

A photographic reference system of micro- and macrostructure of hairs of several East African species

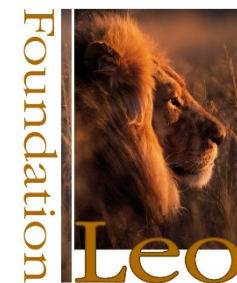
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Supervised by ¹Dr.ir. H.H. de longh, ²Charles Musyoki, ²Tuqa Jirmo and ²Francis Lesilau.

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This Reference Hair Collection should not be distributed directly. Please refer any interested people to Nicholas Beveridge or Jorjaan van den Hoogen. This reference includes several East African species and was compiled to support the identification of prey species of the Lion (*Panthera leo leo*) through scat analysis. This project was part of our master's thesis where we studied the diet of lions of Nairobi National Park (Nicholas Beveridge) and Amboseli National Park (Jorjaan van den Hoogen) in Kenya. This project was developed within a framework of collaboration between the Institute of Environmental Sciences (CML) Leiden University in the Netherlands, Kenya Wildlife Service (KWS) and the Leo Foundation. Dr.ir. H.H. de Jongh supervised from the CML the project. Practical supervision in Nairobi National Park was done by Francis Lesilau and Tuqa Jirimo in Amboseli National Park from the KWS. Charles musyoki was the overall supervisor for the work in Kenya.

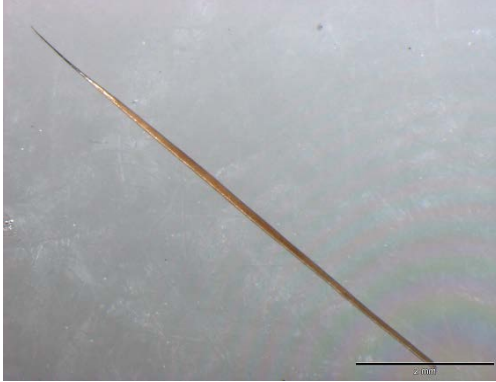
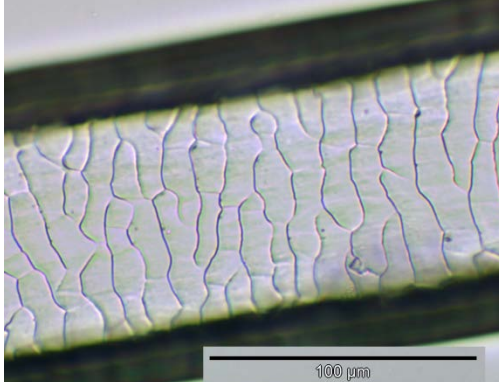
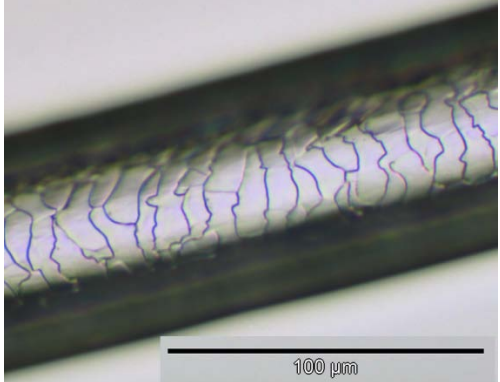

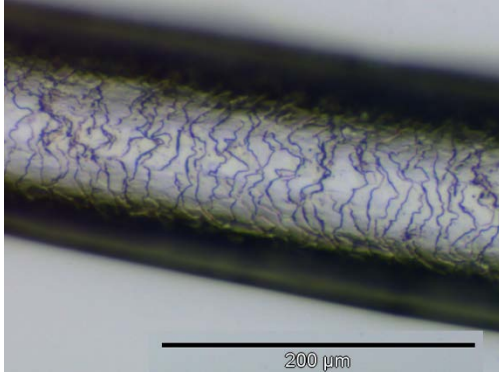
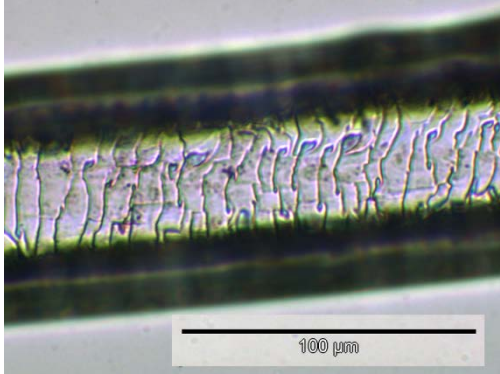
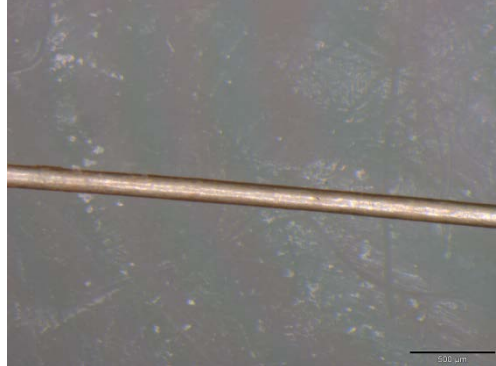
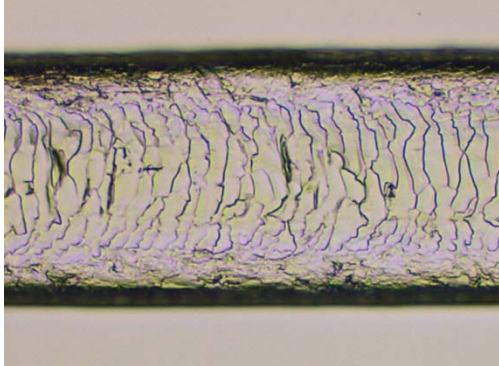
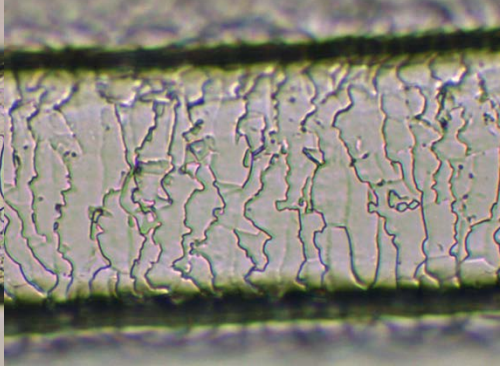
Hairs were collected from preserved specimens from Naturalis Biodiversity Centre in Leiden, the Netherlands. Hair shape, size and colour was analyzed macroscopically with a stereo microscope. Cuticle scale patterns provide more detailed identification for which microscope slides were prepared. In addition to the photographs descriptive text support the identification of hairs with this guide. Descriptive terminology is adapted from Keogh (1983) and Buys & Keogh (1984) and colour descriptions are after Kornerup & Wanscher (1967).

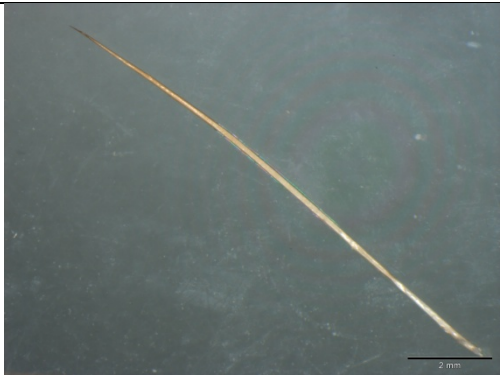
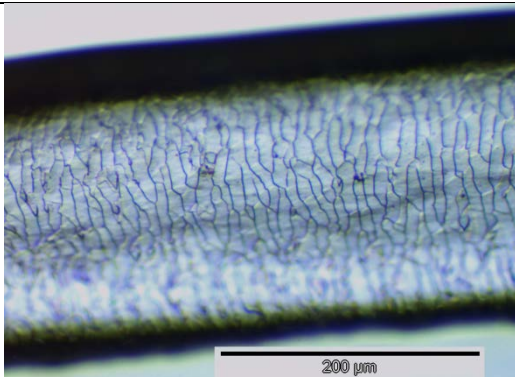
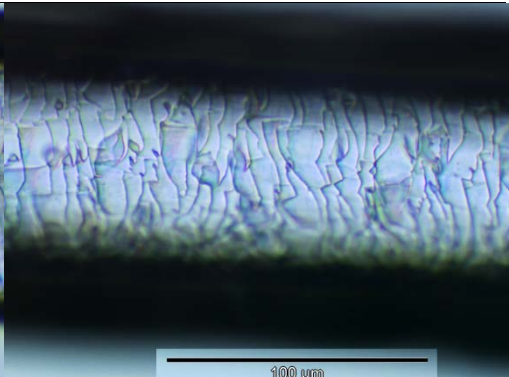
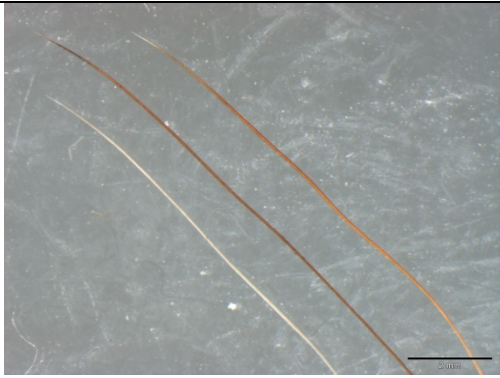
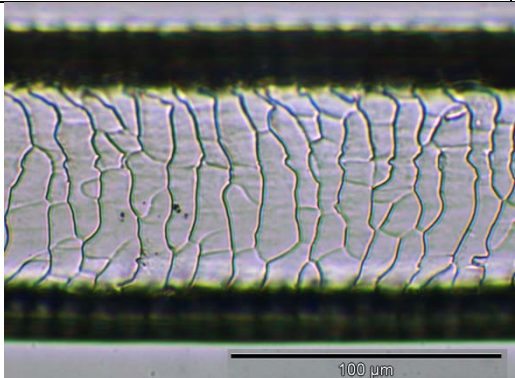
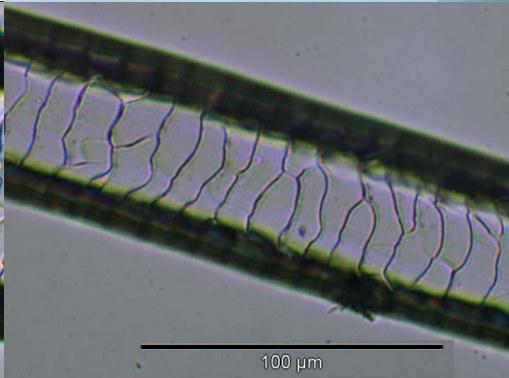
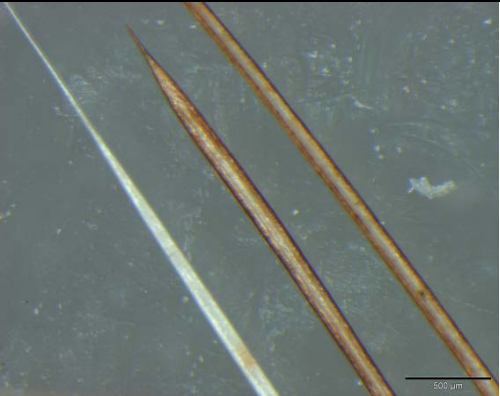
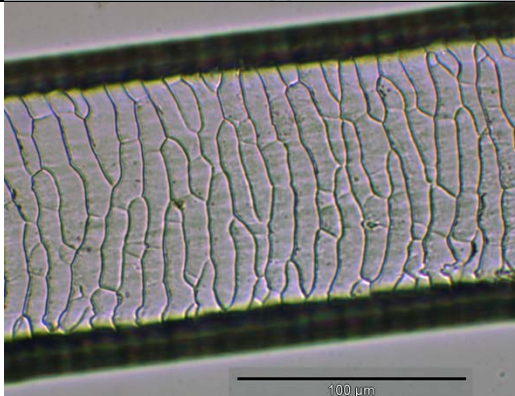
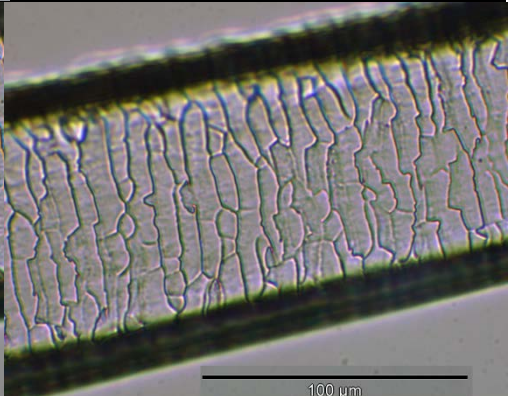
Full references:


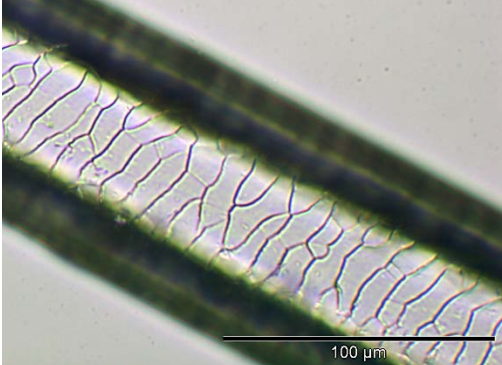
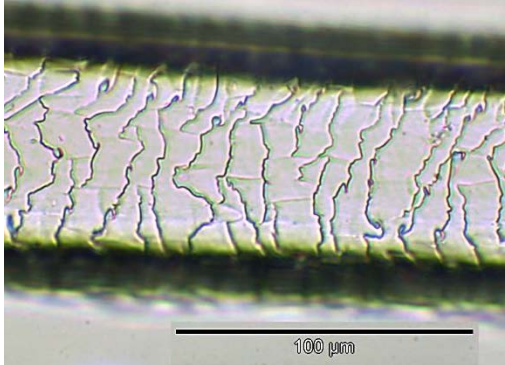

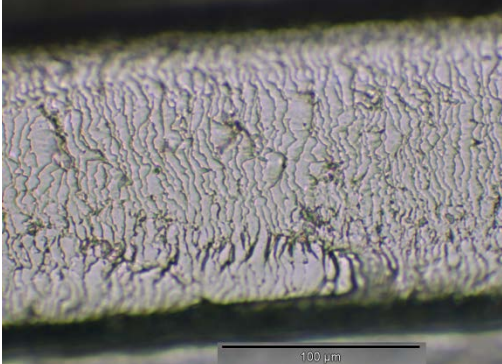
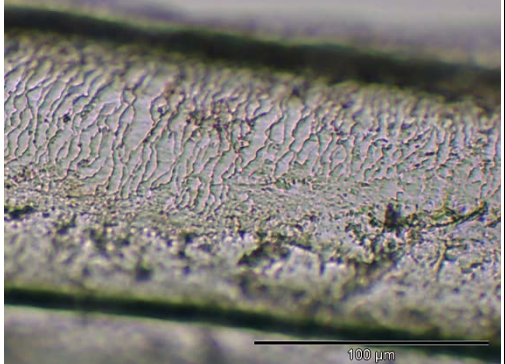
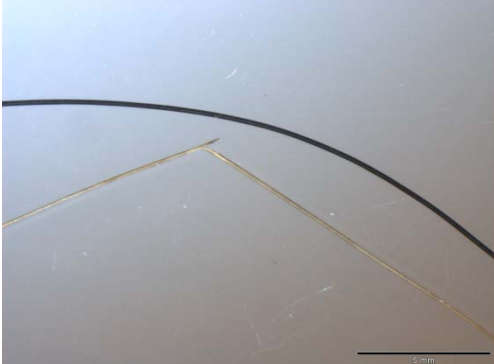
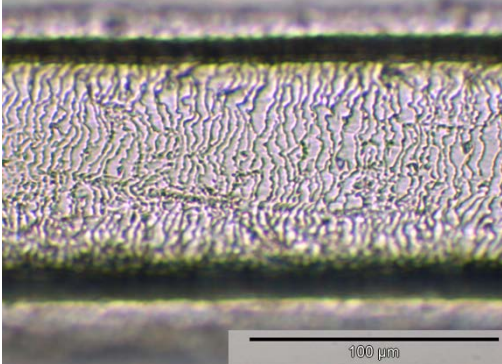
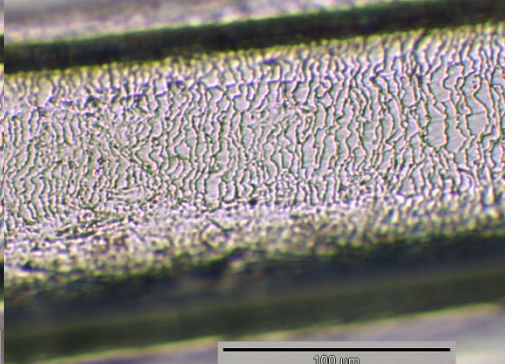
- Buys, D. & Keogh, H.J. 1984. Notes on the microstructure of hair of the Orycteropodidae, Elephantidae, Equidae, Suidae and Giraffidae. *South African Journal of Wildlife Research*, **14**, 111–119.
- Keogh, H.J. (1983). A photographic reference system of the microstructure of the hair of southern African Bovids. *South African Journal of Wildlife Research*, **13**, 89-94.
- Kornerup, A. & Wanscher, J.H. (1967). Methuen handbook of colour. Methuen & Co Ltd, 11 New Fetter Lane London E.C.4.


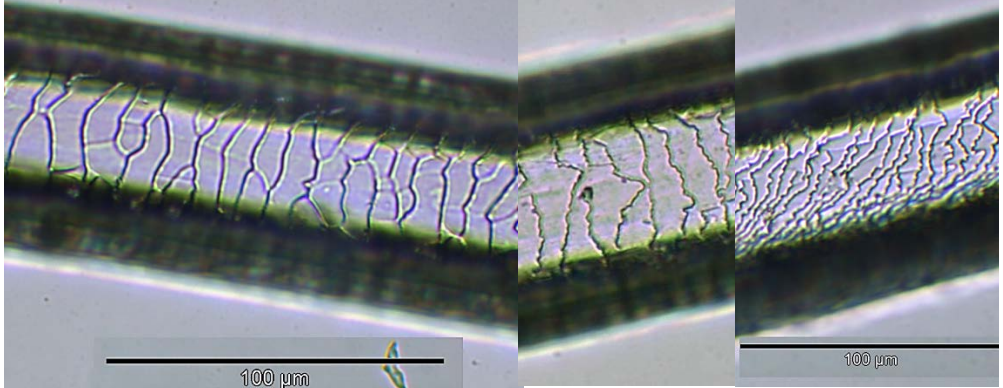

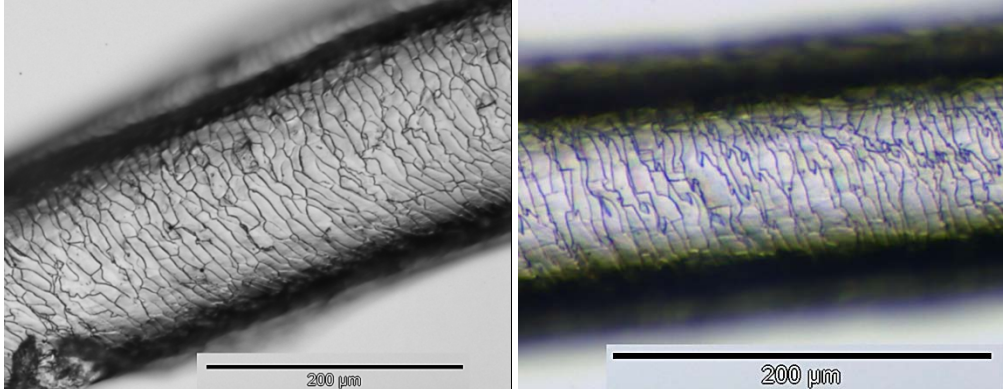
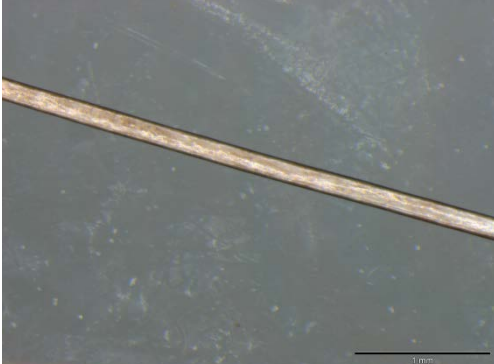
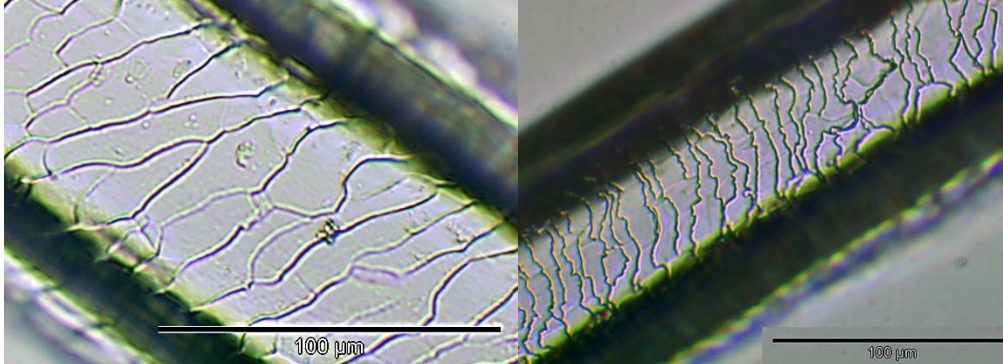
Collected hairs were washed in acetone for 5 minutes, rinsed in 96% alcohol for 5 minutes and dried on filter paper. The cuticle slides were made by soaking 1.7 grams of gelatin (one sheet Dr. Oetker white) 40 ml demi-water for 5 minutes. The solution was then placed on a hot plate (65°C) until the gelatin was completely dissolved. A thin layer of gelatin solution was then spread on a microscope slide and left to dry for 5 minutes. The hairs were placed on the gelatin layer and left until the gelatin was completely dry (minimal 60 minutes). When the gelatin was dry, the hairs were removed with forceps and stored in zip-lock bags. The cuticle imprints were photographed with a light microscope (Olympus Type BH2, series number 214351) and the photographing program Cell^D (Cell^D, Olympus Soft Imaging Solutions). Several photographs were taken from the base towards the tip of the hair so that the change in cuticle pattern along the hair was clearly visible.

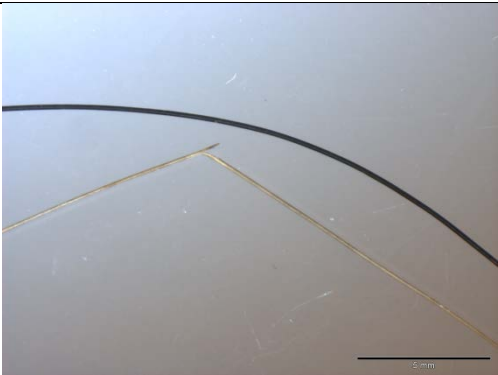
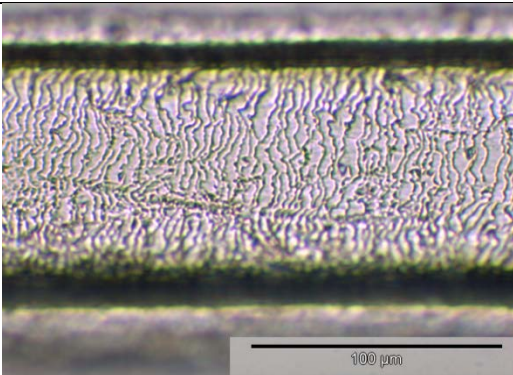
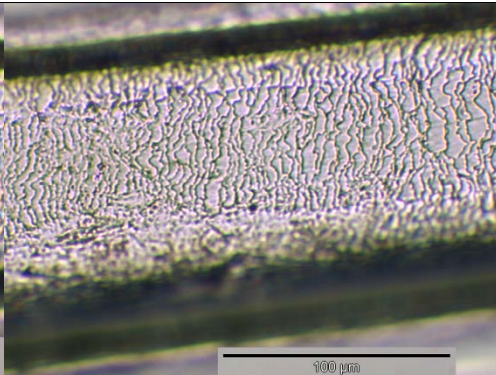
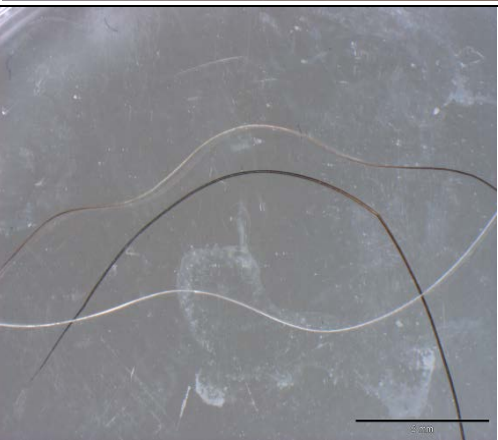
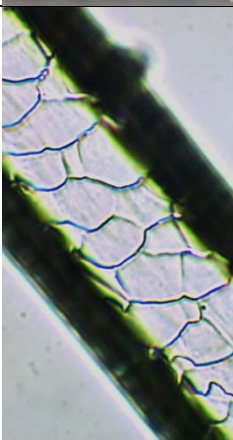
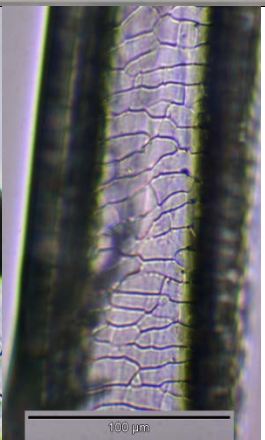
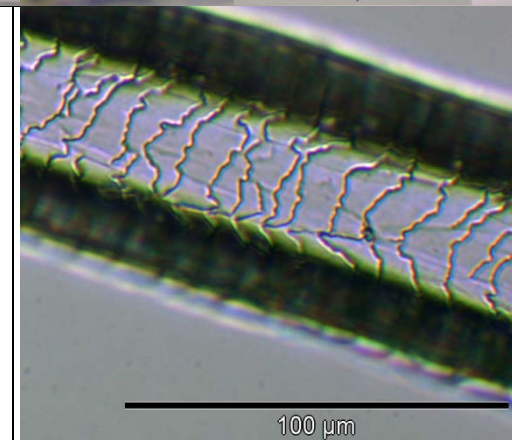

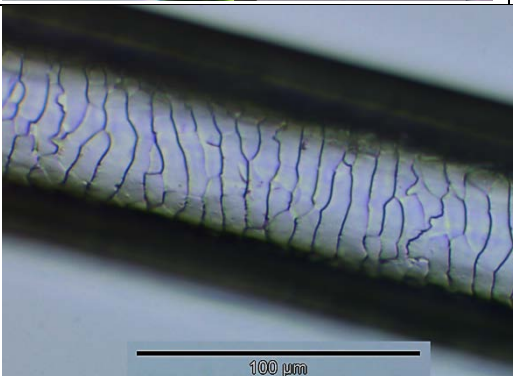
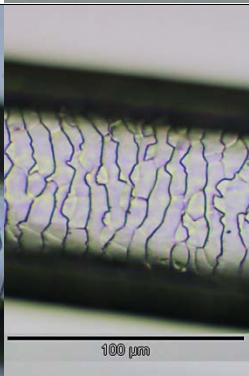
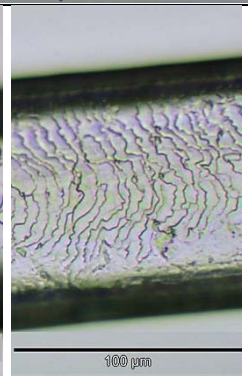
Besides the species included in this guide we have micro and macroscopic photographs of more East African species. The whole list of species can be found below. If you wish to have more information or would like any photographs please contact us. Finally we like to thank Bertie-Joan van Heuven, Raymond Brandt, Steven van der Mije and others for their time and assistance.


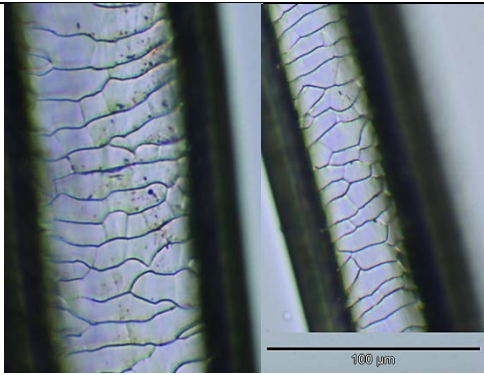
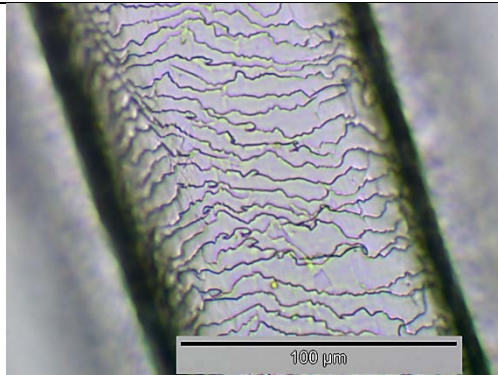

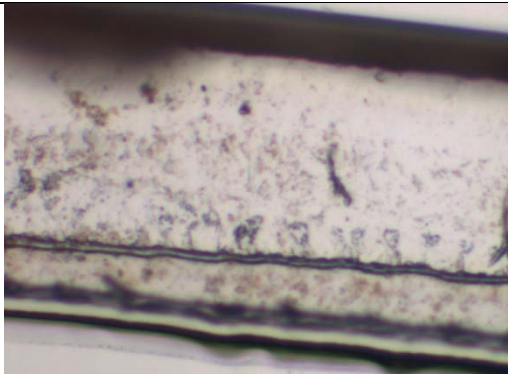
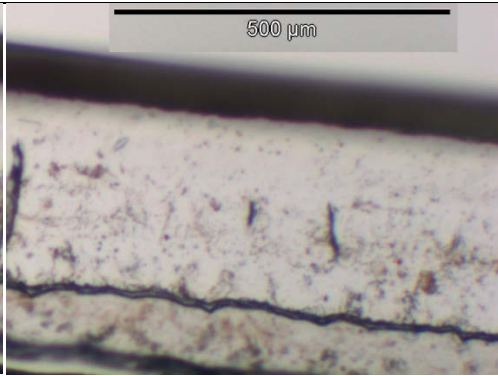

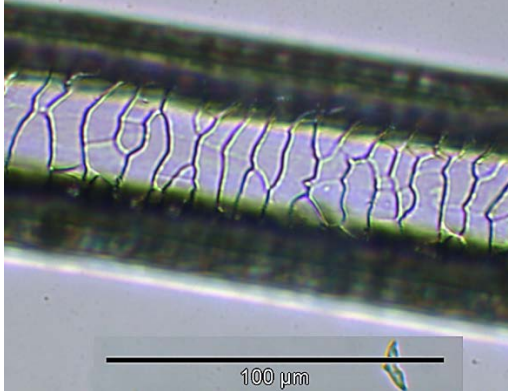
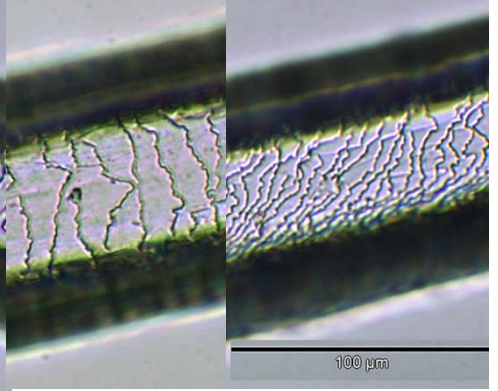
Species	Morphology	Photo	Scale Pattern	Photo Base	Photo Shaft
Impala	Reddish Brown (Raw Sienna) over entire length with black tip (0.8 mm)		Base & Shaft: regular waved mosaic, 2 a 3 scales across width, scale margin smooth. Tip: slightly irregular, scale margin smooth to rippled.		
Eland	Light reddish (Rust Brown) slightly darkening towards tip.		Base: irregular waved mosaic, very short part, smooth scale margin. Shaft and Tip: irregular waved mosaic, 1 scale across width, scale margin rippled (some resembling hooks).		
Hartebeest	Overall fawn; in the flat plane center reflecting Putty, edges Brown-red.		Base: Irregular waved mosaic, 1 (a 2) scales across width, scale margin smooth. Shaft and Tip: Irregular waved mosaic, 1 (a 2) scales across width, scale margin rippled. (Scale bars missing)		

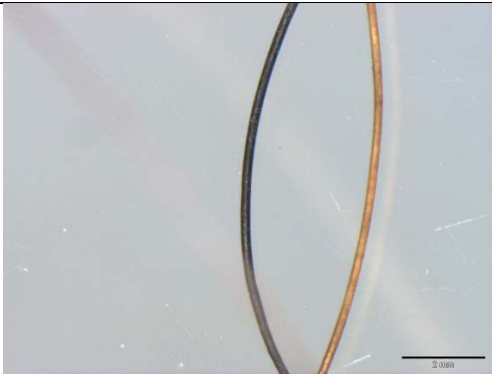
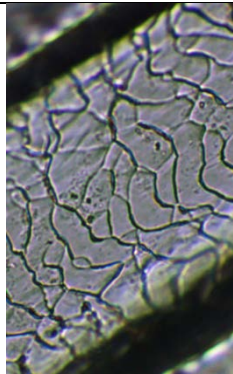
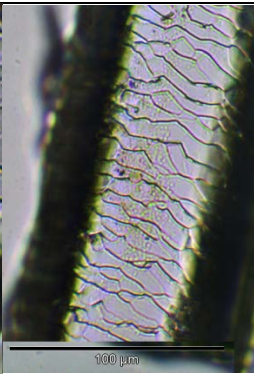
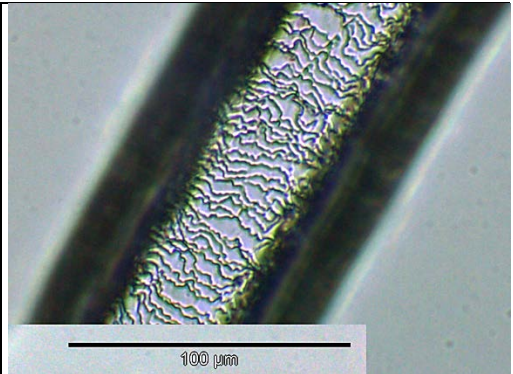
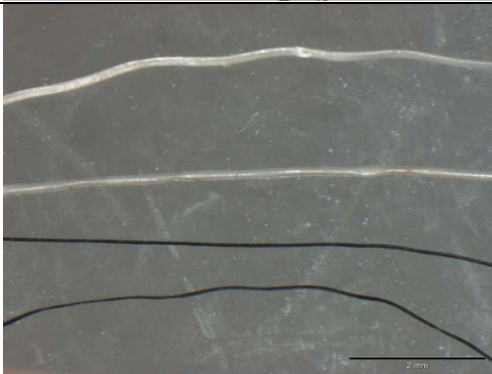
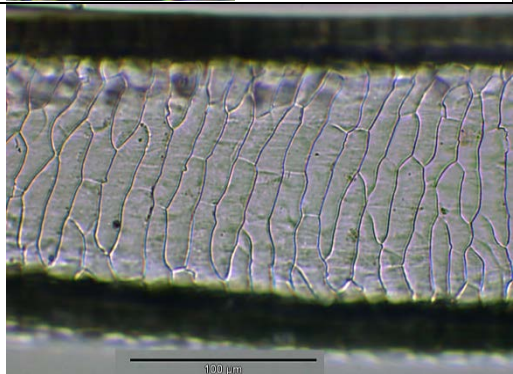
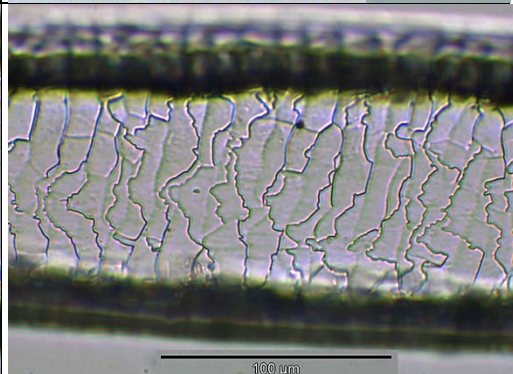
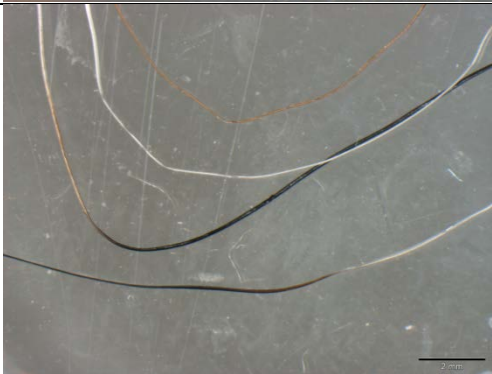
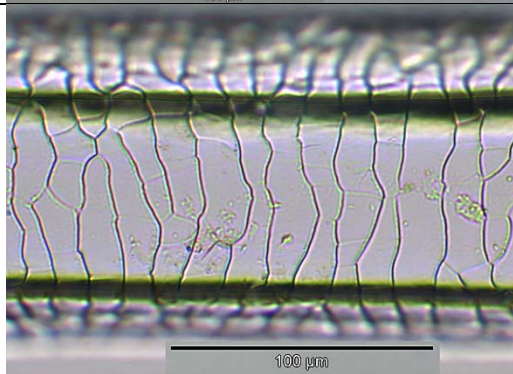
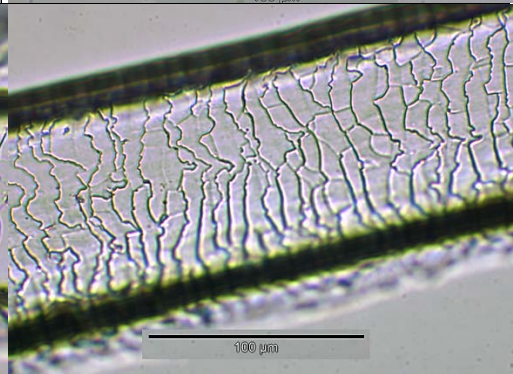
Reedbuck	Light Fawn, mostly white. Slightly more reddish towards tip.		Base: regular waved mosaic, 2 a 3 scales across width, scale margin smooth. Shaft & Tip: irregular waved, scale margin almost hooked.	 
Bushbuck	Between Titian Red and Brownish Orange, slightly darkening towards tip. Some hairs white.		Regular waved mosaic over entire length, 1 a 2 scales across width, scale margin smooth.	 
Grant's gazelle	Overall between Brownish Orange and Light Brown, in the flat plane center reflecting Putty, edges Brownish orange. Some hairs white.		Base: regular waved mosaic, 2 a 3 scales across width, scale margin smooth. Shaft & Tip: regular or slightly irregular waved mosaic, 2 a 3 scales across width, scale margin rippled.	 

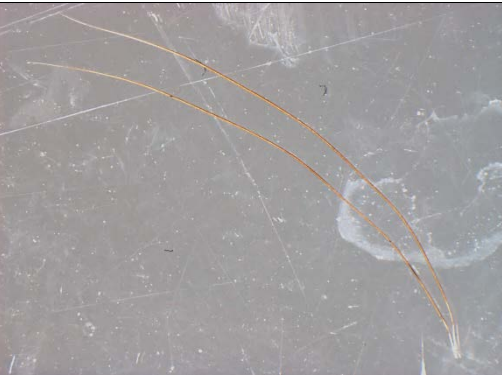
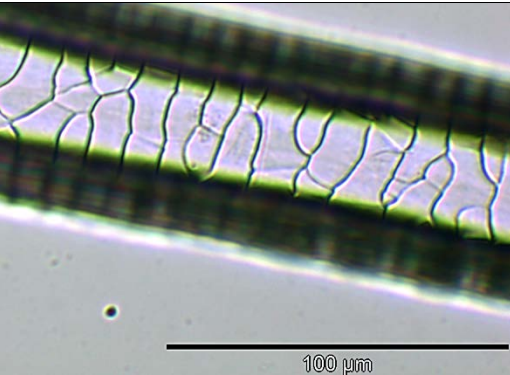
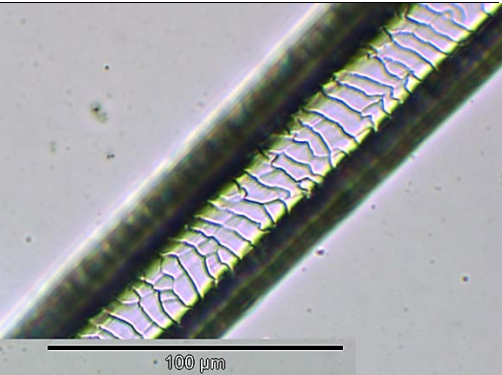
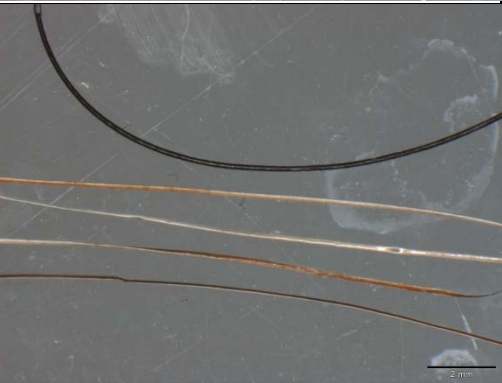
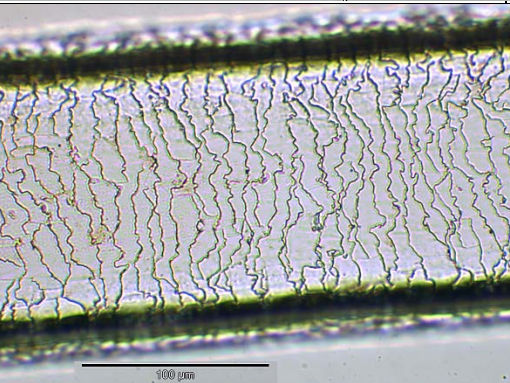
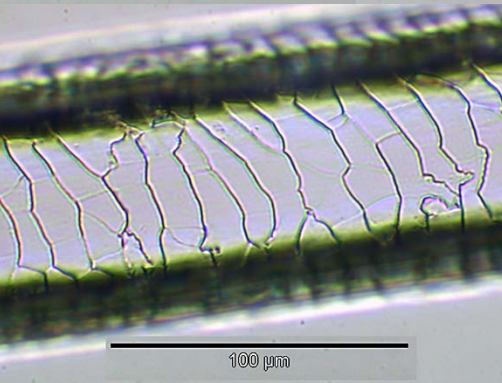
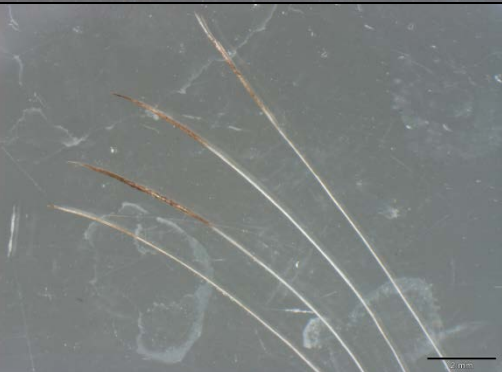
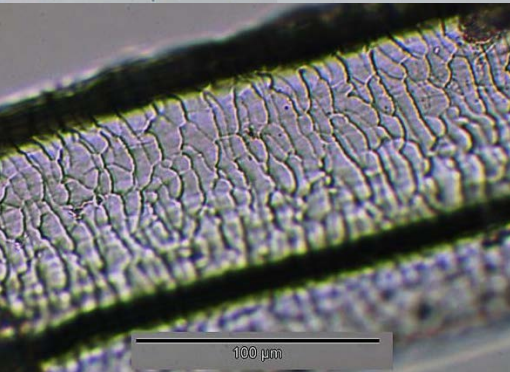
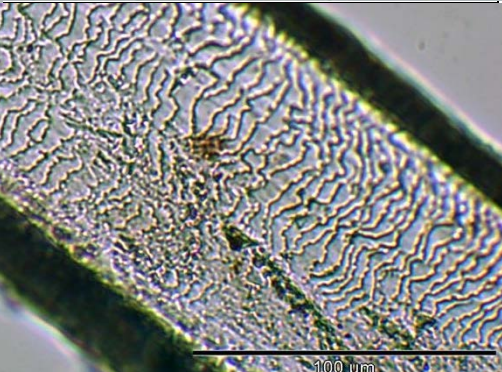
Tompson gazelle	Overall Orange White, darker near base, almost white from halfway to tip. Some are flat.		<p>Base: regular waved mosaic, 1 a 2 scales across width, scale margin smooth.</p> <p>Shaft & Tip: regular waved mosaic, 1 (a 2) scales across width, scale margin rippled.</p> <p>*May be smooth or rippled over length*</p>		
Wharthog	Henna at base to Pompeian Yellow towards tip.		<p>Highly irregular over entire length, 1 scale across width, scale margin crenate. Often guttered imprint.</p>		
Bushpig	Mostly Black, some Golden Blond halfway along shaft and towards tip.		<p>Highly irregular over entire length, 1 scale across width, scale margin crenate. Often guttered imprint.</p>		

Lion	<p>White at base, Apricot Yellow shaft and black tip (max 4.5 mm). Some hairs Black. *Resembles waterbuck, but irregular scale pattern is much more broad*</p>		<p>Base: regular waved mosaic, 1 (a 2) scales across width, scale margin smooth. Shaft & Tip: Irregular waved mosaic, 1 a 2 scales across width, scale margin rippled crenate (towards tip, variation may occur).</p>	
Giraffe	<p>White at base merging Light Brown over shaft towards tip. White. Relative short hairs.</p>		<p>Base: Irregular waved mosaic, 3 (+/-) scales across width, scale margin smooth. Shaft and Tip: Irregular waved mosaic, scale margin rippled crenate. <i>Scale pattern often at sharp angle to shaft.</i></p>	
Wildebeest	<p>1/3 of length from base white, rest dark grey or almost black. Some hairs whitish, in the flat plane center reflecting, edges black. Long hairs entirely black hairs.</p>		<p>Base: regular waved mosaic, 1 a 2 scales across width, scale margin smooth. Shaft & Tip: Irregular waved mosaic, 1 scale across width, scale margin rippled.</p>	

Bushpig	Mostly Black, some Golden Blond halfway along shaft and towards tip.		Highly irregular waved mosaic over entire length, 1 scale across width, scale margin crenate. Often guttered imprint.	 
Donkey	Black. White. Alternating grayish-black and white.		Base: between Regular and Regular waved mosaic, 1 a 2 scales across width, scale margin smooth. Shaft & Tip: irregular waved mosaic, 1 scale across width, scale margin rippled (crenate), distance between scales varies.	  
Zebra (plains)	Black, White or Burned sienna (which may be lighter of color).		Base: regular waved mosaic, 1 (a 2) scales across, scale margin smooth. Shaft & Tip: irregular waved mosaic, 1 (a 2) scale across width, scale margin rippled.	  

Waterbuck	<p>White at base merging tile red, black tipped. White or Greyish white.</p> <p>*Resembles lion, but irregular scale pattern is much finer*</p>		<p>Base: regular waved mosaic, 1 (a 2) scales across width, scale margin smooth.</p> <p>Shaft & Tip: irregular waved mosaic, 1 (a 2) scales across width, scale margin rippled crenate</p> <p>*May be smooth or rippled over length*</p>		
Elephant	<p>Black, extremely fat.</p>		<p>Scale pattern discernible due to coarseness of hair. Irregular waved mosaic across entire length, scale margin rippled or rippled crenate.</p>		
Lion	<p>Some hairs Black. White at base, Apricot Yellow shaft and black tip (max 4.5 mm).</p>		<p>Base: regular waved mosaic, 1 (a 2) scales across width, scale margin smooth.</p> <p>Shaft & Tip: Irregular waved mosaic, 1 (a 2) scales across width, scale margin rippled crenate (towards tip, variation may occur).</p>		

Buffalo	Mostly Black, some Caramel (brown)		<p>Base: regular waved mosaic, 1 (a 2) scales across width, scale margin smooth.</p> <p>Shaft & Tip: highly irregular waved mosaic, 1 (a 2) scales across width, scale margin crenate.</p>			
Sheep	Black. White. May be varied.		<p>Base & Shaft: regular waved mosaic, 2 (a 3) scales across width, scale margin smooth.</p> <p>Tip: irregular waved mosaic, 1 a 2 scales across width, scale margin rippled.</p>			
Goat	Varied. Sample hair: Reddish golden. White. Black. Half Black half White with intermediate middle color.		<p>Base: Regular waved mosaic, 1 a 2 scales across width, scale margin smooth.</p> <p>Shaft & Tip: irregular waved mosaic, 1 (a 2) scales across width, scale margin rippled crenate.</p>			

Cow	<p>Varied. Sample hair: White at base, Tangerine along shaft merging paler towards tip.</p>		<p>Regular waved mosaic over entire length, 1 (a 2) scales across width, scale margin smooth.</p>		
Dog	<p>Varied. Sample hair: Black. White. Greyish orange or Reddish golden.</p>		<p>Base & Shaft: irregular waved mosaic, 1 (a 2) scales across width, scale margin crenate. Tip: Regular waved mosaic, 1 a 2 scales across width, scale margin smooth.</p>		
Pig	<p>White base and shaft, Cognac tip (around 3.5 mm).</p>		<p>Base: Irregular waved mosaic, 2 a 3 scales across width, scale margin smooth (to rippled). Shaft & Tip: Irregular waved mosaic, 1 (a 2) scales across width, scale margin crenate.</p>		

List of the names of all East African species for which we have micro- and macroscopic photographs.

ScientificName	CommonName	ScientificName	CommonName
<i>Aepyceros melampus</i>	Impala	<i>Oreotragus oreotragus</i>	Klipspringer
<i>Alcephalus buselaphus</i>	Hartebeest	<i>Orycteropus afer</i>	Aardvark
<i>Ammelaphus imberbis</i> / <i>Tragelaphus imberbis</i>	Lesser Kudu	<i>Oryx beisa</i>	Oryx, east african
<i>Antidorcas masupialis</i>	Springbok	<i>Ourebia ourebi</i>	Oribi
<i>Camelus bactrianus</i>	Camel	<i>Panthera Leo</i>	Lion
<i>Cephalophys monticola</i>	Blue duiker	<i>Panthera pardus</i>	Leopard
<i>Cercopithecus aethiops</i>	Vervet monkey	<i>Papio cynocephalus</i>	Baboon
<i>Connochaetes taurinus</i>	Wildebeest	<i>Pedetes capensis</i>	Springhare
<i>Crocota crocuta</i>	Spotted Hyena	<i>Phacochoerus africanus</i>	Warthog
<i>Damaliscus pygargus pygargus</i>	Bontebok	<i>Potamochoerus larvatus</i>	Bushpig
<i>Equus asinus</i>	Donkey	<i>Procavia capensis</i>	Rock hyra
<i>Equus burchellii</i>	Zebra plains	<i>Redunca sp.</i>	Reedbuck
<i>Equus grevyi</i>	Zebra grevy	<i>Struthio camelus</i>	Ostrich
<i>Gazella granti</i>	Grant's gazelle	<i>Sylvicapra grimmia</i>	Common duiker
<i>Gazella thomsoni</i>	Thomson's gazelle	<i>Tragelaphus oryx</i>	Eland
<i>Giraffa camelopardalis</i>	Giraffe	<i>Tragelaphus oryx</i>	Eland
<i>Hippotragus equinus</i>	Roan	<i>Tragelaphus scriptus</i>	Bushbuck
<i>Hippotrgus niger</i>	Sable	<i>Tragelaphus strepsiceros</i>	Greater Kudu
<i>Hystrix africaeaustralis</i>	Porcupine		
<i>Kobus ellipsiprymnus</i>	Waterbuck		
<i>Kobus ellipsiprymnus thikae</i>	Waterbuck		
<i>Kobus kob</i>	Kob		
<i>Litocranius wallen</i>	Gerenuk		
<i>Loxodonta Africana</i>	Elephant		
<i>Madoqua kirkii</i>	Dikdik		