	4	,774
	Sus scrofa	,112	28	,200*	,898	28	,010
arcsin_R_HWP.TP	Bab.babyrussa	,383	4	.	,793	4	,090
	P. tajacu	,120	10	,200*	,961	10	,795
	Phac.africanus	,344	3	.	,842	3	,219

	Pot.porcus	,255	4	.	,921	4	,542
	Sus scrofa	,143	28	,149	,920	28	,035
log10_R_BS.NS	Bab.babyrussa	,269	4	.	,900	4	,433
	P. tajacu	,268	10	,040	,807	10	,018
	Phac.africanus	,212	3	.	,990	3	,813
	Pot.porcus	,177	4	.	,979	4	,897
	Sus scrofa	,106	28	,200*	,963	28	,408
log10_R_P.S	Bab.babyrussa	,269	4	.	,882	4	,349
	P. tajacu	,213	10	,200*	,898	10	,210
	Phac.africanus	,354	3	.	,820	3	,164
	Pot.porcus	,240	4	.	,925	4	,567
	Sus scrofa	,100	28	,200*	,982	28	,902
log10_R_WP.HWP.SP	Bab.babyrussa	,279	4	.	,874	4	,315
	P. tajacu	,210	10	,200*	,857	10	,070
	Phac.africanus	,212	3	.	,990	3	,812
	Pot.porcus	,282	4	.	,940	4	,656
	Sus scrofa	,105	28	,200*	,962	28	,393

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 50. Results of the statistical tests for the differences in the lingual non-occlusal facets of the first and second lower incisors between the taxa.

[LABIAL SIDE INTER-TAXA ANALYSIS] STATISTICAL TESTS (N = 51)								
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON- PARAMETRIC TESTS		
	Levene's Test			ANOVA		Kruskal-Wallis Test		
	F	Sig.		Mean Square	F	Sig.	Chi-Square	Sig.
TMF	1,442	,228		7,914	10,261	,000	21,951	,001
X_Length	1,087	,381		,038	9,130	,000	9,872	,079
X_Width	1,167	,340		,086	6,756	,000	15,362	,009
R_Lt.S.TS	2,695	,033		,059	3,726	,007	12,330	,031
R_Ob.S.TS	,687	,636		,013	2,261	,064	7,928	,160
R_Tr.S.TS	3,321	,012		,053	4,069	,004	11,274	,046
R_VSS.TS	1,777	,137		,056	5,781	,000	9,852	,080
R_SS.TS	1,611	,177		,008	1,492	,212	7,702	,173
R_LS.TS	,716	,614		,018	4,976	,001	12,772	,026
R_VLS.TS	2,084	,085		,018	4,989	,001	14,752	,011
R_HLS.TS	,916	,479		,061	5,593	,000	11,915	,036
R_Lt.HLS.TS	,777	,572		,090	12,111	,000	21,787	,001
R_Lt.VLS.HLS.TS	,495	,778		,093	10,954	,000	23,255	,000
R_TP.TMF	,297	,912		,016	2,021	,094	9,341	,096
R_SP.TP	,474	,793		,061	2,258	,065	11,826	,037
R_WP.TP	,251	,937		,016	,665	,652	4,440	,488
R_HWP.TP	,516	,762		,062	3,484	,010	12,212	,032
R_BS.NS	,555	,696		,453	6,615	,000	13,710	,018
R_P.S	,350	,879		,063	1,975	,101	9,241	,100
R_WP.HWP.SP	,450	,811		,205	2,107	,082	11,895	,036

Table 51. Results of post-hoc Multiple Comparisons (Tukey HSD) test for differences on the labial side of the first and second lower incisors between taxa.

MULTIPLE COMPARISONS (TUKEY HSD) – INTER TAXA LABIAL SIDE							
Dependent Variable	(I) taxa	(J) taxa	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
sqrt_TMF	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	1,51246	,51957	,058	-,0338	3,0587
		<i>Phac.africanus</i>	-1,41962	,67076	,298	-3,4158	,5765
		<i>Pot.porcus</i>	,90526	,62100	,692	-,9428	2,7533
		<i>Sus scrofa</i>	-,40559	,46943	,953	-1,8026	,9914
		<i>T. pecari</i>	-1,17866	,76057	,635	-3,4421	1,0848
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-1,51246	,51957	,058	-3,0587	,0338
		<i>Phac.africanus</i>	-2,93208*	,57812	,000	-4,6526	-1,2116
		<i>Pot.porcus</i>	-,60720	,51957	,849	-2,1534	,9390
		<i>Sus scrofa</i>	-1,91804*	,32353	,000	-2,8809	-,9552
		<i>T. pecari</i>	-2,69112*	,68027	,003	-4,7156	-,6666
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	1,41962	,67076	,298	-,5765	3,4158
		<i>P. tajacu</i>	2,93208*	,57812	,000	1,2116	4,6526
		<i>Pot.porcus</i>	2,32488*	,67076	,014	,3287	4,3210
		<i>Sus scrofa</i>	1,01403	,53352	,415	-,5737	2,6018
		<i>T. pecari</i>	,24096	,80171	1,000	-2,1449	2,6268
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,90526	,62100	,692	-2,7533	,9428
		<i>P. tajacu</i>	,60720	,51957	,849	-,9390	2,1534
		<i>Phac.africanus</i>	-2,32488*	,67076	,014	-4,3210	-,3287
		<i>Sus scrofa</i>	-1,31085	,46943	,077	-2,7079	,0862
		<i>T. pecari</i>	-2,08392	,76057	,087	-4,3474	,1795
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,40559	,46943	,953	-,9914	1,8026	
	<i>P. tajacu</i>	1,91804*	,32353	,000	,9552	2,8809	
	<i>Phac.africanus</i>	-1,01403	,53352	,415	-2,6018	,5737	
	<i>Pot.porcus</i>	1,31085	,46943	,077	-,0862	2,7079	
	<i>T. pecari</i>	-,77308	,64280	,833	-2,6860	1,1399	
<i>T. pecari</i>	<i>Bab.babyrussa</i>	1,17866	,76057	,635	-1,0848	3,4421	
	<i>P. tajacu</i>	2,69112*	,68027	,003	,6666	4,7156	
	<i>Phac.africanus</i>	-,24096	,80171	1,000	-2,6268	2,1449	
	<i>Pot.porcus</i>	2,08392	,76057	,087	-,1795	4,3474	
	<i>Sus scrofa</i>	,77308	,64280	,833	-1,1399	2,6860	

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log10_X_L length	<i>Bab.babyrussa</i>	<i>P. tajuca</i>	-,03827	,03811	,914	-,1517	,0751
		<i>Phac.africanus</i>	,03771	,04919	,972	-,1087	,1841
		<i>Pot.porcus</i>	-,03095	,04554	,983	-,1665	,1046
		<i>Sus scrofa</i>	-,02679	,03443	,970	-,1293	,0757
		<i>T. pecari</i>	,27691*	,05578	,000	,1109	,4429
	<i>P. tajuca</i>	<i>Bab.babyrussa</i>	,03827	,03811	,914	-,0751	,1517
		<i>Phac.africanus</i>	,07598	,04240	,481	-,0502	,2022
		<i>Pot.porcus</i>	,00733	,03811	1,000	-,1061	,1207
		<i>Sus scrofa</i>	,01148	,02373	,997	-,0591	,0821
		<i>T. pecari</i>	,31518*	,04989	,000	,1667	,4637
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,03771	,04919	,972	-,1841	,1087
		<i>P. tajuca</i>	-,07598	,04240	,481	-,2022	,0502
		<i>Pot.porcus</i>	-,06866	,04919	,729	-,2151	,0777
		<i>Sus scrofa</i>	-,06450	,03913	,572	-,1809	,0519
		<i>T. pecari</i>	,23920*	,05880	,002	,0642	,4142
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,03095	,04554	,983	-,1046	,1665
		<i>P. tajuca</i>	-,00733	,03811	1,000	-,1207	,1061
		<i>Phac.africanus</i>	,06866	,04919	,729	-,0777	,2151
		<i>Sus scrofa</i>	,00415	,03443	1,000	-,0983	,1066
		<i>T. pecari</i>	,30785*	,05578	,000	,1419	,4739
	<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,02679	,03443	,970	-,0757	,1293
		<i>P. tajuca</i>	-,01148	,02373	,997	-,0821	,0591
		<i>Phac.africanus</i>	,06450	,03913	,572	-,0519	,1809
		<i>Pot.porcus</i>	-,00415	,03443	1,000	-,1066	,0983
		<i>T. pecari</i>	,30370*	,04714	,000	,1634	,4440
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,27691*	,05578	,000	-,4429	-,1109	
	<i>P. tajuca</i>	-,31518*	,04989	,000	-,4637	-,1667	
	<i>Phac.africanus</i>	-,23920*	,05880	,002	-,4142	-,0642	
	<i>Pot.porcus</i>	-,30785*	,05578	,000	-,4739	-,1419	
	<i>Sus scrofa</i>	-,30370*	,04714	,000	-,4440	-,1634	
log10_X_W width	<i>Bab.babyrussa</i>	<i>P. tajuca</i>	-,00992	,06667	1,000	-,2083	,1885
		<i>Phac.africanus</i>	,27767*	,08607	,027	,0215	,5338
		<i>Pot.porcus</i>	-,10228	,07968	,792	-,3394	,1349
		<i>Sus scrofa</i>	,03155	,06023	,995	-,1477	,2108
		<i>T. pecari</i>	,31027*	,09759	,030	,0198	,6007
	<i>P. tajuca</i>	<i>Bab.babyrussa</i>	,00992	,06667	1,000	-,1885	,2083
		<i>Phac.africanus</i>	,28760*	,07418	,004	,0668	,5084
		<i>Pot.porcus</i>	-,09236	,06667	,735	-,2908	,1060
		<i>Sus scrofa</i>	,04148	,04151	,916	-,0821	,1650
		<i>T. pecari</i>	,32019*	,08729	,008	,0604	,5800

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arcsin_R_Lt S.TS	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,27767*	,08607	,027	-,5338	-,0215	
		<i>P. tajacu</i>	-,28760*	,07418	,004	-,5084	-,0668	
		<i>Pot.porcus</i>	-,37996*	,08607	,001	-,6361	-,1238	
		<i>Sus scrofa</i>	-,24612*	,06846	,010	-,4498	-,0424	
		<i>T. pecari</i>	,03259	,10287	1,000	-,2735	,3387	
		<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,10228	,07968	,792	-,1349	,3394
			<i>P. tajacu</i>	,09236	,06667	,735	-,1060	,2908
			<i>Phac.africanus</i>	,37996*	,08607	,001	,1238	,6361
			<i>Sus scrofa</i>	,13383	,06023	,248	-,0454	,3131
			<i>T. pecari</i>	,41255*	,09759	,002	,1221	,7030
		<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,03155	,06023	,995	-,2108	,1477
			<i>P. tajacu</i>	-,04148	,04151	,916	-,1650	,0821
			<i>Phac.africanus</i>	,24612*	,06846	,010	,0424	,4498
			<i>Pot.porcus</i>	-,13383	,06023	,248	-,3131	,0454
			<i>T. pecari</i>	,27871*	,08248	,018	,0333	,5242
		<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,31027*	,09759	,030	-,6007	-,0198
			<i>P. tajacu</i>	-,32019*	,08729	,008	-,5800	-,0604
			<i>Phac.africanus</i>	-,03259	,10287	1,000	-,3387	,2735
			<i>Pot.porcus</i>	-,41255*	,09759	,002	-,7030	-,1221
			<i>Sus scrofa</i>	-,27871*	,08248	,018	-,5242	-,0333
		<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,01418	,07417	1,000	-,2349	,2065
			<i>Phac.africanus</i>	,22029	,09575	,215	-,0647	,5052
			<i>Pot.porcus</i>	-,17790	,08865	,355	-,4417	,0859
			<i>Sus scrofa</i>	-,02673	,06701	,999	-,2262	,1727
			<i>T. pecari</i>	,07390	,10857	,983	-,2492	,3970
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,01418	,07417	1,000	-,2065	,2349	
		<i>Phac.africanus</i>	,23446	,08253	,069	-,0111	,4801	
		<i>Pot.porcus</i>	-,16372	,07417	,255	-,3844	,0570	
		<i>Sus scrofa</i>	-,01255	,04618	1,000	-,1500	,1249	
		<i>T. pecari</i>	,08807	,09711	,943	-,2009	,3771	
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,22029	,09575	,215	-,5052	,0647	
		<i>P. tajacu</i>	-,23446	,08253	,069	-,4801	,0111	
		<i>Pot.porcus</i>	-,39819*	,09575	,002	-,6831	-,1132	
		<i>Sus scrofa</i>	-,24701*	,07616	,025	-,4737	-,0204	
		<i>T. pecari</i>	-,14639	,11444	,795	-,4870	,1942	
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,17790	,08865	,355	-,0859	,4417	
		<i>P. tajacu</i>	,16372	,07417	,255	-,0570	,3844	
		<i>Phac.africanus</i>	,39819*	,09575	,002	,1132	,6831	
		<i>Sus scrofa</i>	,15117	,06701	,234	-,0483	,3506	
		<i>T. pecari</i>	,25180	,10857	,208	-,0713	,5749	

(Continued next page)

<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,02673	,06701	,999	-,1727	,2262
	<i>P. tajacu</i>	,01255	,04618	1,000	-,1249	,1500
	<i>Phac.africanus</i>	,24701*	,07616	,025	,0204	,4737
	<i>Pot.porcus</i>	-,15117	,06701	,234	-,3506	,0483
	<i>T. pecari</i>	,10062	,09176	,880	-,1725	,3737
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,07390	,10857	,983	-,3970	,2492
	<i>P. tajacu</i>	-,08807	,09711	,943	-,3771	,2009
	<i>Phac.africanus</i>	,14639	,11444	,795	-,1942	,4870
	<i>Pot.porcus</i>	-,25180	,10857	,208	-,5749	,0713
	<i>Sus scrofa</i>	-,10062	,09176	,880	-,3737	,1725
arcsin_R_V SS.TS	<i>Bab.babyrussa</i>	,04044	,05829	,982	-,1330	,2139
	<i>P. tajacu</i>	-,04046	,07526	,994	-,2644	,1835
	<i>Phac.africanus</i>	-,05358	,06967	,971	-,2609	,1538
	<i>Sus scrofa</i>	,03839	,05267	,977	-,1184	,1951
	<i>T. pecari</i>	-,32510*	,08533	,005	-,5790	-,0712
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,04044	,05829	,982	-,2139	,1330
	<i>Phac.africanus</i>	-,08090	,06486	,811	-,2739	,1121
	<i>Pot.porcus</i>	-,09402	,05829	,595	-,2675	,0795
	<i>Sus scrofa</i>	-,00205	,03630	1,000	-,1101	,1060
	<i>T. pecari</i>	-,36554*	,07632	,000	-,5927	-,1384
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,04046	,07526	,994	-,1835	,2644
	<i>P. tajacu</i>	,08090	,06486	,811	-,1121	,2739
	<i>Pot.porcus</i>	-,01313	,07526	1,000	-,2371	,2108
	<i>Sus scrofa</i>	,07884	,05986	,774	-,0993	,2570
	<i>T. pecari</i>	-,28464*	,08995	,031	-,5523	-,0170
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,05358	,06967	,971	-,1538	,2609
	<i>P. tajacu</i>	,09402	,05829	,595	-,0795	,2675
	<i>Phac.africanus</i>	,01313	,07526	1,000	-,2108	,2371
	<i>Sus scrofa</i>	,09197	,05267	,510	-,0648	,2487
	<i>T. pecari</i>	-,27152*	,08533	,030	-,5255	-,0176
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,03839	,05267	,977	-,1951	,1184
	<i>P. tajacu</i>	,00205	,03630	1,000	-,1060	,1101
	<i>Phac.africanus</i>	-,07884	,05986	,774	-,2570	,0993
	<i>Pot.porcus</i>	-,09197	,05267	,510	-,2487	,0648
	<i>T. pecari</i>	-,36349*	,07212	,000	-,5781	-,1489
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,32510*	,08533	,005	,0712	,5790
	<i>P. tajacu</i>	,36554*	,07632	,000	,1384	,5927
	<i>Phac.africanus</i>	,28464*	,08995	,031	,0170	,5523
	<i>Pot.porcus</i>	,27152*	,08533	,030	,0176	,5255
	<i>Sus scrofa</i>	,36349*	,07212	,000	,1489	,5781

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arcsin_R_L	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	,01617	,03512	,997	-,0883	,1207
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S.TS	<i>Phac.africanus</i>		-,00770	,04534	1,000	-,1426	,1272	
	<i>Pot.porcus</i>		,05418	,04197	,788	-,0707	,1791	
	<i>Sus scrofa</i>		-,02556	,03173	,965	-,1200	,0689	
	<i>T. pecari</i>		,16563*	,05141	,027	,0126	,3186	
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>		-,01617	,03512	,997	-,1207	,0883
		<i>Phac.africanus</i>		-,02387	,03908	,990	-,1402	,0924
		<i>Pot.porcus</i>		,03801	,03512	,886	-,0665	,1425
		<i>Sus scrofa</i>		-,04173	,02187	,411	-,1068	,0234
		<i>T. pecari</i>		,14946*	,04598	,025	,0126	,2863
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>		,00770	,04534	1,000	-,1272	,1426
		<i>P. tajacu</i>		,02387	,03908	,990	-,0924	,1402
		<i>Pot.porcus</i>		,06188	,04534	,747	-,0730	,1968
		<i>Sus scrofa</i>		-,01786	,03606	,996	-,1252	,0895
		<i>T. pecari</i>		,17332*	,05419	,029	,0121	,3346
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>		-,05418	,04197	,788	-,1791	,0707
		<i>P. tajacu</i>		-,03801	,03512	,886	-,1425	,0665
		<i>Phac.africanus</i>		-,06188	,04534	,747	-,1968	,0730
		<i>Sus scrofa</i>		-,07974	,03173	,142	-,1742	,0147
		<i>T. pecari</i>		,11145	,05141	,273	-,0415	,2644
	<i>Sus scrofa</i>	<i>Bab.babyrussa</i>		,02556	,03173	,965	-,0689	,1200
<i>P. tajacu</i>			,04173	,02187	,411	-,0234	,1068	
<i>Phac.africanus</i>			,01786	,03606	,996	-,0895	,1252	
<i>Pot.porcus</i>			,07974	,03173	,142	-,0147	,1742	
<i>T. pecari</i>			,19118*	,04345	,001	,0619	,3205	
<i>T. pecari</i>	<i>Bab.babyrussa</i>		-,16563*	,05141	,027	-,3186	-,0126	
	<i>P. tajacu</i>		-,14946*	,04598	,025	-,2863	-,0126	
	<i>Phac.africanus</i>		-,17332*	,05419	,029	-,3346	-,0121	
	<i>Pot.porcus</i>		-,11145	,05141	,273	-,2644	,0415	
	<i>Sus scrofa</i>		-,19118*	,04345	,001	-,3205	-,0619	
arcsin_R_V LS.TS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	-,08951	,03504	,130	-,1938	,0148	
		<i>Phac.africanus</i>	,00646	,04524	1,000	-,1282	,1411	
		<i>Pot.porcus</i>	,00373	,04188	1,000	-,1209	,1284	
		<i>Sus scrofa</i>	-,05562	,03166	,503	-,1498	,0386	
		<i>T. pecari</i>	,09481	,05129	,446	-,0578	,2475	
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>		,08951	,03504	,130	-,0148	,1938
		<i>Phac.africanus</i>		,09597	,03899	,158	-,0201	,2120
		<i>Pot.porcus</i>		,09323	,03504	,104	-,0110	,1975
		<i>Sus scrofa</i>		,03389	,02182	,633	-,0310	,0988
		<i>T. pecari</i>		,18432*	,04588	,003	,0478	,3209

(Continued next page)

arcsin_R_H LS.TS	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,00646	,04524	1,000	-,1411	,1282	
		<i>P. tajacu</i>	-,09597	,03899	,158	-,2120	,0201	
		<i>Pot.porcus</i>	-,00273	,04524	1,000	-,1374	,1319	
		<i>Sus scrofa</i>	-,06208	,03598	,523	-,1692	,0450	
		<i>T. pecari</i>	,08835	,05407	,581	-,0726	,2493	
		<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,00373	,04188	1,000	-,1284	,1209
			<i>P. tajacu</i>	-,09323	,03504	,104	-,1975	,0110
			<i>Phac.africanus</i>	,00273	,04524	1,000	-,1319	,1374
			<i>Sus scrofa</i>	-,05935	,03166	,431	-,1536	,0349
			<i>T. pecari</i>	,09109	,05129	,491	-,0616	,2437
		<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,05562	,03166	,503	-,0386	,1498
			<i>P. tajacu</i>	-,03389	,02182	,633	-,0988	,0310
			<i>Phac.africanus</i>	,06208	,03598	,523	-,0450	,1692
			<i>Pot.porcus</i>	,05935	,03166	,431	-,0349	,1536
			<i>T. pecari</i>	,15043*	,04335	,014	,0214	,2794
		<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,09481	,05129	,446	-,2475	,0578
			<i>P. tajacu</i>	-,18432*	,04588	,003	-,3209	-,0478
			<i>Phac.africanus</i>	-,08835	,05407	,581	-,2493	,0726
			<i>Pot.porcus</i>	-,09109	,05129	,491	-,2437	,0616
			<i>Sus scrofa</i>	-,15043*	,04335	,014	-,2794	-,0214
		<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,04786	,06158	,970	-,2311	,1354
			<i>Phac.africanus</i>	,04614	,07950	,992	-,1905	,2827
			<i>Pot.porcus</i>	-,12291	,07361	,558	-,3420	,0961
			<i>Sus scrofa</i>	-,01377	,05564	1,000	-,1794	,1518
			<i>T. pecari</i>	,32727*	,09015	,009	,0590	,5956
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,04786	,06158	,970	-,1354	,2311	
		<i>Phac.africanus</i>	,09400	,06852	,743	-,1099	,2979	
		<i>Pot.porcus</i>	-,07505	,06158	,825	-,2583	,1082	
		<i>Sus scrofa</i>	,03409	,03835	,947	-,0800	,1482	
		<i>T. pecari</i>	,37513*	,08063	,000	,1352	,6151	
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,04614	,07950	,992	-,2827	,1905	
		<i>P. tajacu</i>	-,09400	,06852	,743	-,2979	,1099	
		<i>Pot.porcus</i>	-,16906	,07950	,293	-,4057	,0675	
		<i>Sus scrofa</i>	-,05991	,06324	,932	-,2481	,1283	
		<i>T. pecari</i>	,28113	,09502	,052	-,0017	,5639	
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,12291	,07361	,558	-,0961	,3420	
		<i>P. tajacu</i>	,07505	,06158	,825	-,1082	,2583	
		<i>Phac.africanus</i>	,16906	,07950	,293	-,0675	,4057	
		<i>Sus scrofa</i>	,10914	,05564	,380	-,0564	,2747	
		<i>T. pecari</i>	,45019*	,09015	,000	,1819	,7185	

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<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,01377	,05564	1,000	-,1518	,1794
	<i>P. tajacu</i>	-,03409	,03835	,947	-,1482	,0800
	<i>Phac.africanus</i>	,05991	,06324	,932	-,1283	,2481
	<i>Pot.porcus</i>	-,10914	,05564	,380	-,2747	,0564
	<i>T. pecari</i>	,34105*	,07619	,001	,1143	,5678
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,32727*	,09015	,009	-,5956	-,0590
	<i>P. tajacu</i>	-,37513*	,08063	,000	-,6151	-,1352
	<i>Phac.africanus</i>	-,28113	,09502	,052	-,5639	,0017
	<i>Pot.porcus</i>	-,45019*	,09015	,000	-,7185	-,1819
	<i>Sus scrofa</i>	-,34105*	,07619	,001	-,5678	-,1143
arcsin_R_Lt .HLS.TS	<i>Bab.babyrussa</i>	-,06454	,05112	,803	-,2167	,0876
	<i>P. tajacu</i>	,17592	,06599	,103	-,0205	,3723
	<i>Pot.porcus</i>	-,17006	,06110	,079	-,3519	,0118
	<i>Sus scrofa</i>	-,01858	,04619	,999	-,1560	,1189
	<i>T. pecari</i>	,31734*	,07483	,001	,0946	,5400
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,06454	,05112	,803	-,0876	,2167
	<i>Phac.africanus</i>	,24046*	,05688	,002	,0712	,4097
	<i>Pot.porcus</i>	-,10551	,05112	,324	-,2576	,0466
	<i>Sus scrofa</i>	,04597	,03183	,700	-,0488	,1407
	<i>T. pecari</i>	,38189*	,06693	,000	,1827	,5811
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,17592	,06599	,103	-,3723	,0205
	<i>P. tajacu</i>	-,24046*	,05688	,002	-,4097	-,0712
	<i>Pot.porcus</i>	-,34597*	,06599	,000	-,5424	-,1496
	<i>Sus scrofa</i>	-,19449*	,05249	,007	-,3507	-,0383
	<i>T. pecari</i>	,14143	,07888	,480	-,0933	,3762
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,17006	,06110	,079	-,0118	,3519
	<i>P. tajacu</i>	,10551	,05112	,324	-,0466	,2576
	<i>Phac.africanus</i>	,34597*	,06599	,000	,1496	,5424
	<i>Sus scrofa</i>	,15148*	,04619	,023	,0140	,2889
	<i>T. pecari</i>	,48740*	,07483	,000	,2647	,7101
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,01858	,04619	,999	-,1189	,1560
	<i>P. tajacu</i>	-,04597	,03183	,700	-,1407	,0488
	<i>Phac.africanus</i>	,19449*	,05249	,007	,0383	,3507
	<i>Pot.porcus</i>	-,15148*	,04619	,023	-,2889	-,0140
	<i>T. pecari</i>	,33592*	,06324	,000	,1477	,5241
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,31734*	,07483	,001	-,5400	-,0946
	<i>P. tajacu</i>	-,38189*	,06693	,000	-,5811	-,1827
	<i>Phac.africanus</i>	-,14143	,07888	,480	-,3762	,0933
	<i>Pot.porcus</i>	-,48740*	,07483	,000	-,7101	-,2647
	<i>Sus scrofa</i>	-,33592*	,06324	,000	-,5241	-,1477

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arcsin_R_Lt .VLS.HLS. TS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	-,08829	,05440	,588	-,2502	,0736
		<i>Phac.africanus</i>	,23054*	,07022	,023	,0216	,4395
		<i>Pot.porcus</i>	-,14886	,06501	,220	-,3423	,0446
		<i>Sus scrofa</i>	-,03154	,04915	,987	-,1778	,1147
		<i>T. pecari</i>	,25989*	,07963	,024	,0229	,4969
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,08829	,05440	,588	-,0736	,2502
		<i>Phac.africanus</i>	,31883*	,06053	,000	,1387	,4990
		<i>Pot.porcus</i>	-,06056	,05440	,873	-,2224	,1013
		<i>Sus scrofa</i>	,05675	,03387	,555	-,0440	,1576
		<i>T. pecari</i>	,34819*	,07122	,000	,1362	,5601
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,23054*	,07022	,023	-,4395	-,0216
		<i>P. tajacu</i>	-,31883*	,06053	,000	-,4990	-,1387
		<i>Pot.porcus</i>	-,37940*	,07022	,000	-,5884	-,1704
		<i>Sus scrofa</i>	-,26208*	,05586	,000	-,4283	-,0959
		<i>T. pecari</i>	,02935	,08393	,999	-,2204	,2791
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,14886	,06501	,220	-,0446	,3423
		<i>P. tajacu</i>	,06056	,05440	,873	-,1013	,2224
		<i>Phac.africanus</i>	,37940*	,07022	,000	,1704	,5884
		<i>Sus scrofa</i>	,11732	,04915	,183	-,0289	,2636
		<i>T. pecari</i>	,40875*	,07963	,000	,1718	,6457
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,03154	,04915	,987	-,1147	,1778	
	<i>P. tajacu</i>	-,05675	,03387	,555	-,1576	,0440	
	<i>Phac.africanus</i>	,26208*	,05586	,000	,0959	,4283	
	<i>Pot.porcus</i>	-,11732	,04915	,183	-,2636	,0289	
	<i>T. pecari</i>	,29143*	,06730	,001	,0912	,4917	
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,25989*	,07963	,024	-,4969	-,0229	
	<i>P. tajacu</i>	-,34819*	,07122	,000	-,5601	-,1362	
	<i>Phac.africanus</i>	-,02935	,08393	,999	-,2791	,2204	
	<i>Pot.porcus</i>	-,40875*	,07963	,000	-,6457	-,1718	
	<i>Sus scrofa</i>	-,29143*	,06730	,001	-,4917	-,0912	
arcsin_R_H WP.TP	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	,13262	,07892	,551	-,1022	,3675
		<i>Phac.africanus</i>	,20149	,10188	,371	-,1017	,5047
		<i>Pot.porcus</i>	,06768	,09433	,979	-,2130	,3484
		<i>Sus scrofa</i>	,24166*	,07130	,017	,0295	,4539
		<i>T. pecari</i>	,18821	,11553	,584	-,1556	,5320
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,13262	,07892	,551	-,3675	,1022
		<i>Phac.africanus</i>	,06887	,08781	,969	-,1925	,3302
		<i>Pot.porcus</i>	-,06494	,07892	,962	-,2998	,1699
		<i>Sus scrofa</i>	,10905	,04914	,249	-,0372	,2553
		<i>T. pecari</i>	,05559	,10333	,994	-,2519	,3631

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<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,20149	,10188	,371	-,5047	,1017
	<i>P. tajacu</i>	-,06887	,08781	,969	-,3302	,1925
	<i>Pot.porcus</i>	-,13381	,10188	,776	-,4370	,1694
	<i>Sus scrofa</i>	,04017	,08104	,996	-,2010	,2813
	<i>T. pecari</i>	-,01328	,12177	1,000	-,3757	,3491
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,06768	,09433	,979	-,3484	,2130
	<i>P. tajacu</i>	,06494	,07892	,962	-,1699	,2998
	<i>Phac.africanus</i>	,13381	,10188	,776	-,1694	,4370
	<i>Sus scrofa</i>	,17399	,07130	,165	-,0382	,3862
	<i>T. pecari</i>	,12053	,11553	,901	-,2233	,4643
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,24166*	,07130	,017	-,4539	-,0295
	<i>P. tajacu</i>	-,10905	,04914	,249	-,2553	,0372
	<i>Phac.africanus</i>	-,04017	,08104	,996	-,2813	,2010
	<i>Pot.porcus</i>	-,17399	,07130	,165	-,3862	,0382
	<i>T. pecari</i>	-,05346	,09764	,994	-,3440	,2371
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,18821	,11553	,584	-,5320	,1556
	<i>P. tajacu</i>	-,05559	,10333	,994	-,3631	,2519
	<i>Phac.africanus</i>	,01328	,12177	1,000	-,3491	,3757
	<i>Pot.porcus</i>	-,12053	,11553	,901	-,4643	,2233
	<i>Sus scrofa</i>	,05346	,09764	,994	-,2371	,3440

*. The mean difference is significant at the 0.05 level.

- LINGUAL NON-OCCLUSAL FACET INTER-TAXA ANALYSIS -

Table 52. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first and second lower incisors in *Babyroussa babyroussa*.

SEM: <i>Babyroussa babyroussa</i> LINGUAL NON-OCCLUSAL FACET VARIABLES (n=5)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	89,40	20,007	400,300	-,604	-3,317	67	105	67,50	103,00	104,50
TS	41,20	15,802	249,700	1,691	3,102	29	68	29,50	39,00	54,00
LtS	16,00	5,000	25,000	,000	1,608	9	23	12,00	16,00	20,00
ObS	11,60	4,615	21,300	,401	-2,910	7	17	7,50	10,00	16,50
TrS	13,60	9,685	93,800	1,139	1,468	4	29	5,50	13,00	22,00
VSS	18,40	6,656	44,300	1,957	4,015	14	30	14,00	17,00	23,50
SS	6,60	3,507	12,300	-,025	-2,064	3	11	3,00	8,00	9,50
LS	5,80	3,899	15,200	,461	-3,115	2	10	2,50	4,00	10,00
VLS	5,40	3,362	11,300	-,379	-1,913	1	9	2,00	6,00	8,50
HLS	5,00	3,536	12,500	,000	-2,608	1	9	1,50	5,00	8,50
Lt_HLS	,80	,837	,700	,512	-,612	0	2	,00	1,00	1,50
Lt_VLS.HLS	2,40	1,517	2,300	,315	-3,081	1	4	1,00	2,00	4,00
BS	11,20	9,039	81,700	1,342	2,389	2	26	4,50	9,00	19,00
NS	30,00	8,746	76,500	,000	,893	18	42	22,50	30,00	37,50
TP	48,20	20,179	407,200	,612	-2,137	28	75	32,00	38,00	69,50
SP	30,20	15,304	234,200	-,138	-2,967	14	46	14,50	32,00	45,00
WP	13,00	6,633	44,000	,685	1,132	5	23	8,00	11,00	19,00
HWP	5,00	4,301	18,500	,754	-1,682	1	11	1,50	3,00	9,50
X_Length	170,84	36,493	1331,774	-,912	1,917	114	213	141,19	172,36	199,73
X_Width	4,32	1,546	2,389	,224	-2,119	3	6	2,83	4,24	5,85

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 53. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first and second lower incisors of *Babyroussa babyroussa*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Babyroussa babyroussa</i> LINGUAL NON-OCCLUSAL FACET RATIOS (n=5)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.TS	39,83	8,729	76,204	,990	,736	31	53	32,43	38,46	47,92
R_ObS.TS	28,92	9,567	91,531	1,080	,118	20	44	21,77	24,14	38,46
R_TrS.TS	31,25	14,590	212,864	-,521	-2,845	13	45	15,64	37,50	43,74
R_VSS.TS	45,49	7,674	58,890	,466	,729	36	57	39,20	44,12	52,48
R_SS.TS	16,18	7,596	57,705	,382	-,985	8	27	9,02	16,18	23,34
R_LS.TS	13,45	7,364	54,223	1,513	2,292	7	26	8,45	10,00	20,18
R_VLS.TS	13,37	9,192	84,487	,904	1,123	3	28	5,51	13,24	21,30
R_HLS.TS	11,51	7,468	55,768	,902	1,178	3	23	5,12	11,76	17,79
R_Lt.HLS.TS	1,82	2,131	4,541	1,054	,619	0	5	,00	1,47	3,82
R_Lt.VLS.HLS.TS	5,56	2,712	7,356	1,403	2,019	3	10	3,39	5,13	7,94
R_TP.TMF	53,22	15,119	228,586	-,167	-1,849	35	71	37,90	56,72	66,79
R_SP.TP	61,44	17,361	301,395	,076	-,526	39	84	46,23	58,67	78,04
R_WP.TP	27,42	9,753	95,127	-,552	,520	13	39	18,30	30,56	34,98
R_HWP.TP	11,14	11,263	126,845	1,860	3,616	3	31	3,66	7,14	20,62
R_BS.NS	,37	,261	,068	,185	-2,460	0	1	,14	,30	,65
R_P.S	1,34	,791	,626	,694	-,237	1	3	,62	1,31	2,07
R_WP.HWP.SP	,74	,532	,283	,971	,980	0	2	,29	,70	1,22

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 54. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first and second lower incisors in *Pecari tajacu*.

SEM: <i>Pecari tajacu</i> LINGUAL NON-OCCLUSAL FACET VARIABLES (n=7)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	103,71	16,368	267,905	,037	-,966	81	128	90,00	108,00	115,00
TS	65,86	13,993	195,810	,069	-1,118	48	85	50,00	65,00	81,00
LtS	43,71	14,384	206,905	,733	,455	26	69	32,00	44,00	53,00
ObS	10,57	3,910	15,286	,357	-1,604	6	16	7,00	10,00	15,00
TrS	11,57	4,036	16,286	,352	-1,992	7	17	8,00	10,00	16,00
VSS	24,29	6,422	41,238	-,021	-1,732	16	33	18,00	25,00	29,00
SS	19,00	5,657	32,000	-,456	-1,096	10	25	15,00	19,00	24,00
LS	6,71	1,890	3,571	,779	-,087	5	10	5,00	7,00	8,00
VLS	6,43	2,699	7,286	,501	,052	3	11	4,00	7,00	8,00
HLS	9,43	4,894	23,952	,497	-1,386	4	17	5,00	7,00	13,00
Lt_HLS	9,43	4,894	23,952	,497	-1,386	4	17	5,00	7,00	13,00
Lt_VLS.HLS	14,14	5,928	35,143	,653	-,504	8	24	8,00	13,00	19,00
BS	12,14	4,880	23,810	1,578	3,056	7	22	9,00	11,00	14,00
NS	53,71	16,660	277,571	-,607	-,330	26	73	40,00	56,00	70,00
TP	37,86	12,020	144,476	1,899	3,856	29	63	30,00	33,00	40,00
SP	12,71	4,889	23,905	1,308	1,377	8	22	9,00	11,00	16,00
WP	16,14	8,174	66,810	1,235	2,142	8	32	8,00	16,00	18,00
HWP	9,00	3,055	9,333	-,736	-,664	4	12	6,00	9,00	12,00
X_Length	176,70	11,306	127,827	1,126	-,615	167	195	168,56	172,38	190,45
X_Width	3,98	1,447	2,095	1,317	1,168	3	7	2,79	3,50	5,06

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 55. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first and second lower incisors of *Pecari tajacu*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Pecari tajacu</i> LINGUAL NON-OCCLUSAL FACET RATIOS (n=7)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.TS	65,51	10,974	120,421	-,248	-,556	49	81	54,17	65,43	72,00
R_ObS.TS	16,41	5,712	32,632	-,126	,404	7	25	14,00	15,63	22,06
R_TrS.TS	18,08	7,095	50,342	,840	-1,209	12	29	12,50	14,00	26,15
R_VSS.TS	36,67	4,300	18,492	,107	-1,354	31	43	33,33	36,00	40,74
R_SS.TS	29,14	7,177	51,512	-1,36	3,568	15	38	28,24	29,69	32,00
R_LS.TS	10,45	3,228	10,417	,933	-,958	7	15	7,81	9,41	14,58
R_VLS.TS	9,97	4,253	18,089	,379	-1,608	5	16	6,25	8,24	14,00
R_HLS.TS	13,77	5,026	25,260	-,058	-1,822	8	20	8,00	14,58	19,12
R_Lt.HLS.TS	13,77	5,026	25,260	-,058	-1,822	8	20	8,00	14,58	19,12
R_Lt.VLS.HLS.TS	21,03	5,743	32,980	-,054	-,625	12	28	16,67	20,31	27,94
R_TP.TMF	36,53	8,845	78,242	,155	-1,512	26	49	27,03	37,04	44,44
R_SP.TP	33,26	5,281	27,891	,081	-1,504	27	40	27,50	33,33	39,39
R_WP.TP	41,46	11,682	136,474	-,710	-,916	24	55	26,67	45,00	50,79
R_HWP.TP	25,28	10,993	120,855	,130	-2,022	14	40	14,29	27,50	36,36
R_BS.NS	,28	,258	,066	2,369	5,851	0	1	,16	,16	,28
R_P.S	,60	,232	,054	,475	-1,000	0	1	,37	,59	,80
R_WP.HWP.SP	2,07	,494	,244	,284	-1,448	2	3	1,54	2,00	2,64

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 56. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first and second lower incisors in *Phacochoerus africanus*.

SEM: <i>Phacochoerus africanus</i> LINGUAL NON-OCCLUSAL FACET VARIABLES										
(n=28)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	97,33	45,459	2066,500	1,669	3,854	46	203	64,50	90,00	109,50
TS	63,89	41,096	1688,861	2,130	5,094	30	164	39,50	45,00	75,00
LtS	19,56	10,899	118,778	1,598	2,701	10	44	11,00	18,00	25,00
ObS	17,11	7,865	61,861	,697	,219	7	32	11,00	17,00	22,50
TrS	27,22	24,417	596,194	2,323	5,880	10	88	12,50	18,00	33,00
VSS	25,00	15,532	241,250	1,113	,272	9	55	13,00	19,00	37,50
SS	18,89	13,081	171,111	1,767	3,322	8	49	9,50	16,00	25,00
LS	10,11	9,280	86,111	2,050	4,018	4	32	4,50	7,00	13,50
VLS	5,89	3,333	11,111	1,036	2,320	1	13	4,00	5,00	7,50
HLS	4,00	4,583	21,000	1,974	4,692	0	15	,50	3,00	5,00
Lt_HLS	,89	1,167	1,361	,875	-,808	0	3	,00	,00	2,00
Lt_VLS.HLS	2,67	2,449	6,000	,430	-,573	0	7	,00	3,00	4,50
BS	8,78	9,094	82,694	,881	-,608	0	25	1,00	6,00	17,50
NS	55,11	41,093	1688,611	2,324	6,239	15	158	36,00	41,00	61,00
TP	33,44	12,680	160,778	,112	-1,628	16	50	22,50	29,00	47,00
SP	21,44	10,345	107,028	-,088	-1,063	7	36	11,00	23,00	30,50
WP	8,78	7,085	50,194	,535	-,889	0	21	3,00	6,00	15,00
HWP	3,22	3,193	10,194	,363	-1,653	0	8	,00	3,00	6,50
X_Length	163,35	32,184	1035,841	-1,715	4,052	88	200	154,13	165,96	184,35
X_Width	3,43	2,157	4,653	1,359	1,565	1	8	1,82	2,51	4,78

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 57. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first and second lower incisors of *Phacochoerus africanus*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Phacochoerus africanus</i> LINGUAL NON-OCCLUSAL FACET RATIOS (n=28)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	31,61	5,367	28,805	,500	-1,103	25	40	27,05	30,77	36,52
R_Ob.S.TS	29,19	9,851	97,049	,714	-,850	20	45	19,85	27,78	37,82
R_Tr.S.TS	39,21	9,662	93,353	,377	-,781	26	54	31,67	39,74	48,18
R_VSS.TS	39,35	11,497	132,174	1,958	4,240	30	67	31,83	33,54	43,61
R_SS.TS	29,03	6,210	38,560	1,148	,660	23	41	24,34	26,67	33,23
R_LS.TS	14,82	5,549	30,794	,513	-,267	8	25	10,01	15,56	18,51
R_VLS.TS	10,46	4,894	23,952	-,319	,157	2	18	7,44	9,76	14,36
R_HLS.TS	6,34	5,493	30,173	,503	-,861	0	15	1,25	5,56	11,24
R_Lt.HLS.TS	1,33	1,812	3,285	1,257	1,094	0	5	,00	,00	2,50
R_Lt.VLS.HLS.TS	4,25	3,929	15,437	,320	-1,342	0	10	,00	4,17	8,15
R_TP.TMF	36,63	11,897	141,548	,184	-,759	19	56	26,49	34,78	46,55
R_SP.TP	65,99	26,451	699,660	-,473	-1,118	24	100	40,49	72,00	87,34
R_WP.TP	25,68	20,630	425,612	,598	-1,245	0	56	11,13	17,86	49,02
R_HWP.TP	8,33	8,053	64,854	,259	-1,689	0	21	,00	8,16	15,78
R_BS.NS	,25	,334	,111	1,677	2,648	0	1	,02	,10	,44
R_P.S	,63	,332	,110	,847	,073	0	1	,36	,53	,88
R_WP.HWP.SP	,88	1,076	1,159	1,512	1,447	0	3	,15	,39	1,59

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 58. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first and second lower incisors in *Potamochoerus porcus*.

SEM: <i>Potamochoerus porcus</i> LINGUAL NON-OCCLUSAL FACET VARIABLES										
(n=17)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	136,59	54,147	2931,882	,531	-,902	66	233	88,50	128,00	185,50
TS	69,76	26,708	713,316	,954	-,111	37	124	50,50	62,00	87,00
LtS	45,53	14,820	219,640	,741	,287	22	79	35,00	40,00	55,50
ObS	14,82	9,126	83,279	,796	-,192	2	33	7,50	13,00	19,00
TrS	9,41	9,193	84,507	2,593	7,772	2	40	4,00	6,00	10,50
VSS	37,88	24,882	619,110	,729	-,931	9	82	18,00	29,00	61,50
SS	17,12	4,859	23,610	1,112	3,836	8	31	14,00	17,00	18,50
LS	6,29	2,519	6,346	-,350	-,212	1	10	5,00	6,00	8,50
VLS	4,24	2,513	6,316	,020	-1,209	0	8	2,00	4,00	6,50
HLS	4,24	3,527	12,441	1,774	4,850	0	15	2,00	4,00	5,50
Lt_HLS	4,00	3,588	12,875	1,757	4,928	0	15	1,50	3,00	5,50
Lt_VLS.HLS	8,06	4,437	19,684	,009	-,920	1	16	5,00	9,00	11,00
BS	18,35	9,280	86,118	1,214	2,145	6	43	13,00	18,00	21,00
NS	51,41	23,524	553,382	,919	-,190	21	101	32,50	45,00	70,00
TP	66,82	32,063	1028,029	,493	-,126	25	138	40,00	62,00	87,00
SP	39,71	22,033	485,471	,202	-,940	9	82	19,00	40,00	59,00
WP	17,94	8,975	80,559	,803	,980	4	39	11,50	18,00	21,00
HWP	9,18	4,377	19,154	-,130	-,271	1	17	6,50	10,00	11,50
X_Length	140,04	42,201	1780,884	,385	-,670	71	216	101,45	138,95	165,34
X_Width	4,42	1,615	2,607	1,053	,398	3	8	3,19	3,64	5,48

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 59. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first and second lower incisors of *Potamochoerus porcus*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Potamochoerus porcus</i> LINGUAL NON-OCCLUSAL FACET RATIOS (n=17)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.TS	66,98	10,433	108,853	,216	-,820	51	85	57,96	67,24	75,54
R_Obs.TS	20,78	8,920	79,570	-,169	-,597	4	35	12,67	22,03	27,36
R_TrS.TS	12,24	7,121	50,706	1,553	2,881	4	32	7,63	10,34	16,28
R_VSS.TS	49,87	17,149	294,084	-,308	-,718	22	78	38,36	50,00	64,79
R_SS.TS	26,12	7,194	51,754	,309	-,967	15	39	20,28	25,00	33,33
R_LS.TS	10,28	5,389	29,047	,341	-,416	1	20	6,47	9,09	14,08
R_VLS.TS	6,61	4,646	21,582	,930	,542	0	17	3,60	5,41	9,49
R_HLS.TS	7,12	6,974	48,641	1,860	4,562	0	28	2,07	4,94	10,87
R_Lt.HLS.TS	6,80	7,080	50,129	1,847	4,557	0	28	1,63	4,84	10,41
R_Lt.VLS.HLS.TS	13,09	8,978	80,612	,777	-,362	1	30	6,04	10,87	18,33
R_TP.TMF	47,56	9,306	86,605	-,016	-1,432	34	61	39,24	46,78	56,85
R_SP.TP	56,66	10,680	114,065	-,998	1,462	29	71	51,44	56,18	63,96
R_WP.TP	27,47	7,419	55,040	,455	-,098	15	43	21,50	28,00	31,60
R_HWP.TP	15,87	9,660	93,322	1,072	,852	2	37	9,82	14,63	18,14
R_BS.NS	,42	,274	,075	1,108	,196	0	1	,22	,34	,54
R_P.S	,97	,357	,128	,319	-1,422	1	2	,65	,88	1,32
R_WP.HWP.SP	,85	,482	,232	2,464	7,500	0	2	,57	,78	,96

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 60. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first and second lower incisors in *Sus scrofa*.

SEM: <i>Sus scrofa</i> LINGUAL NON-OCCLUSAL FACET VARIABLES (n=39)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	122,59	28,380	805,406	,704	-,013	81	197	98,00	117,00	146,00
TS	82,03	19,730	389,289	,976	1,037	53	141	70,00	77,00	92,00
LtS	54,56	15,305	234,252	,722	,286	28	89	45,00	53,00	60,00
ObS	14,13	7,526	56,641	,675	,323	1	34	9,00	13,00	18,00
TrS	13,33	9,345	87,333	,803	-,432	1	32	6,00	11,00	19,00
VSS	27,26	11,502	132,301	,855	,815	11	62	19,00	26,00	33,00
SS	19,87	7,197	51,799	,410	-,266	7	36	15,00	18,00	25,00
LS	10,31	4,502	20,271	,540	,537	2	23	7,00	10,00	12,00
VLS	9,00	4,968	24,684	1,212	3,691	0	27	6,00	8,00	11,00
HLS	15,59	6,536	42,722	-,033	,134	0	32	11,00	16,00	20,00
Lt_HLS	16,05	9,495	90,155	2,529	10,230	6	59	9,00	15,00	20,00
Lt_VLS.HLS	21,59	8,822	77,827	,074	-,304	0	39	15,00	21,00	29,00
BS	14,13	7,306	53,378	,732	,258	2	32	9,00	13,00	19,00
NS	67,90	21,503	462,358	1,013	1,461	35	137	53,00	63,00	85,00
TP	40,56	14,610	213,463	,859	,815	19	83	31,00	41,00	47,00
SP	20,00	9,428	88,895	,549	-,456	7	43	11,00	20,00	26,00
WP	13,62	7,995	63,927	1,005	,593	2	34	8,00	13,00	17,00
HWP	6,95	4,148	17,208	,083	-1,288	0	14	4,00	7,00	11,00
X_Length	202,63	25,385	644,401	-,037	,586	135	265	186,28	200,28	220,50
X_Width	3,62	1,032	1,065	,167	-,497	2	6	2,82	3,62	4,38

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 61. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first and second lower incisors of *Sus scrofa*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Sus scrofa</i> LINGUAL NON-OCCLUSAL FACET RATIOS (n=39)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	67,06	13,031	169,803	-,009	-1,125	44	88	54,35	66,67	77,03
R_Ob.S.TS	16,76	6,750	45,560	-,236	-,095	1	31	13,21	18,06	22,08
R_Tr.S.TS	16,19	11,102	123,247	1,002	,474	2	46	8,45	12,82	22,70
R_VSS.TS	32,55	9,201	84,652	,604	,974	16	61	25,68	31,82	38,20
R_SS.TS	24,02	6,217	38,649	,203	-,793	13	38	18,92	23,85	29,03
R_LS.TS	13,04	5,986	35,837	,570	,520	3	30	8,79	13,48	16,22
R_VLS.TS	11,01	5,481	30,038	,518	,996	0	27	8,26	10,89	13,89
R_HLS.TS	19,38	7,529	56,681	-,313	-,235	0	33	13,48	20,00	25,47
R_Lt.HLS.TS	19,49	9,697	94,038	1,911	6,439	7	60	11,43	18,18	25,47
R_Lt.VLS.HLS.TS	26,61	9,422	88,779	-,187	,599	0	49	18,64	26,76	33,91
R_TP.TMF	32,76	7,501	56,270	,157	-,427	20	50	27,59	32,09	37,82
R_SP.TP	49,22	15,976	255,244	,640	,379	22	90	36,67	46,88	55,56
R_WP.TP	32,89	12,728	162,004	,078	,044	7	65	24,07	33,33	42,86
R_HWP.TP	17,90	10,933	119,522	,615	,209	0	48	9,76	15,66	25,00
R_BS.NS	,24	,169	,029	1,259	1,680	0	1	,12	,20	,35
R_P.S	,51	,176	,031	,716	,443	0	1	,38	,47	,61
R_WP.HWP.SP	1,26	,788	,621	1,081	1,030	0	4	,80	1,13	1,73

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 62. Summary statistics of the microfeature counts on the lingual non-occlusal facet of the first and second lower incisors in *Tayassu pecari*.

SEM: <i>Tayassu pecari</i> LINGUAL NON-OCCLUSAL FACET VARIABLES (n=13)										
Variables	Mean	Std. Deviation	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
TMF	186,00	79,260	6282,167	,670	,018	87	352	108,50	190,00	227,50
TS	74,69	25,464	648,397	,644	,876	34	132	55,50	77,00	90,00
LtS	33,85	11,768	138,474	,048	-,221	14	53	26,50	37,00	39,50
ObS	18,31	5,964	35,564	,368	-,428	9	30	13,50	17,00	23,00
TrS	22,54	12,467	155,436	,669	,033	7	49	13,00	20,00	31,50
VSS	55,69	21,013	441,564	,445	-,579	24	94	37,00	54,00	71,50
SS	15,62	8,312	69,090	,258	-1,015	3	30	9,00	14,00	23,50
LS	2,77	2,587	6,692	,778	-,339	0	8	,50	2,00	5,00
VLS	,46	,776	,603	1,413	,546	0	2	,00	,00	1,00
HLS	,15	,376	,141	2,179	3,223	0	1	,00	,00	,00
Lt_HLS	,08	,277	,077	3,606	13,000	0	1	,00	,00	,00
Lt_VLS.HLS	,38	,870	,756	2,663	7,470	0	3	,00	,00	,50
BS	9,23	4,126	17,026	-,110	,706	1	17	7,50	9,00	12,00
NS	65,46	24,244	587,769	,595	,306	30	118	43,00	66,00	81,00
TP	111,31	58,917	3471,231	,562	-,436	37	220	53,00	105,00	149,50
SP	65,85	45,813	2098,808	,779	-,275	11	159	31,50	54,00	102,50
WP	30,31	13,913	193,564	,035	-,910	8	54	17,50	30,00	42,50
HWP	15,15	12,536	157,141	1,913	3,823	5	49	6,50	11,00	20,50
X_Length	81,08	20,009	400,364	-,892	,538	36	107	68,07	83,78	97,82
X_Width	2,84	1,103	1,217	1,262	2,193	1	6	2,30	2,63	3,16

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 63. Summary statistics of the microfeature ratios on the lingual non-occlusal facet of the first and second lower incisors of *Tayassu pecari*. The ratios above the grey band are expressed as a percentage.

SEM: <i>Tayassu pecari</i> LINGUAL NON-OCCLUSAL FACET RATIOS (n=13)										
Variables	Mean	Std. Dev.	Variance	Sk	Kt	Min	Max	Percentiles		
								25	50 (Median)	75
R_Lt.S.TS	45,50	8,149	66,410	1,220	1,828	34	65	40,67	42,53	48,10
R_Ob.S.TS	25,64	7,205	51,912	-,020	,126	12	38	22,48	24,14	31,83
R_Tr.S.TS	28,86	9,169	84,075	-,602	-,904	12	40	19,44	31,25	36,95
R_VSS.TS	74,23	10,712	114,743	,480	-,136	56	95	68,90	70,59	84,04
R_SS.TS	20,66	8,761	76,755	,517	1,457	5	41	14,52	22,08	25,25
R_LS.TS	4,26	4,369	19,088	1,101	,311	0	13	,64	3,13	6,90
R_VLS.TS	,59	1,159	1,344	2,449	6,510	0	4	,00	,00	1,09
R_HLS.TS	,25	,636	,404	2,409	4,961	0	2	,00	,00	,00
R_Lt.HLS.TS	,15	,555	,308	3,606	13,000	0	2	,00	,00	,00
R_Lt.VLS.HLS.TS	,63	1,664	2,770	3,261	11,057	0	6	,00	,00	,52
R_TP.TMF	57,36	10,600	112,368	,008	-1,269	42	74	48,86	54,69	66,18
R_SP.TP	55,32	17,954	322,351	-,411	-1,660	30	75	35,41	60,39	71,35
R_WP.TP	29,27	9,814	96,322	,547	-,914	15	47	21,08	26,09	39,54
R_HWP.TP	15,42	10,564	111,592	,863	-,586	4	35	7,02	12,96	25,03
R_BS.NS	,16	,095	,009	1,405	2,824	0	0	,11	,13	,21
R_P.S	1,50	,666	,444	,686	-,420	1	3	,96	1,21	1,96
R_WP.HWP.SP	1,04	,795	,633	,812	-1,100	0	2	,40	,66	1,85

Std.Dev. Standard Deviation

Sk. Skewness

Kt. Kurtosis

Min. Minimum

Max. Maximum

Table 64. Normality tests for data regarding transformed variables on the lingual non-occlusal facet of the first and second lower incisors between the taxa.

	taxa	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
sqrt_TMF	<i>Bab.babyrussa</i>	,353	5	,041	,718	5	,015
	<i>P. tajacu</i>	,186	7	,200*	,965	7	,861
	<i>Phac.africanus</i>	,243	7	,200*	,903	7	,350
	<i>Pot.porcus</i>	,129	17	,200*	,946	17	,403
	<i>Sus scrofa</i>	,110	39	,200*	,959	39	,164
	<i>T. pecari</i>	,152	13	,200*	,946	13	,538
log10_X_Length	<i>Bab.babyrussa</i>	,314	5	,120	,885	5	,334
	<i>P. tajacu</i>	,310	7	,041	,804	7	,045
	<i>Phac.africanus</i>	,281	7	,100	,786	7	,030
	<i>Pot.porcus</i>	,110	17	,200*	,964	17	,705
	<i>Sus scrofa</i>	,070	39	,200*	,977	39	,590
	<i>T. pecari</i>	,182	13	,200*	,857	13	,035
log10_X_Width	<i>Bab.babyrussa</i>	,200	5	,200*	,934	5	,621
	<i>P. tajacu</i>	,166	7	,200*	,913	7	,415
	<i>Phac.africanus</i>	,143	7	,200*	,966	7	,870
	<i>Pot.porcus</i>	,186	17	,121	,933	17	,248
	<i>Sus scrofa</i>	,128	39	,108	,974	39	,484
	<i>T. pecari</i>	,184	13	,200*	,958	13	,730
arcsin_R_LtS.TS	<i>Bab.babyrussa</i>	,175	5	,200*	,944	5	,694
	<i>P. tajacu</i>	,173	7	,200*	,964	7	,849
	<i>Phac.africanus</i>	,196	7	,200*	,875	7	,204
	<i>Pot.porcus</i>	,127	17	,200*	,962	17	,675
	<i>Sus scrofa</i>	,092	39	,200*	,958	39	,157
	<i>T. pecari</i>	,219	13	,089	,903	13	,147
arcsin_R_ObS.TS	<i>Bab.babyrussa</i>	,286	5	,200*	,901	5	,416
	<i>P. tajacu</i>	,220	7	,200*	,938	7	,623
	<i>Phac.africanus</i>	,206	7	,200*	,848	7	,118
	<i>Pot.porcus</i>	,162	17	,200*	,961	17	,646
	<i>Sus scrofa</i>	,131	39	,090	,949	39	,076
	<i>T. pecari</i>	,181	13	,200*	,955	13	,672
arcsin_R_TrS.TS	<i>Bab.babyrussa</i>	,277	5	,200*	,848	5	,188
	<i>P. tajacu</i>	,283	7	,096	,848	7	,118
	<i>Phac.africanus</i>	,162	7	,200*	,943	7	,670
	<i>Pot.porcus</i>	,160	17	,200*	,940	17	,316
	<i>Sus scrofa</i>	,107	39	,200*	,971	39	,409
	<i>T. pecari</i>	,167	13	,200*	,911	13	,189

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arcsin_R_VSS.TS	<i>Bab.babyrussa</i>	,169	5	,200*	,982	5	,944
	<i>P. tajacu</i>	,149	7	,200*	,965	7	,864
	<i>Phac.africanus</i>	,273	7	,124	,753	7	,014
	<i>Pot.porcus</i>	,140	17	,200*	,941	17	,335
	<i>Sus scrofa</i>	,058	39	,200*	,977	39	,599
	<i>T. pecari</i>	,245	13	,032	,911	13	,191
arcsin_R_SS.TS	<i>Bab.babyrussa</i>	,173	5	,200*	,975	5	,905
	<i>P. tajacu</i>	,325	7	,024	,818	7	,061
	<i>Phac.africanus</i>	,208	7	,200*	,894	7	,296
	<i>Pot.porcus</i>	,115	17	,200*	,967	17	,769
	<i>Sus scrofa</i>	,109	39	,200*	,976	39	,575
	<i>T. pecari</i>	,136	13	,200*	,967	13	,854
arcsin_R_LS.TS	<i>Bab.babyrussa</i>	,270	5	,200*	,894	5	,377
	<i>P. tajacu</i>	,250	7	,200*	,860	7	,150
	<i>Phac.africanus</i>	,144	7	,200*	,984	7	,976
	<i>Pot.porcus</i>	,115	17	,200*	,974	17	,881
	<i>Sus scrofa</i>	,117	39	,192	,986	39	,888
	<i>T. pecari</i>	,147	13	,200*	,939	13	,443
arcsin_R_VLS.TS	<i>Bab.babyrussa</i>	,186	5	,200*	,984	5	,953
	<i>P. tajacu</i>	,205	7	,200*	,939	7	,633
	<i>Phac.africanus</i>	,185	7	,200*	,938	7	,617
	<i>Pot.porcus</i>	,171	17	,200*	,960	17	,625
	<i>Sus scrofa</i>	,137	39	,062	,955	39	,119
	<i>T. pecari</i>	,419	13	,000	,663	13	,000
arcsin_R_HLS.TS	<i>Bab.babyrussa</i>	,203	5	,200*	,975	5	,908
	<i>P. tajacu</i>	,167	7	,200*	,908	7	,381
	<i>Phac.africanus</i>	,192	7	,200*	,889	7	,269
	<i>Pot.porcus</i>	,103	17	,200*	,967	17	,768
	<i>Sus scrofa</i>	,095	39	,200*	,895	39	,002
	<i>T. pecari</i>	,504	13	,000	,462	13	,000
arcsin_R_Lt.HLS.TS	<i>Bab.babyrussa</i>	,244	5	,200*	,895	5	,383
	<i>P. tajacu</i>	,167	7	,200*	,908	7	,381
	<i>Phac.africanus</i>	,350	7	,010	,774	7	,023
	<i>Pot.porcus</i>	,108	17	,200*	,956	17	,551
	<i>Sus scrofa</i>	,071	39	,200*	,915	39	,006
	<i>T. pecari</i>	,532	13	,000	,311	13	,000
arcsin_R_Lt.VLS.HLS.TS	<i>Bab.babyrussa</i>	,217	5	,200*	,889	5	,350
	<i>P. tajacu</i>	,164	7	,200*	,945	7	,681
	<i>Phac.africanus</i>	,216	7	,200*	,876	7	,210
	<i>Pot.porcus</i>	,100	17	,200*	,971	17	,829
	<i>Sus scrofa</i>	,107	39	,200*	,874	39	,000
	<i>T. pecari</i>	,450	13	,000	,554	13	,000

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arcsin_R_TP.TMF	<i>Bab.babyrussa</i>	,187	5	,200*	,957	5	,785
	<i>P. tajacu</i>	,151	7	,200*	,943	7	,667
	<i>Phac.africanus</i>	,137	7	,200*	,964	7	,852
	<i>Pot.porcus</i>	,148	17	,200*	,928	17	,201
	<i>Sus scrofa</i>	,075	39	,200*	,980	39	,690
	<i>T. pecari</i>	,142	13	,200*	,951	13	,608
arcsin_R_SP.TP	<i>Bab.babyrussa</i>	,176	5	,200*	,988	5	,972
	<i>P. tajacu</i>	,161	7	,200*	,928	7	,537
	<i>Phac.africanus</i>	,162	7	,200*	,930	7	,550
	<i>Pot.porcus</i>	,191	17	,100	,930	17	,218
	<i>Sus scrofa</i>	,128	39	,105	,952	39	,097
	<i>T. pecari</i>	,196	13	,183	,860	13	,039
arcsin_R_WP.TP	<i>Bab.babyrussa</i>	,237	5	,200*	,945	5	,701
	<i>P. tajacu</i>	,285	7	,089	,873	7	,195
	<i>Phac.africanus</i>	,239	7	,200*	,844	7	,107
	<i>Pot.porcus</i>	,115	17	,200*	,977	17	,924
	<i>Sus scrofa</i>	,076	39	,200*	,983	39	,824
	<i>T. pecari</i>	,159	13	,200*	,938	13	,431
arcsin_R_HWP.TP	<i>Bab.babyrussa</i>	,255	5	,200*	,882	5	,316
	<i>P. tajacu</i>	,254	7	,191	,865	7	,169
	<i>Phac.africanus</i>	,200	7	,200*	,902	7	,346
	<i>Pot.porcus</i>	,174	17	,182	,950	17	,463
	<i>Sus scrofa</i>	,063	39	,200*	,974	39	,482
	<i>T. pecari</i>	,185	13	,200*	,925	13	,297
log10_R_BS.NS	<i>Bab.babyrussa</i>	,202	5	,200*	,913	5	,487
	<i>P. tajacu</i>	,260	7	,167	,845	7	,111
	<i>Phac.africanus</i>	,154	7	,200*	,952	7	,748
	<i>Pot.porcus</i>	,151	17	,200*	,956	17	,551
	<i>Sus scrofa</i>	,094	39	,200*	,967	39	,311
	<i>T. pecari</i>	,249	13	,027	,861	13	,040
log10_R_P.S	<i>Bab.babyrussa</i>	,183	5	,200*	,960	5	,808
	<i>P. tajacu</i>	,149	7	,200*	,943	7	,669
	<i>Phac.africanus</i>	,130	7	,200*	,967	7	,873
	<i>Pot.porcus</i>	,144	17	,200*	,929	17	,211
	<i>Sus scrofa</i>	,075	39	,200*	,978	39	,624
	<i>T. pecari</i>	,145	13	,200*	,951	13	,621
log10_R_WP.HWP.SP	<i>Bab.babyrussa</i>	,185	5	,200*	,984	5	,954
	<i>P. tajacu</i>	,158	7	,200*	,929	7	,542
	<i>Phac.africanus</i>	,166	7	,200*	,935	7	,597
	<i>Pot.porcus</i>	,188	17	,114	,931	17	,223
	<i>Sus scrofa</i>	,143	39	,042	,937	39	,029
	<i>T. pecari</i>	,186	13	,200*	,868	13	,049

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 65. Results of the statistical tests for differences in the lingual non-occlusal facets between the first and second lower incisors.

[LINGUAL NON-OCCLUSAL FACET INTER-TAXA ANALYSIS] STATISTICAL TESTS (N = 90)							
VARIABLES/ RATIOS	PARAMETRIC TESTS					NON-PARAMETRIC TESTS	
	Levene's Test		Mean Square	ANOVA		Kruskal-Wallis Test	
	F	Sig.		F	Sig.	Chi-Square	Sig.
TMF	4,749	,001	21,605	6,294	,000	19,026	,002
X_Length	4,421	,001	,348	39,693	,000	54,577	,000
X_Width	2,331	,049	,073	2,980	,016	12,408	,030
R_Lt.S.TS	3,091	,013	,325	22,329	,000	50,083	,000
R_ObS.TS	,676	,643	,064	6,139	,000	24,628	,000
R_TrS.TS	1,699	,144	,203	12,046	,000	36,479	,000
R_VSS.TS	2,720	,025	,411	27,536	,000	46,088	,000
R_SS.TS	,795	,556	,029	4,117	,002	15,839	,007
R_LS.TS	1,009	,418	,080	8,943	,000	23,693	,000
R_VLS.TS	,468	,799	,178	19,075	,000	36,376	,000
R_HLS.TS	2,002	,087	,400	30,488	,000	53,942	,000
R_Lt.HLS.TS	3,111	,013	,539	43,312	,000	64,427	,000
R_Lt.VLS.HLS.TS	1,586	,173	,604	42,951	,000	59,996	,000
R_TP.TMF	2,029	,083	,169	17,664	,000	44,457	,000
R_SP.TP	4,818	,001	,137	4,169	,002	18,031	,003
R_WP.TP	3,900	,003	,043	2,052	,080	9,610	,087
R_HWP.TP	,859	,512	,078	3,179	,011	11,796	,038
R_BS.NS	1,886	,106	,322	2,661	,028	13,279	,021
R_P.S	1,664	,152	,549	17,306	,000	44,311	,000
R_WP.HWP.SP	3,804	,004	,327	3,296	,009	16,888	,005

Table 66. Results of post-hoc Multiple Comparisons (Tukey HSD) test for differences on the lingual non-occlusal facet of the first and second lower incisors between the taxa.

MULTIPLE COMPARISONS (TUKEY HSD) – INTER TAXA LINGUAL NON-OCCLUSAL FACET							
Dependent Variable	(I) taxa	(J) taxa	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
sqrt_TMF	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	-,75148	1,08489	,982	-3,9156	2,4127
		<i>Phac.africanus</i>	-,25263	1,03344	1,000	-3,2667	2,7615
		<i>Pot.porcus</i>	-2,06819	,94261	,251	-4,8173	,6810
		<i>Sus scrofa</i>	-1,59749	,88011	,462	-4,1644	,9694
		<i>T. pecari</i>	-3,95039*	,97501	,002	-6,7940	-1,1067
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,75148	1,08489	,982	-2,4127	3,9156
		<i>Phac.africanus</i>	,49884	,93373	,995	-2,2244	3,2221
		<i>Pot.porcus</i>	-1,31671	,83207	,612	-3,7435	1,1101
		<i>Sus scrofa</i>	-,84602	,76055	,875	-3,0642	1,3722
		<i>T. pecari</i>	-3,19891*	,86861	,005	-5,7322	-,6656
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,25263	1,03344	1,000	-2,7615	3,2667
		<i>P. tajacu</i>	-,49884	,93373	,995	-3,2221	2,2244
		<i>Pot.porcus</i>	-1,81556	,76378	,176	-4,0432	,4121
		<i>Sus scrofa</i>	-1,34486	,68517	,372	-3,3432	,6535
		<i>T. pecari</i>	-3,69776*	,80343	,000	-6,0410	-1,3545
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	2,06819	,94261	,251	-,6810	4,8173
		<i>P. tajacu</i>	1,31671	,83207	,612	-1,1101	3,7435
		<i>Phac.africanus</i>	1,81556	,76378	,176	-,4121	4,0432
		<i>Sus scrofa</i>	,47069	,53848	,952	-1,0998	2,0412
		<i>T. pecari</i>	-1,88220	,68264	,075	-3,8732	,1088
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	1,59749	,88011	,462	-,9694	4,1644	
	<i>P. tajacu</i>	,84602	,76055	,875	-1,3722	3,0642	
	<i>Phac.africanus</i>	1,34486	,68517	,372	-,6535	3,3432	
	<i>Pot.porcus</i>	-,47069	,53848	,952	-2,0412	1,0998	
	<i>T. pecari</i>	-2,35289*	,59337	,002	-4,0835	-,6223	

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<i>T. pecari</i>	<i>Bab.babyrussa</i>	3,95039*	,97501	,002	1,1067	6,7940
	<i>P. tajacu</i>	3,19891*	,86861	,005	,6656	5,7322
	<i>Phac.africanus</i>	3,69776*	,80343	,000	1,3545	6,0410
	<i>Pot.porcus</i>	1,88220	,68264	,075	-,1088	3,8732
	<i>Sus scrofa</i>	2,35289*	,59337	,002	,6223	4,0835
log10_X_L ength	<i>Bab.babyrussa</i>	-,02289	,05481	,998	-,1828	,1370
	<i>Phac.africanus</i>	,02019	,05221	,999	-,1321	,1725
	<i>Pot.porcus</i>	,09635	,04762	,338	-,0426	,2352
	<i>Sus scrofa</i>	-,07968	,04447	,476	-,2094	,0500
	<i>T. pecari</i>	,33005*	,04926	,000	,1864	,4737
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,02289	,05481	,998	-,1370	,1828
	<i>Phac.africanus</i>	,04308	,04718	,942	-,0945	,1807
	<i>Pot.porcus</i>	,11924	,04204	,061	-,0034	,2419
	<i>Sus scrofa</i>	-,05679	,03843	,679	-,1689	,0553
	<i>T. pecari</i>	,35295*	,04389	,000	,2250	,4809
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,02019	,05221	,999	-,1725	,1321
	<i>P. tajacu</i>	-,04308	,04718	,942	-,1807	,0945
	<i>Pot.porcus</i>	,07616	,03859	,366	-,0364	,1887
	<i>Sus scrofa</i>	-,09987	,03462	,054	-,2008	,0011
	<i>T. pecari</i>	,30987*	,04059	,000	,1915	,4283
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,09635	,04762	,338	-,2352	,0426
	<i>P. tajacu</i>	-,11924	,04204	,061	-,2419	,0034
	<i>Phac.africanus</i>	-,07616	,03859	,366	-,1887	,0364
	<i>Sus scrofa</i>	-,17603*	,02721	,000	-,2554	-,0967
	<i>T. pecari</i>	,23371*	,03449	,000	,1331	,3343
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,07968	,04447	,476	-,0500	,2094
	<i>P. tajacu</i>	,05679	,03843	,679	-,0553	,1689
	<i>Phac.africanus</i>	,09987	,03462	,054	-,0011	,2008
	<i>Pot.porcus</i>	,17603*	,02721	,000	,0967	,2554
	<i>T. pecari</i>	,40973*	,02998	,000	,3223	,4972
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,33005*	,04926	,000	-,4737	-,1864
	<i>P. tajacu</i>	-,35295*	,04389	,000	-,4809	-,2250
	<i>Phac.africanus</i>	-,30987*	,04059	,000	-,4283	-,1915
	<i>Pot.porcus</i>	-,23371*	,03449	,000	-,3343	-,1331
	<i>Sus scrofa</i>	-,40973*	,02998	,000	-,4972	-,3223

log10_X_W idth	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	,03374	,09146	,999	-,2330	,3005
		<i>Phac.africanus</i>	,14454	,08712	,562	-,1096	,3986
		<i>Pot.porcus</i>	-,00822	,07947	1,000	-,2400	,2235
		<i>Sus scrofa</i>	,07219	,07420	,925	-,1442	,2886
		<i>T. pecari</i>	,18663	,08220	,218	-,0531	,4264
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,03374	,09146	,999	-,3005	,2330
		<i>Phac.africanus</i>	,11080	,07872	,722	-,1188	,3404
		<i>Pot.porcus</i>	-,04197	,07015	,991	-,2466	,1626
		<i>Sus scrofa</i>	,03845	,06412	,991	-,1486	,2254
		<i>T. pecari</i>	,15289	,07323	,304	-,0607	,3665
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,14454	,08712	,562	-,3986	,1096
		<i>P. tajacu</i>	-,11080	,07872	,722	-,3404	,1188
		<i>Pot.porcus</i>	-,15277	,06439	,178	-,3406	,0350
		<i>Sus scrofa</i>	-,07235	,05776	,809	-,2408	,0961
		<i>T. pecari</i>	,04209	,06773	,989	-,1555	,2396
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,00822	,07947	1,000	-,2235	,2400
		<i>P. tajacu</i>	,04197	,07015	,991	-,1626	,2466
		<i>Phac.africanus</i>	,15277	,06439	,178	-,0350	,3406
		<i>Sus scrofa</i>	,08041	,04540	,490	-,0520	,2128
		<i>T. pecari</i>	,19486*	,05755	,013	,0270	,3627
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,07219	,07420	,925	-,2886	,1442	
	<i>P. tajacu</i>	-,03845	,06412	,991	-,2254	,1486	
	<i>Phac.africanus</i>	,07235	,05776	,809	-,0961	,2408	
	<i>Pot.porcus</i>	-,08041	,04540	,490	-,2128	,0520	
	<i>T. pecari</i>	,11445	,05002	,211	-,0315	,2603	
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,18663	,08220	,218	-,4264	,0531	
	<i>P. tajacu</i>	-,15289	,07323	,304	-,3665	,0607	
	<i>Phac.africanus</i>	-,04209	,06773	,989	-,2396	,1555	
	<i>Pot.porcus</i>	-,19486*	,05755	,013	-,3627	-,0270	
	<i>Sus scrofa</i>	-,11445	,05002	,211	-,2603	,0315	
arcsin_R_Lt S.TS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	-,26514*	,07063	,004	-,4711	-,0592
		<i>Phac.africanus</i>	,08595	,06728	,796	-,1103	,2822
		<i>Pot.porcus</i>	-,28167*	,06136	,000	-,4606	-,1027
		<i>Sus scrofa</i>	-,28546*	,05730	,000	-,4526	-,1184
		<i>T. pecari</i>	-,05827	,06347	,941	-,2434	,1269

<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,26514*	,07063	,004	,0592	,4711
	<i>Phac.africanus</i>	,35109*	,06079	,000	,1738	,5284
	<i>Pot.porcus</i>	-,01652	,05417	1,000	-,1745	,1415
	<i>Sus scrofa</i>	-,02031	,04951	,998	-,1647	,1241
	<i>T. pecari</i>	,20687*	,05655	,006	,0419	,3718
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,08595	,06728	,796	-,2822	,1103
	<i>P. tajacu</i>	-,35109*	,06079	,000	-,5284	-,1738
	<i>Pot.porcus</i>	-,36761*	,04972	,000	-,5126	-,2226
	<i>Sus scrofa</i>	-,37141*	,04460	,000	-,5015	-,2413
	<i>T. pecari</i>	-,14422	,05230	,075	-,2968	,0083
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,28167*	,06136	,000	,1027	,4606
	<i>P. tajacu</i>	,01652	,05417	1,000	-,1415	,1745
	<i>Phac.africanus</i>	,36761*	,04972	,000	,2226	,5126
	<i>Sus scrofa</i>	-,00379	,03506	1,000	-,1060	,0984
	<i>T. pecari</i>	,22339*	,04444	,000	,0938	,3530
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,28546*	,05730	,000	,1184	,4526
	<i>P. tajacu</i>	,02031	,04951	,998	-,1241	,1647
	<i>Phac.africanus</i>	,37141*	,04460	,000	,2413	,5015
	<i>Pot.porcus</i>	,00379	,03506	1,000	-,0984	,1060
	<i>T. pecari</i>	,22718*	,03863	,000	,1145	,3398
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,05827	,06347	,941	-,1269	,2434
	<i>P. tajacu</i>	-,20687*	,05655	,006	-,3718	-,0419
	<i>Phac.africanus</i>	,14422	,05230	,075	-,0083	,2968
	<i>Pot.porcus</i>	-,22339*	,04444	,000	-,3530	-,0938
	<i>Sus scrofa</i>	-,22718*	,03863	,000	-,3398	-,1145
arcsin_R_O bS.TS	<i>P. tajacu</i>	,15225	,05971	,122	-,0219	,3264
	<i>Phac.africanus</i>	-,00224	,05688	1,000	-,1681	,1637
	<i>Pot.porcus</i>	,10111	,05188	,380	-,0502	,2524
	<i>Sus scrofa</i>	,15179*	,04844	,028	,0105	,2931
	<i>T. pecari</i>	,03693	,05367	,983	-,1196	,1935
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,15225	,05971	,122	-,3264	,0219
	<i>Phac.africanus</i>	-,15449*	,05139	,039	-,3044	-,0046
	<i>Pot.porcus</i>	-,05115	,04580	,873	-,1847	,0824
	<i>Sus scrofa</i>	-,00046	,04186	1,000	-,1225	,1216
	<i>T. pecari</i>	-,11532	,04781	,164	-,2548	,0241

<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,00224	,05688	1,000	-,1637	,1681
	<i>P. tajacu</i>	,15449*	,05139	,039	,0046	,3044
	<i>Pot.porcus</i>	,10335	,04204	,149	-,0193	,2260
	<i>Sus scrofa</i>	,15403*	,03771	,001	,0440	,2640
	<i>T. pecari</i>	,03917	,04422	,949	-,0898	,1681
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,10111	,05188	,380	-,2524	,0502
	<i>P. tajacu</i>	,05115	,04580	,873	-,0824	,1847
	<i>Phac.africanus</i>	-,10335	,04204	,149	-,2260	,0193
	<i>Sus scrofa</i>	,05069	,02964	,529	-,0358	,1371
	<i>T. pecari</i>	-,06417	,03757	,531	-,1738	,0454
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,15179*	,04844	,028	-,2931	-,0105
	<i>P. tajacu</i>	,00046	,04186	1,000	-,1216	,1225
	<i>Phac.africanus</i>	-,15403*	,03771	,001	-,2640	-,0440
	<i>Pot.porcus</i>	-,05069	,02964	,529	-,1371	,0358
	<i>T. pecari</i>	-,11486*	,03266	,009	-,2101	-,0196
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,03693	,05367	,983	-,1935	,1196
	<i>P. tajacu</i>	,11532	,04781	,164	-,0241	,2548
	<i>Phac.africanus</i>	-,03917	,04422	,949	-,1681	,0898
	<i>Pot.porcus</i>	,06417	,03757	,531	-,0454	,1738
	<i>Sus scrofa</i>	,11486*	,03266	,009	,0196	,2101
arcsin_R_Tr S.TS	<i>Bab.babyrussa</i>	,14951	,07597	,369	-,0721	,3711
	<i>P. tajacu</i>	-,09169	,07237	,802	-,3028	,1194
	<i>Pot.porcus</i>	,23664*	,06601	,007	,0441	,4292
	<i>Sus scrofa</i>	,18957*	,06163	,033	,0098	,3693
	<i>T. pecari</i>	,02144	,06828	1,000	-,1777	,2206
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,14951	,07597	,369	-,3711	,0721
	<i>Phac.africanus</i>	-,24120*	,06538	,005	-,4319	-,0505
	<i>Pot.porcus</i>	,08712	,05827	,668	-,0828	,2571
	<i>Sus scrofa</i>	,04006	,05326	,975	-,1153	,1954
	<i>T. pecari</i>	-,12808	,06083	,294	-,3055	,0493
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,09169	,07237	,802	-,1194	,3028
	<i>P. tajacu</i>	,24120*	,06538	,005	,0505	,4319
	<i>Pot.porcus</i>	,32833*	,05348	,000	,1723	,4843
	<i>Sus scrofa</i>	,28126*	,04798	,000	,1413	,4212
	<i>T. pecari</i>	,11313	,05626	,345	-,0510	,2772

<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,23664*	,06601	,007	-,4292	-,0441
	<i>P. tajacu</i>	-,08712	,05827	,668	-,2571	,0828
	<i>Phac.africanus</i>	-,32833*	,05348	,000	-,4843	-,1723
	<i>Sus scrofa</i>	-,04707	,03771	,812	-,1570	,0629
	<i>T. pecari</i>	-,21520*	,04780	,000	-,3546	-,0758
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,18957*	,06163	,033	-,3693	-,0098
	<i>P. tajacu</i>	-,04006	,05326	,975	-,1954	,1153
	<i>Phac.africanus</i>	-,28126*	,04798	,000	-,4212	-,1413
	<i>Pot.porcus</i>	,04707	,03771	,812	-,0629	,1570
	<i>T. pecari</i>	-,16813*	,04155	,002	-,2893	-,0469
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,02144	,06828	1,000	-,2206	,1777
	<i>P. tajacu</i>	,12808	,06083	,294	-,0493	,3055
	<i>Phac.africanus</i>	-,11313	,05626	,345	-,2772	,0510
	<i>Pot.porcus</i>	,21520*	,04780	,000	,0758	,3546
	<i>Sus scrofa</i>	,16813*	,04155	,002	,0469	,2893
arcsin_R_V SS.TS	<i>Bab.babyrussa</i>	,08994	,07152	,807	-,1186	,2985
	<i>P. tajacu</i>	,06307	,06813	,939	-,1356	,2618
	<i>Phac.africanus</i>	-,04305	,06214	,982	-,2243	,1382
	<i>Pot.porcus</i>	-,04305	,06214	,982	-,2243	,1382
	<i>Sus scrofa</i>	,13609	,05802	,188	-,0331	,3053
<i>P. tajacu</i>	<i>T. pecari</i>	-,30909*	,06428	,000	-,4966	-,1216
	<i>Bab.babyrussa</i>	-,08994	,07152	,807	-,2985	,1186
	<i>Phac.africanus</i>	-,02687	,06155	,998	-,2064	,1527
	<i>Pot.porcus</i>	-,13299	,05485	,160	-,2930	,0270
	<i>Sus scrofa</i>	,04615	,05014	,940	-,1001	,1924
<i>Phac.africanus</i>	<i>T. pecari</i>	-,39903*	,05726	,000	-,5660	-,2320
	<i>Bab.babyrussa</i>	-,06307	,06813	,939	-,2618	,1356
	<i>P. tajacu</i>	,02687	,06155	,998	-,1527	,2064
	<i>Pot.porcus</i>	-,10611	,05035	,294	-,2530	,0407
	<i>Sus scrofa</i>	,07303	,04517	,590	-,0587	,2048
<i>Pot.porcus</i>	<i>T. pecari</i>	-,37216*	,05296	,000	-,5266	-,2177
	<i>Bab.babyrussa</i>	,04305	,06214	,982	-,1382	,2243
	<i>P. tajacu</i>	,13299	,05485	,160	-,0270	,2930
	<i>Phac.africanus</i>	,10611	,05035	,294	-,0407	,2530
	<i>Sus scrofa</i>	,17914*	,03550	,000	,0756	,2827
	<i>T. pecari</i>	-,26604*	,04500	,000	-,3973	-,1348

<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,13609	,05802	,188	-,3053	,0331
	<i>P. tajacu</i>	-,04615	,05014	,940	-,1924	,1001
	<i>Phac.africanus</i>	-,07303	,04517	,590	-,2048	,0587
	<i>Pot.porcus</i>	-,17914*	,03550	,000	-,2827	-,0756
	<i>T. pecari</i>	-,44518*	,03912	,000	-,5593	-,3311
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,30909*	,06428	,000	,1216	,4966
	<i>P. tajacu</i>	,39903*	,05726	,000	,2320	,5660
	<i>Phac.africanus</i>	,37216*	,05296	,000	,2177	,5266
	<i>Pot.porcus</i>	,26604*	,04500	,000	,1348	,3973
	<i>Sus scrofa</i>	,44518*	,03912	,000	,3311	,5593
arcsin_R_S S.TS	<i>Bab.babyrussa</i>	-,16129*	,04897	,018	-,3041	-,0185
	<i>P. tajacu</i>	-,16158*	,04665	,011	-,2976	-,0255
	<i>Phac.africanus</i>	-,12725*	,04255	,041	-,2514	-,0032
	<i>Pot.porcus</i>	-,10328	,03973	,109	-,2191	,0126
	<i>T. pecari</i>	-,05744	,04401	,781	-,1858	,0709
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,16129*	,04897	,018	,0185	,3041
	<i>Phac.africanus</i>	-,00029	,04215	1,000	-,1232	,1226
	<i>Pot.porcus</i>	,03404	,03756	,944	-,0755	,1436
	<i>Sus scrofa</i>	,05801	,03433	,542	-,0421	,1581
	<i>T. pecari</i>	,10385	,03921	,097	-,0105	,2182
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,16158*	,04665	,011	,0255	,2976
	<i>P. tajacu</i>	,00029	,04215	1,000	-,1226	,1232
	<i>Pot.porcus</i>	,03433	,03448	,918	-,0662	,1349
	<i>Sus scrofa</i>	,05831	,03093	,418	-,0319	,1485
	<i>T. pecari</i>	,10414	,03627	,056	-,0016	,2099
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,12725*	,04255	,041	,0032	,2514
	<i>P. tajacu</i>	-,03404	,03756	,944	-,1436	,0755
	<i>Phac.africanus</i>	-,03433	,03448	,918	-,1349	,0662
	<i>Sus scrofa</i>	,02398	,02431	,921	-,0469	,0949
	<i>T. pecari</i>	,06981	,03081	,220	-,0201	,1597
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,10328	,03973	,109	-,0126	,2191
	<i>P. tajacu</i>	-,05801	,03433	,542	-,1581	,0421
	<i>Phac.africanus</i>	-,05831	,03093	,418	-,1485	,0319
	<i>Pot.porcus</i>	-,02398	,02431	,921	-,0949	,0469
	<i>T. pecari</i>	,04583	,02679	,528	-,0323	,1240

<i>T. pecari</i>	<i>Bab.babyrussa</i>	,05744	,04401	,781	-,0709	,1858
	<i>P. tajacu</i>	-,10385	,03921	,097	-,2182	,0105
	<i>Phac.africanus</i>	-,10414	,03627	,056	-,2099	,0016
	<i>Pot.porcus</i>	-,06981	,03081	,220	-,1597	,0201
	<i>Sus scrofa</i>	-,04583	,02679	,528	-,1240	,0323
arcsin_R_L S.TS	<i>Bab.babyrussa</i>	,04043	,05550	,978	-,1215	,2023
	<i>P. tajacu</i>	-,02301	,05287	,998	-,1772	,1312
	<i>Phac.africanus</i>	,05199	,04823	,889	-,0887	,1926
	<i>Sus scrofa</i>	,00634	,04503	1,000	-,1250	,1377
	<i>T. pecari</i>	,19482*	,04988	,003	,0493	,3403
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,04043	,05550	,978	-,2023	,1215
	<i>Phac.africanus</i>	-,06344	,04777	,769	-,2028	,0759
	<i>Pot.porcus</i>	,01156	,04257	1,000	-,1126	,1357
	<i>Sus scrofa</i>	-,03409	,03891	,951	-,1476	,0794
	<i>T. pecari</i>	,15440*	,04444	,010	,0248	,2840
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,02301	,05287	,998	-,1312	,1772
	<i>P. tajacu</i>	,06344	,04777	,769	-,0759	,2028
	<i>Pot.porcus</i>	,07500	,03908	,398	-,0390	,1890
	<i>Sus scrofa</i>	,02935	,03505	,960	-,0729	,1316
	<i>T. pecari</i>	,21783*	,04110	,000	,0980	,3377
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,05199	,04823	,889	-,1926	,0887
	<i>P. tajacu</i>	-,01156	,04257	1,000	-,1357	,1126
	<i>Phac.africanus</i>	-,07500	,03908	,398	-,1890	,0390
	<i>Sus scrofa</i>	-,04565	,02755	,564	-,1260	,0347
	<i>T. pecari</i>	,14284*	,03492	,001	,0410	,2447
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,00634	,04503	1,000	-,1377	,1250
	<i>P. tajacu</i>	,03409	,03891	,951	-,0794	,1476
	<i>Phac.africanus</i>	-,02935	,03505	,960	-,1316	,0729
	<i>Pot.porcus</i>	,04565	,02755	,564	-,0347	,1260
	<i>T. pecari</i>	,18848*	,03036	,000	,0999	,2770
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,19482*	,04988	,003	-,3403	-,0493
	<i>P. tajacu</i>	-,15440*	,04444	,010	-,2840	-,0248
	<i>Phac.africanus</i>	-,21783*	,04110	,000	-,3377	-,0980
	<i>Pot.porcus</i>	-,14284*	,03492	,001	-,2447	-,0410
	<i>Sus scrofa</i>	-,18848*	,03036	,000	-,2770	-,0999

arcsin_R_V LS.TS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	,04213	,05652	,976	-,1227	,2070
		<i>Phac.africanus</i>	,03854	,05384	,980	-,1185	,1956
		<i>Pot.porcus</i>	,11614	,04910	,181	-,0271	,2593
		<i>Sus scrofa</i>	,03226	,04585	,981	-,1015	,1660
		<i>T. pecari</i>	,31645*	,05079	,000	,1683	,4646
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,04213	,05652	,976	-,2070	,1227
		<i>Phac.africanus</i>	-,00359	,04864	1,000	-,1455	,1383
		<i>Pot.porcus</i>	,07400	,04335	,531	-,0524	,2004
		<i>Sus scrofa</i>	-,00987	,03962	1,000	-,1254	,1057
		<i>T. pecari</i>	,27432*	,04525	,000	,1423	,4063
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,03854	,05384	,980	-,1956	,1185
		<i>P. tajacu</i>	,00359	,04864	1,000	-,1383	,1455
		<i>Pot.porcus</i>	,07760	,03979	,380	-,0384	,1936
		<i>Sus scrofa</i>	-,00628	,03569	1,000	-,1104	,0978
		<i>T. pecari</i>	,27791*	,04185	,000	,1558	,4000
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,11614	,04910	,181	-,2593	,0271
		<i>P. tajacu</i>	-,07400	,04335	,531	-,2004	,0524
		<i>Phac.africanus</i>	-,07760	,03979	,380	-,1936	,0384
		<i>Sus scrofa</i>	-,08388*	,02805	,041	-,1657	-,0021
		<i>T. pecari</i>	,20031*	,03556	,000	,0966	,3040
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,03226	,04585	,981	-,1660	,1015	
	<i>P. tajacu</i>	,00987	,03962	1,000	-,1057	,1254	
	<i>Phac.africanus</i>	,00628	,03569	1,000	-,0978	,1104	
	<i>Pot.porcus</i>	,08388*	,02805	,041	,0021	,1657	
	<i>T. pecari</i>	,28419*	,03091	,000	,1940	,3743	
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,31645*	,05079	,000	-,4646	-,1683	
	<i>P. tajacu</i>	-,27432*	,04525	,000	-,4063	-,1423	
	<i>Phac.africanus</i>	-,27791*	,04185	,000	-,4000	-,1558	
	<i>Pot.porcus</i>	-,20031*	,03556	,000	-,3040	-,0966	
	<i>Sus scrofa</i>	-,28419*	,03091	,000	-,3743	-,1940	
arcsin_R_H LS.TS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	-,04264	,06707	,988	-,2383	,1530
		<i>Phac.africanus</i>	,11544	,06389	,467	-,0709	,3018
		<i>Pot.porcus</i>	,09512	,05827	,580	-,0748	,2651
		<i>Sus scrofa</i>	-,11204	,05441	,319	-,2707	,0467
		<i>T. pecari</i>	,31266*	,06028	,000	,1369	,4885

<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,04264	,06707	,988	-,1530	,2383
	<i>Phac.africanus</i>	,15808	,05772	,078	-,0103	,3264
	<i>Pot.porcus</i>	,13776	,05144	,091	-,0123	,2878
	<i>Sus scrofa</i>	-,06940	,04702	,680	-,2065	,0677
	<i>T. pecari</i>	,35530*	,05370	,000	,1987	,5119
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,11544	,06389	,467	-,3018	,0709
	<i>P. tajacu</i>	-,15808	,05772	,078	-,3264	,0103
	<i>Pot.porcus</i>	-,02032	,04722	,998	-,1580	,1174
	<i>Sus scrofa</i>	-,22748*	,04236	,000	-,3510	-,1039
	<i>T. pecari</i>	,19722*	,04967	,002	,0524	,3421
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,09512	,05827	,580	-,2651	,0748
	<i>P. tajacu</i>	-,13776	,05144	,091	-,2878	,0123
	<i>Phac.africanus</i>	,02032	,04722	,998	-,1174	,1580
	<i>Sus scrofa</i>	-,20716*	,03329	,000	-,3042	-,1101
	<i>T. pecari</i>	,21754*	,04220	,000	,0945	,3406
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,11204	,05441	,319	-,0467	,2707
	<i>P. tajacu</i>	,06940	,04702	,680	-,0677	,2065
	<i>Phac.africanus</i>	,22748*	,04236	,000	,1039	,3510
	<i>Pot.porcus</i>	,20716*	,03329	,000	,1101	,3042
	<i>T. pecari</i>	,42470*	,03668	,000	,3177	,5317
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,31266*	,06028	,000	-,4885	-,1369
	<i>P. tajacu</i>	-,35530*	,05370	,000	-,5119	-,1987
	<i>Phac.africanus</i>	-,19722*	,04967	,002	-,3421	-,0524
	<i>Pot.porcus</i>	-,21754*	,04220	,000	-,3406	-,0945
	<i>Sus scrofa</i>	-,42470*	,03668	,000	-,5317	-,3177
arcsin_R_Lt .HLS.TS	<i>P. tajacu</i>	-,27325*	,06532	,001	-,4637	-,0827
	<i>Phac.africanus</i>	,02601	,06222	,998	-,1555	,2075
	<i>Pot.porcus</i>	-,12229	,05675	,270	-,2878	,0432
	<i>Sus scrofa</i>	-,34639*	,05299	,000	-,5009	-,1918
	<i>T. pecari</i>	,09084	,05870	,635	-,0804	,2620
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,27325*	,06532	,001	,0827	,4637
	<i>Phac.africanus</i>	,29926*	,05622	,000	,1353	,4632
	<i>Pot.porcus</i>	,15095*	,05010	,039	,0048	,2971
	<i>Sus scrofa</i>	-,07315	,04579	,603	-,2067	,0604
	<i>T. pecari</i>	,36409*	,05230	,000	,2116	,5166

<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,02601	,06222	,998	-,2075	,1555
	<i>P. tajacu</i>	-,29926*	,05622	,000	-,4632	-,1353
	<i>Pot.porcus</i>	-,14831*	,04598	,021	-,2824	-,0142
	<i>Sus scrofa</i>	-,37241*	,04125	,000	-,4927	-,2521
	<i>T. pecari</i>	,06483	,04837	,762	-,0762	,2059
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,12229	,05675	,270	-,0432	,2878
	<i>P. tajacu</i>	-,15095*	,05010	,039	-,2971	-,0048
	<i>Phac.africanus</i>	,14831*	,04598	,021	,0142	,2824
	<i>Sus scrofa</i>	-,22410*	,03242	,000	-,3186	-,1295
	<i>T. pecari</i>	,21314*	,04110	,000	,0933	,3330
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,34639*	,05299	,000	,1918	,5009
	<i>P. tajacu</i>	,07315	,04579	,603	-,0604	,2067
	<i>Phac.africanus</i>	,37241*	,04125	,000	,2521	,4927
	<i>Pot.porcus</i>	,22410*	,03242	,000	,1295	,3186
	<i>T. pecari</i>	,43724*	,03572	,000	,3330	,5414
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,09084	,05870	,635	-,2620	,0804
	<i>P. tajacu</i>	-,36409*	,05230	,000	-,5166	-,2116
	<i>Phac.africanus</i>	-,06483	,04837	,762	-,2059	,0762
	<i>Pot.porcus</i>	-,21314*	,04110	,000	-,3330	-,0933
	<i>Sus scrofa</i>	-,43724*	,03572	,000	-,5414	-,3330
arcsin_R_Lt .VLS.HLS. TS	<i>Bab.babyrussa</i>	-,24011*	,06946	,011	-,4427	-,0375
	<i>P. tajacu</i>					
	<i>Phac.africanus</i>	,06669	,06616	,914	-,1263	,2597
	<i>Pot.porcus</i>	-,11719	,06035	,384	-,2932	,0588
	<i>Sus scrofa</i>	-,29833*	,05635	,000	-,4627	-,1340
	<i>T. pecari</i>	,19798*	,06242	,025	,0159	,3800
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,24011*	,06946	,011	,0375	,4427
	<i>Phac.africanus</i>	,30680*	,05978	,000	,1325	,4811
	<i>Pot.porcus</i>	,12292	,05327	,203	-,0324	,2783
	<i>Sus scrofa</i>	-,05821	,04869	,838	-,2002	,0838
	<i>T. pecari</i>	,43809*	,05561	,000	,2759	,6003
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,06669	,06616	,914	-,2597	,1263
	<i>P. tajacu</i>	-,30680*	,05978	,000	-,4811	-,1325
	<i>Pot.porcus</i>	-,18388*	,04890	,004	-,3265	-,0413
	<i>Sus scrofa</i>	-,36502*	,04387	,000	-,4930	-,2371
	<i>T. pecari</i>	,13129	,05144	,121	-,0187	,2813

<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,11719	,06035	,384	-,0588	,2932
	<i>P. tajacu</i>	-,12292	,05327	,203	-,2783	,0324
	<i>Phac.africanus</i>	,18388*	,04890	,004	,0413	,3265
	<i>Sus scrofa</i>	-,18113*	,03447	,000	-,2817	-,0806
	<i>T. pecari</i>	,31517*	,04370	,000	,1877	,4426
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,29833*	,05635	,000	,1340	,4627
	<i>P. tajacu</i>	,05821	,04869	,838	-,0838	,2002
	<i>Phac.africanus</i>	,36502*	,04387	,000	,2371	,4930
	<i>Pot.porcus</i>	,18113*	,03447	,000	,0806	,2817
	<i>T. pecari</i>	,49631*	,03799	,000	,3855	,6071
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,19798*	,06242	,025	-,3800	-,0159
	<i>P. tajacu</i>	-,43809*	,05561	,000	-,6003	-,2759
	<i>Phac.africanus</i>	-,13129	,05144	,121	-,2813	,0187
	<i>Pot.porcus</i>	-,31517*	,04370	,000	-,4426	-,1877
	<i>Sus scrofa</i>	-,49631*	,03799	,000	-,6071	-,3855
arcsin_R_T P.TMF	<i>Bab.babyrussa</i>	,17168*	,05730	,041	,0046	,3388
	<i>P. tajacu</i>	,17259*	,05458	,026	,0134	,3318
	<i>Pot.porcus</i>	,05814	,04979	,851	-,0871	,2033
	<i>Sus scrofa</i>	,21167*	,04649	,000	,0761	,3472
	<i>T. pecari</i>	-,04223	,05150	,963	-,1924	,1080
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,17168*	,05730	,041	-,3388	-,0046
	<i>Phac.africanus</i>	,00090	,04932	1,000	-,1429	,1447
	<i>Pot.porcus</i>	-,11355	,04395	,113	-,2417	,0146
	<i>Sus scrofa</i>	,03999	,04017	,918	-,0772	,1571
	<i>T. pecari</i>	-,21391*	,04588	,000	-,3477	-,0801
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,17259*	,05458	,026	-,3318	-,0134
	<i>P. tajacu</i>	-,00090	,04932	1,000	-,1447	,1429
	<i>Pot.porcus</i>	-,11445	,04034	,061	-,2321	,0032
	<i>Sus scrofa</i>	,03909	,03619	,888	-,0665	,1446
	<i>T. pecari</i>	-,21481*	,04244	,000	-,3386	-,0910
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,05814	,04979	,851	-,2033	,0871
	<i>P. tajacu</i>	,11355	,04395	,113	-,0146	,2417
	<i>Phac.africanus</i>	,11445	,04034	,061	-,0032	,2321
	<i>Sus scrofa</i>	,15354*	,02844	,000	,0706	,2365
	<i>T. pecari</i>	-,10036	,03606	,070	-,2055	,0048

<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,21167*	,04649	,000	-,3472	-,0761
	<i>P. tajacu</i>	-,03999	,04017	,918	-,1571	,0772
	<i>Phac.africanus</i>	-,03909	,03619	,888	-,1446	,0665
	<i>Pot.porcus</i>	-,15354*	,02844	,000	-,2365	-,0706
	<i>T. pecari</i>	-,25390*	,03134	,000	-,3453	-,1625
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,04223	,05150	,963	-,1080	,1924
	<i>P. tajacu</i>	,21391*	,04588	,000	,0801	,3477
	<i>Phac.africanus</i>	,21481*	,04244	,000	,0910	,3386
	<i>Pot.porcus</i>	,10036	,03606	,070	-,0048	,2055
	<i>Sus scrofa</i>	,25390*	,03134	,000	,1625	,3453
arcsin_R_S P.TP	<i>Bab.babyrussa</i>	,29444	,10606	,071	-,0149	,6038
	<i>P. tajacu</i>	-,08164	,10103	,965	-,3763	,2130
	<i>Pot.porcus</i>	,05519	,09215	,991	-,2136	,3239
	<i>Sus scrofa</i>	,12869	,08604	,668	-,1222	,3796
	<i>T. pecari</i>	,06736	,09532	,981	-,2106	,3453
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,29444	,10606	,071	-,6038	,0149
	<i>Phac.africanus</i>	-,37608*	,09128	,001	-,6423	-,1099
	<i>Pot.porcus</i>	-,23925*	,08134	,047	-,4765	-,0020
	<i>Sus scrofa</i>	-,16575	,07435	,236	-,3826	,0511
	<i>T. pecari</i>	-,22709	,08491	,091	-,4747	,0206
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	,08164	,10103	,965	-,2130	,3763
	<i>P. tajacu</i>	,37608*	,09128	,001	,1099	,6423
	<i>Pot.porcus</i>	,13683	,07467	,451	-,0809	,3546
	<i>Sus scrofa</i>	,21033*	,06698	,027	,0150	,4057
	<i>T. pecari</i>	,14900	,07854	,411	-,0801	,3781
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,05519	,09215	,991	-,3239	,2136
	<i>P. tajacu</i>	,23925*	,08134	,047	,0020	,4765
	<i>Phac.africanus</i>	-,13683	,07467	,451	-,3546	,0809
	<i>Sus scrofa</i>	,07350	,05264	,729	-,0800	,2270
	<i>T. pecari</i>	,01216	,06673	1,000	-,1825	,2068
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,12869	,08604	,668	-,3796	,1222
	<i>P. tajacu</i>	,16575	,07435	,236	-,0511	,3826
	<i>Phac.africanus</i>	-,21033*	,06698	,027	-,4057	-,0150
	<i>Pot.porcus</i>	-,07350	,05264	,729	-,2270	,0800
	<i>T. pecari</i>	-,06133	,05801	,897	-,2305	,1078

<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,06736	,09532	,981	-,3453	,2106
	<i>P. tajacu</i>	,22709	,08491	,091	-,0206	,4747
	<i>Phac.africanus</i>	-,14900	,07854	,411	-,3781	,0801
	<i>Pot.porcus</i>	-,01216	,06673	1,000	-,2068	,1825
	<i>Sus scrofa</i>	,06133	,05801	,897	-,1078	,2305
arcsin_R_H WP.TP	<i>Bab.babyrussa</i>	-,20446	,09157	,234	-,4715	,0626
	<i>P. tajacu</i>	,08144	,08723	,937	-,1730	,3358
	<i>Pot.porcus</i>	-,08017	,07956	,914	-,3122	,1519
	<i>Sus scrofa</i>	-,09899	,07429	,766	-,3157	,1177
	<i>T. pecari</i>	-,07113	,08230	,954	-,3112	,1689
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,20446	,09157	,234	-,0626	,4715
	<i>Phac.africanus</i>	,28590*	,07881	,006	,0560	,5158
	<i>Pot.porcus</i>	,12428	,07023	,491	-,0805	,3291
	<i>Sus scrofa</i>	,10547	,06419	,573	-,0818	,2927
	<i>T. pecari</i>	,13333	,07331	,460	-,0805	,3472
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,08144	,08723	,937	-,3358	,1730
	<i>P. tajacu</i>	-,28590*	,07881	,006	-,5158	-,0560
	<i>Pot.porcus</i>	-,16161	,06447	,134	-,3496	,0264
	<i>Sus scrofa</i>	-,18043*	,05783	,029	-,3491	-,0118
	<i>T. pecari</i>	-,15257	,06781	,227	-,3504	,0452
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,08017	,07956	,914	-,1519	,3122
	<i>P. tajacu</i>	-,12428	,07023	,491	-,3291	,0805
	<i>Phac.africanus</i>	,16161	,06447	,134	-,0264	,3496
	<i>Sus scrofa</i>	-,01882	,04545	,998	-,1514	,1137
	<i>T. pecari</i>	,00904	,05762	1,000	-,1590	,1771
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,09899	,07429	,766	-,1177	,3157
	<i>P. tajacu</i>	-,10547	,06419	,573	-,2927	,0818
	<i>Phac.africanus</i>	,18043*	,05783	,029	,0118	,3491
	<i>Pot.porcus</i>	,01882	,04545	,998	-,1137	,1514
	<i>T. pecari</i>	,02786	,05008	,993	-,1182	,1739
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,07113	,08230	,954	-,1689	,3112
	<i>P. tajacu</i>	-,13333	,07331	,460	-,3472	,0805
	<i>Phac.africanus</i>	,15257	,06781	,227	-,0452	,3504
	<i>Pot.porcus</i>	-,00904	,05762	1,000	-,1771	,1590
	<i>Sus scrofa</i>	-,02786	,05008	,993	-,1739	,1182

arcsin_R_B S.NS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	,00779	,01152	,984	-,0258	,0414
		<i>Phac.africanus</i>	,01899	,01097	,516	-,0130	,0510
		<i>Pot.porcus</i>	-,00434	,01001	,998	-,0335	,0248
		<i>Sus scrofa</i>	,01121	,00934	,836	-,0160	,0385
		<i>T. pecari</i>	,01949	,01035	,420	-,0107	,0497
	<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,00779	,01152	,984	-,0414	,0258
		<i>Phac.africanus</i>	,01120	,00991	,868	-,0177	,0401
		<i>Pot.porcus</i>	-,01213	,00883	,743	-,0379	,0136
		<i>Sus scrofa</i>	,00342	,00807	,998	-,0201	,0270
		<i>T. pecari</i>	,01170	,00922	,801	-,0152	,0386
	<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,01899	,01097	,516	-,0510	,0130
		<i>P. tajacu</i>	-,01120	,00991	,868	-,0401	,0177
		<i>Pot.porcus</i>	-,02333	,00811	,055	-,0470	,0003
		<i>Sus scrofa</i>	-,00778	,00727	,892	-,0290	,0134
		<i>T. pecari</i>	,00050	,00853	1,000	-,0244	,0254
	<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,00434	,01001	,998	-,0248	,0335
		<i>P. tajacu</i>	,01213	,00883	,743	-,0136	,0379
		<i>Phac.africanus</i>	,02333	,00811	,055	-,0003	,0470
		<i>Sus scrofa</i>	,01555	,00572	,082	-,0011	,0322
		<i>T. pecari</i>	,02384*	,00725	,018	,0027	,0450
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,01121	,00934	,836	-,0385	,0160	
	<i>P. tajacu</i>	-,00342	,00807	,998	-,0270	,0201	
	<i>Phac.africanus</i>	,00778	,00727	,892	-,0134	,0290	
	<i>Pot.porcus</i>	-,01555	,00572	,082	-,0322	,0011	
	<i>T. pecari</i>	,00828	,00630	,776	-,0101	,0267	
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,01949	,01035	,420	-,0497	,0107	
	<i>P. tajacu</i>	-,01170	,00922	,801	-,0386	,0152	
	<i>Phac.africanus</i>	-,00050	,00853	1,000	-,0254	,0244	
	<i>Pot.porcus</i>	-,02384*	,00725	,018	-,0450	-,0027	
	<i>Sus scrofa</i>	-,00828	,00630	,776	-,0267	,0101	
log10_R_B S.NS	<i>Bab.babyrussa</i>	<i>P. tajacu</i>	,10569	,20356	,995	-,4883	,6997
		<i>Phac.africanus</i>	,21296	,20356	,901	-,3811	,8070
		<i>Pot.porcus</i>	-,08985	,17686	,996	-,6060	,4263
		<i>Sus scrofa</i>	,18168	,16513	,880	-,3002	,6636
		<i>T. pecari</i>	,33585	,18294	,449	-,1980	,8697

<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,10569	,20356	,995	-,6997	,4883
	<i>Phac.africanus</i>	,10727	,18582	,992	-,4350	,6495
	<i>Pot.porcus</i>	-,19553	,15612	,809	-,6511	,2601
	<i>Sus scrofa</i>	,07600	,14270	,995	-,3404	,4924
	<i>T. pecari</i>	,23016	,16297	,720	-,2454	,7058
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,21296	,20356	,901	-,8070	,3811
	<i>P. tajacu</i>	-,10727	,18582	,992	-,6495	,4350
	<i>Pot.porcus</i>	-,30281	,15612	,386	-,7584	,1528
	<i>Sus scrofa</i>	-,03127	,14270	1,000	-,4477	,3852
	<i>T. pecari</i>	,12289	,16297	,974	-,3527	,5985
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,08985	,17686	,996	-,4263	,6060
	<i>P. tajacu</i>	,19553	,15612	,809	-,2601	,6511
	<i>Phac.africanus</i>	,30281	,15612	,386	-,1528	,7584
	<i>Sus scrofa</i>	,27153	,10103	,089	-,0233	,5664
	<i>T. pecari</i>	,42569*	,12808	,016	,0519	,7995
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,18168	,16513	,880	-,6636	,3002
	<i>P. tajacu</i>	-,07600	,14270	,995	-,4924	,3404
	<i>Phac.africanus</i>	,03127	,14270	1,000	-,3852	,4477
	<i>Pot.porcus</i>	-,27153	,10103	,089	-,5664	,0233
	<i>T. pecari</i>	,15416	,11133	,736	-,1707	,4791
<i>T. pecari</i>	<i>Bab.babyrussa</i>	-,33585	,18294	,449	-,8697	,1980
	<i>P. tajacu</i>	-,23016	,16297	,720	-,7058	,2454
	<i>Phac.africanus</i>	-,12289	,16297	,974	-,5985	,3527
	<i>Pot.porcus</i>	-,42569*	,12808	,016	-,7995	-,0519
	<i>Sus scrofa</i>	-,15416	,11133	,736	-,4791	,1707
log10_R_P. S	<i>Bab.babyrussa</i>	,30774*	,10426	,046	,0037	,6118
	<i>P. tajacu</i>	,31273*	,09931	,027	,0231	,6024
	<i>Pot.porcus</i>	,10356	,09058	,862	-,1606	,3678
	<i>Sus scrofa</i>	,38123*	,08458	,000	,1345	,6279
	<i>T. pecari</i>	-,07525	,09370	,966	-,3485	,1980
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	-,30774*	,10426	,046	-,6118	-,0037
	<i>Phac.africanus</i>	,00500	,08973	1,000	-,2567	,2667
	<i>Pot.porcus</i>	-,20417	,07996	,121	-,4374	,0290
	<i>Sus scrofa</i>	,07349	,07309	,915	-,1397	,2867
	<i>T. pecari</i>	-,38299*	,08347	,000	-,6264	-,1395

<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,31273*	,09931	,027	-,6024	-,0231
	<i>P. tajacu</i>	-,00500	,08973	1,000	-,2667	,2567
	<i>Pot.porcus</i>	-,20917	,07340	,059	-,4232	,0049
	<i>Sus scrofa</i>	,06849	,06584	,903	-,1235	,2605
	<i>T. pecari</i>	-,38798*	,07721	,000	-,6132	-,1628
<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	-,10356	,09058	,862	-,3678	,1606
	<i>P. tajacu</i>	,20417	,07996	,121	-,0290	,4374
	<i>Phac.africanus</i>	,20917	,07340	,059	-,0049	,4232
	<i>Sus scrofa</i>	,27766*	,05175	,000	,1267	,4286
	<i>T. pecari</i>	-,17881	,06560	,081	-,3701	,0125
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	-,38123*	,08458	,000	-,6279	-,1345
	<i>P. tajacu</i>	-,07349	,07309	,915	-,2867	,1397
	<i>Phac.africanus</i>	-,06849	,06584	,903	-,2605	,1235
	<i>Pot.porcus</i>	-,27766*	,05175	,000	-,4286	-,1267
	<i>T. pecari</i>	-,45647*	,05702	,000	-,6228	-,2902
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,07525	,09370	,966	-,1980	,3485
	<i>P. tajacu</i>	,38299*	,08347	,000	,1395	,6264
	<i>Phac.africanus</i>	,38798*	,07721	,000	,1628	,6132
	<i>Pot.porcus</i>	,17881	,06560	,081	-,0125	,3701
	<i>Sus scrofa</i>	,45647*	,05702	,000	,2902	,6228
log10_R_W	<i>Bab.babyrussa</i>	-,53585	,18445	,052	-1,0740	,0023
P.HWP.SP	<i>P. tajacu</i>					
	<i>Phac.africanus</i>	,02955	,17959	1,000	-,4944	,5535
	<i>Pot.porcus</i>	-,11112	,16026	,982	-,5787	,3564
	<i>Sus scrofa</i>	-,23568	,14964	,617	-,6722	,2009
	<i>T. pecari</i>	-,12818	,16577	,971	-,6118	,3554
<i>P. tajacu</i>	<i>Bab.babyrussa</i>	,53585	,18445	,052	-,0023	1,0740
	<i>Phac.africanus</i>	,56541*	,16304	,010	,0898	1,0410
	<i>Pot.porcus</i>	,42473*	,14147	,040	,0120	,8375
	<i>Sus scrofa</i>	,30018	,12931	,197	-,0771	,6774
	<i>T. pecari</i>	,40767	,14768	,074	-,0232	,8385
<i>Phac.africanus</i>	<i>Bab.babyrussa</i>	-,02955	,17959	1,000	-,5535	,4944
	<i>P. tajacu</i>	-,56541*	,16304	,010	-1,0410	-,0898
	<i>Pot.porcus</i>	-,14067	,13506	,902	-,5347	,2534
	<i>Sus scrofa</i>	-,26523	,12227	,263	-,6219	,0915
	<i>T. pecari</i>	-,15773	,14156	,874	-,5707	,2552

<i>Pot.porcus</i>	<i>Bab.babyrussa</i>	,11112	,16026	,982	-,3564	,5787
	<i>P. tajacu</i>	-,42473*	,14147	,040	-,8375	-,0120
	<i>Phac.africanus</i>	,14067	,13506	,902	-,2534	,5347
	<i>Sus scrofa</i>	-,12456	,09155	,750	-,3916	,1425
	<i>T. pecari</i>	-,01706	,11606	1,000	-,3557	,3215
<i>Sus scrofa</i>	<i>Bab.babyrussa</i>	,23568	,14964	,617	-,2009	,6722
	<i>P. tajacu</i>	-,30018	,12931	,197	-,6774	,0771
	<i>Phac.africanus</i>	,26523	,12227	,263	-,0915	,6219
	<i>Pot.porcus</i>	,12456	,09155	,750	-,1425	,3916
	<i>T. pecari</i>	,10750	,10089	,894	-,1868	,4018
<i>T. pecari</i>	<i>Bab.babyrussa</i>	,12818	,16577	,971	-,3554	,6118
	<i>P. tajacu</i>	-,40767	,14768	,074	-,8385	,0232
	<i>Phac.africanus</i>	,15773	,14156	,874	-,2552	,5707
	<i>Pot.porcus</i>	,01706	,11606	1,000	-,3215	,3557
	<i>Sus scrofa</i>	-,10750	,10089	,894	-,4018	,1868

*. The mean difference is significant at the 0.05 level.