African Invertebrates 59(2): 111–126 (2018)
doi: 10.3897/AfrInvertebr.59.26617
http://africaninvertebrates.pensoft.net

RESEARCH ARTICLE

African Invertebrates
A journal of biodiversity research

On four species of the genus *Mistaria* Lehtinen, 1967 (Araneae, Agelenidae) from Kenya

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Academic editor: *Y. Mutafchiev* | Received 12 May 2018 | Accepted 12 July 2018 | Published 6 August 2018

http://zoobank.org/8AEAA62F-A445-4852-8AB9-232D13D2D150

Citation: Kioko GM, Kioko EN, Li S, Ji L (2018) On four species of the genus *Mistaria* Lehtinen, 1967 (Araneae, Agelenidae) from Kenya. African Invertebrates 59(2): 111–126. https://doi.org/10.3897/AfrInvertebr.59.26617

Abstract

In the current study, three species reported from Kenya are transferred from *Agelena* Walckenaer, 1805 to *Mistaria* Lehtinen, 1967, i.e. *M. fagei* (Caporiacco, 1949), **comb. n.**, *M. nairobii* (Caporiacco, 1949), **comb. n.** and *M. zorica* (Strand, 1913), **comb. n.** One new species *M. nyeupenyeusi* G.M. Kioko & S. Li, **sp. n.** is described.

Keywords

Africa, Ageleninae, *Agelena*, redescription, new species

Introduction

The funnel-weaver spider family Agelenidae C.L. Koch, 1837 contains 1,282 species belonging to 78 genera (World Spider Catalog 2018). Systematics of the subfamily Ageleninae and its type genus *Agelena* Walckenaer, 1805, are still not well understood as revealed by the studies of Lehtinen (1967) and Zhang et al. (2005) (see also Dippenaar-Schoeman and Jocqué 1997). Lehtinen (1967) proposed six new genera within Ageleninae, including *Mistaria* Lehtinen, 1967. In addition, Lehtinen (1967) provided a list of 21 *Agelena* species which may belong to the newly erected *Mistaria* but without making any combinations for them. Currently, *Mistaria* comprises one species and its two subspecies: the nominotypical *M. leucopyga leucopyga* (Pavesi, 1883) described based on three adult females from Ethiopia by Pavesi (1883) and its male subsequently described

by Simon (1909) and the subspecies *M. leucopyga niangarensis* (Lessert, 1927) described based on a single female specimen from the Congo (Lessert 1927).

The aim of this study is to revise the position of three *Agelena* species by proposing their transfer to the genus *Mistaria* and describe one new *Mistaria* species from Kenya.

Materials and methods

All spiders were preserved in 95% or 75% alcohol. Specimens were examined and measured using a LEICA M205C stereomicroscope. Images were captured using an Olympus C7070 wide zoom camera mounted on an Olympus SZX12 dissecting microscope. Male and female copulatory organs were dissected from the body and photographed separately. Epigynes were cleaned by first removing the tissues using a needle then boiled in 10% potassium hydroxide for 3–5 minutes. Leg measurements are given as follows: Total length (femur, patellar and tibia, metatarsus, tarsus). All measurements are reported in millimetres.

References to figures in the cited papers are listed in lowercase (fig. or figs); figures from this paper are noted with an initial capital (Fig. or Figs). Newly collected samples were deposited in the collections of the Institute of Zoology, Chinese Academy of Sciences in Beijing, China (IZCAS) and the National Museums of Kenya in Nairobi, Kenya (NMK). Type material from the collection of the Natural History Museum "La Specola" in Firenze, Italy (NMLS) was re-examined.

The abbreviations used in the paper include: ALE, anterior lateral eye; AME, anterior median eye; AME–ALE, distance between AME and ALE; AME–AME, distance between the two AME; C, Conductor; Cb, Cymbium; CD, Copulatory duct; CF, Cymbial furrow; E, Embolus; Eo, Embolic outgrowth; ET, Epigynal teeth; F, Fulcrum; FD, Fertilisation duct; LTA, Lateral tibial apophysis; MA, Median apophysis; PA, Patellar apophysis; PLE, Posterior lateral eyes; PME, Posterior median eyes; PME–PLE, distance between PME and PLE; PME–PME, distance between the two PME; RTA, Retrolateral tibial apophysis; S, Spermatheca; T, Tegulum. Apart from the eye abbreviations which are used in the text, all other abbreviations are cited in the figures. Labelling of figures follows Santos and van Harten (2007) and Zhang et al. (2005).

Taxonomy

Family: Agelenidae C.L. Koch, 1837
Subfamily: Ageleninae C.L. Koch, 1837

Mistaria Lehtinen, 1967

Lehtinen (1967: 249) and Santos and van Harten (2007: 166).

Diagnosis. The genus *Mistaria* shares various characters with three other genera from the subfamily Ageleninae i.e. *Agelescape* Levy, 1996, *Hololena* Chamberlin & Gertsch,

1929 and *Rualena* Chamberlin & Ivie, 1942 such as the presence of epigynal teeth in females and a palpal fucrum in males. Males of *Mistaria* can however be distinguished from those of *Agelena* by the presence of a large translucent fulcrum of the male palp (Fig. 5E); from males of *Agelescape* by the absence of a tegular projection between the conductor and median apophysis and the presence of two tibial apophysis (see figure 1 in Guseinov et al. 2005); from males of *Hololena* by having patellar apophysis (Fig. 2C) which is absent in *Hololena*; and from males of *Rualena* by the absence of conductor projections (see figure 12 in Maya-Morales and Jiménez 2016). Female *Mistaria* have epigynes that can be distinguished from those of *Agelena* by having epigynal teeth and lateral notches (Fig. 3A); from those of *Agelescape* by the lack of a scape (Fig. 3A); from those of *Hololena* by the posterior position of the epigynal teeth (see figure 8 in Chamberlin and Ivie 1942); and from those of *Rualena* by the absence of copulatory openings and hyaline spurs (see figure 40 in Maya-Morales and Jiménez 2016).

Description. Medium to large spiders, 5–12 mm. Chelicerae with 3 retromarginal and 2 promarginal teeth. Labium as long as wide. Labium and endites apically cream-coloured. The carapace has distinct or obscure lateral bands and a long and deep fovea. Chevron markings and a central band are present on the abdomen. Colulus is a paired hairy plate.

Male palp. One long retrolateral tibial apophysis and an adjacent lateral tibial apophysis, patellar apophysis acute apically. Alternating position of the patellar apophysis relative to the retrolateral tibial apophysis, separated by length of tibia. Tegulum ovoid posteriorly. Cymbial furrow short at the base of the cymbium (Fig. 2C). Median apophysis long, curved at apex. Fulcrum well sclerotised with a membranous edge and projecting between the embolus and sub-tegulum. Conductor well-developed and sclerotised. Fulcrum and primary conductor forming a functional conductor. Embolus shortened, S-shaped, spine-like, originating basally or centrally.

Epigyne. Pit horseshoe shaped, plate weakly delimited. Atria wide, teeth on margin originating centrally or almost anteriorly. Atria delimited by a posterior sclerotised border. Copulatory ducts close or widely separated. Three retrolateral spermathecal lobes.

Type species. *Mistaria leucopyga* (Pavesi, 1883) from Ethiopia.

Mistaria fagei (Caporiacco, 1949), comb. n.

Fig. 1

Synonym: *Agelena fagei* Caporiacco, 1949 see Caporiacco (1949: 330, fig. 8, ♀) and Roewer (1955: 29, fig. 7, ♀).

Type material examined. Lectotype, ♀, Kenya, Mau, January 1946, Meneghetti (NMLS).

Diagnosis. *M. fagei*, *M. leucopyga* and *M. nairobii* all have a concave shaped sclerotised delimiting edge. *M. fagei* can be distinguished from *M. leucopyga* by the conspicous copulatory ducts (Fig. 1B). It can be separated from *M. nairobii* by the shape

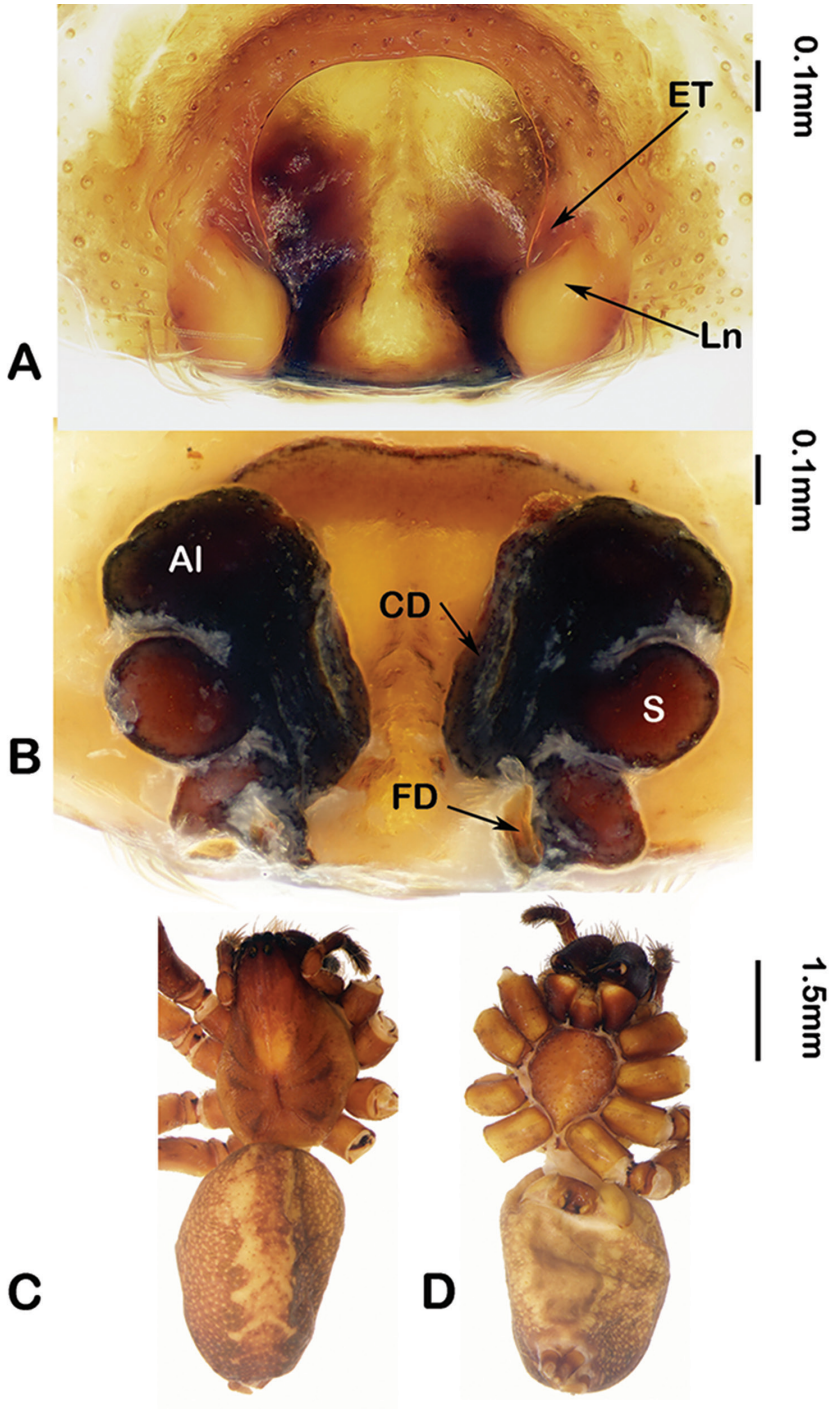

Figure 1. *Mistaria fagei*, female lectotype. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Female habitus, dorsal view **D** Female habitus, ventral view. Scale bars: equal for **C, D**; Al–Anterior lobe; CD–Copulatory duct, ET–Epigynal teeth, FD–Fertilization duct, Ln–Lateral notches, S–Spermatheca

of the spermathecae lobes which are rounded compared to ovoid in this species and by the absence of a septum in the latter species (Figs 1B, 3B).

Redescription. Female. Total body length 11.86. Carapace 5.13 long, 3.85 wide. Abdomen 6.73 long, 4.49 wide. Habitus as in Figs 1C, D. Carapace longer than wide, brown-yellow, four pairs of lateral bands. Eye sizes and interdistances: AME 0.24, ALE 0.28, PME 0.20, PLE 0.24, AME–AME 0.12, AME–ALE 0.10, PME–PME 0.19, PME–PLE 0.28. Chelicerae, labium and endites brown-yellow. Sternum as long as wide, brown-yellow with an indistinct horizontal median band. Legs brown-yellow. Leg measurements: III 15.12 (4.51, 4.50, 3.51, 2.60), IV 17.62 (4.81, 5.51, 5.10, 2.20). Legs I and II missing. Abdomen oval, brown-yellow with yellowish spots, two distinct chevron marks and one indistict below (Fig. 1C). Ventre with two faint horizontal black lines (Fig. 1D). Distal segment of posterior spinnerets brown-yellow, proximal segment brown.

Epigyne as in Fig. 1A, B. Epigyne teeth wide posteriorly and narrow distally, equidistant from the lateral notches, central origin (Fig. 1A). Copulatory duct long, positioned at the epigyne base, about 2/3 of the length of the pit, heavily sclerotised, black (Fig. 1B). Three retrolateral spermathecae lobes decreasing in size posteriorly, first lobe ovoid (Fig. 1B). Distinct septum on pit about 1/5 width of pit (Fig. 1A).

Male unknown.

Distribution. Kenya (Mau) (Fig. 7).

***Mistaria nairobii* (Caporiacco, 1949), comb. n.**
Figs 2, 3

Synonyms: *Agelena leucopyga nairobii* Caporiacco, 1949 (Caporiacco 1949: 329, fig. 7, ♂♀); *Agelena nairobii* Caporiacco, 1949 in Roewer (1955: 46, fig. 16a–c, ♂♀).

Type material examined. Lectotype, ♂, Kenya, Nairobi, 1944, Meneghetti (NMLS).

Other materal examined. 1♀, Kenya, Kakamega County, Kakamega Town, Kakamega Forest, Isecheno forest station, Mutere Trail, N00°17.300', E34°51.220', 1,630 m a.s.l., 15th July 2017, Q. Zhao. & G. Kioko (NMK).

Diagnosis. Males of this species can be distinguished from *M. leucopyga* by the size ratio of the retrolateral tibial apophysis to the lateral tibial apophysis, which is 3:1 compared to 5:1 in the latter species (Fig. 2B). Compared to *M. nyeupenyeusi* G.M. Kioko & S. Li, sp. n., *M. nairobii* is relatively large. The colour pattern can also be used to separate the two species whereby *M. nyeupenyeusi* G.M. Kioko & S. Li, sp. n. is generally black and white compared to brown-yellow in *M. nairobii*. The females of *M. nairobii* can be separated from *M. leucopyga* and *M. fagei* by the circular lobes of the retrolateral spermatheca compared to ovoid lobes in the latter two species (Figs 1B, 3B).

Redescription. Male. Total length 11.86. Carapace 5.77 long, 4.49 wide. Abdomen 6.09 long, 3.85 wide. Habitus as in Fig. 3C. Carapace rounded, red-brown with numerous white setae and distinct pattern comprising four pairs of lateral bands

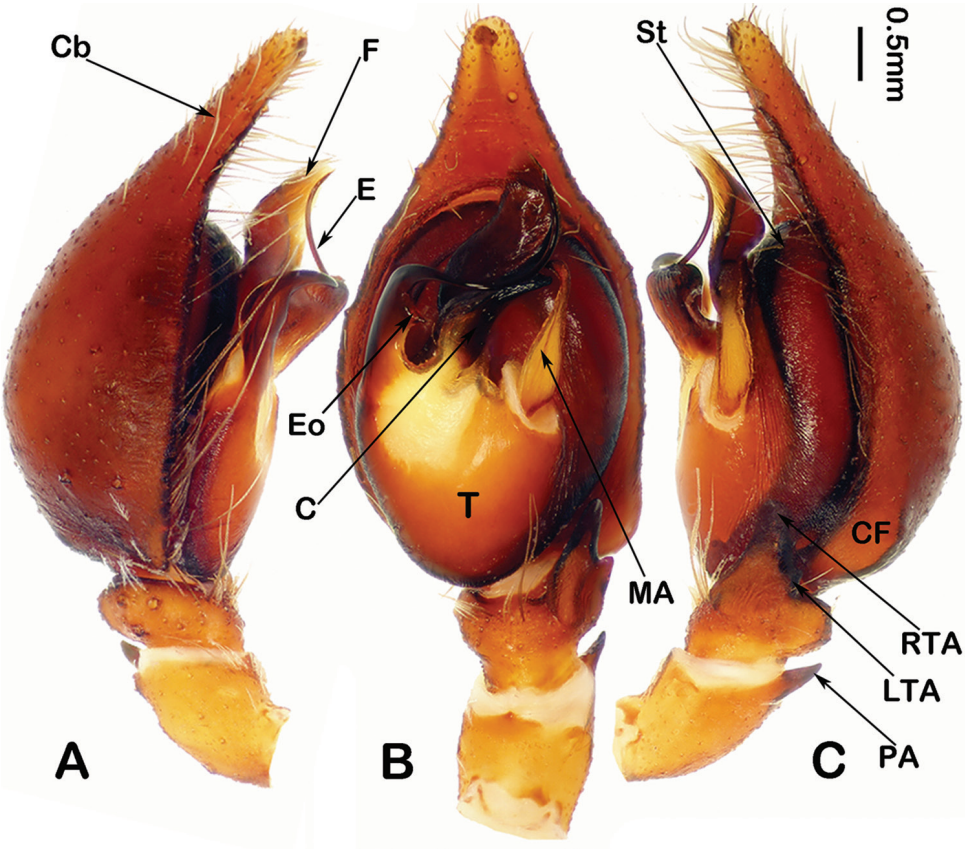

Figure 2. Left palp of *Mistaria nairobii*, male lectotype. **A** Prolateral view **B** Ventral view **C** Retrolateral view. Scale bar: equal for **A, B, C**; C–Conductor, Cb–cymbium, CF–Cymbium furrow, E–Embolus, F–Fulcrum, LTA–Prolateral tibial apophysis, MA–Median apophysis, PA–Patellar apophysis, RTA–Retrolateral tibial apophysis, ST–Sub tegulum, T–Tegulum

(Fig. 5A). Eye sizes and interdistances: AME 0.28, ALE 0.31, PME 0.28, PLE 0.32, AME–AME 0.09, AME–ALE 0.06, PME–PME 0.20, PME–PLE 0.25. Chelicerae, labium and endites red-brown. Sternum brown, indistinct median band. Legs brown. Leg measurements: II 19.62 (5.51, 6.71, 4.80, 2.60). Legs I, II and IV missing. Abdomen oval, cream-white with black spots, four chevron markings, ventre with a pair of horizontal black stripes. Posterior spinneret segments equal in size, brown.

Palp as in Fig. 2A, C. Cymbium 2.56 long, rounded and thick, red-brown with a creamy apex and tip about 1/3 the length of cymbium (Fig. 2B). Cymbial furrow short, about 1/6 length of cymbium. Retrolateral tibial apophysis triangular, 1.5 times the length of the tibia (Fig. 2C). Apex blunt with a small adjacent lateral tibial apophysis. Size ratio of the retrolateral tibial apophysis to the lateral tibial apophysis: 3:1 (Fig. 2B). Patellar apophysis cone-shaped, approximately as long as the tibia. Edge of sub-tegulum slanting at point of attachment to fulcrum (Fig. 2C). Median apophysis

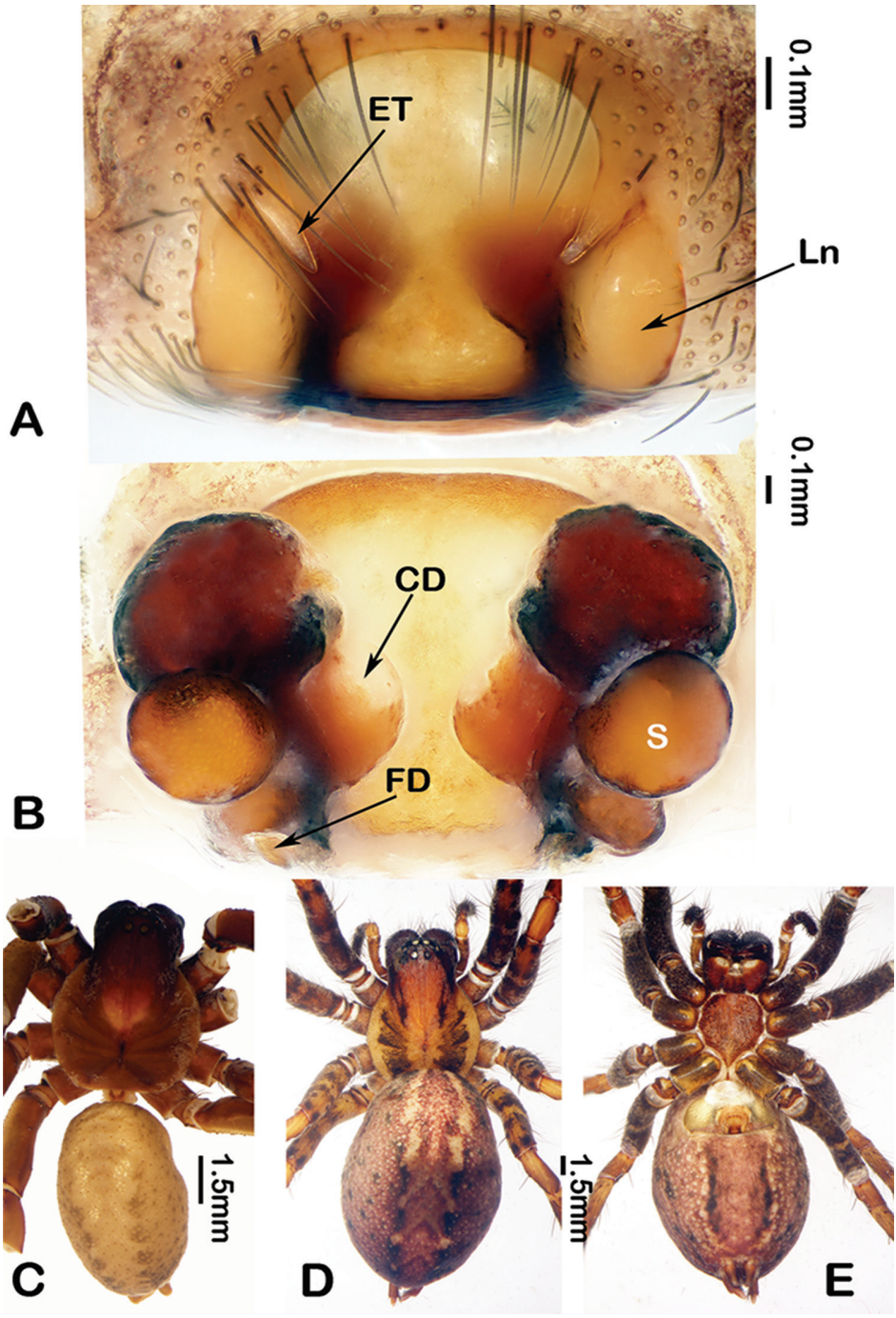

Figure 3. *Mistaria nairobii,* female from Kakamega. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view. Scale bars: equal for **D, E**; Al–Anterior lobe, CD–Copulatory duct, ET–Epigynal teeth, FD–Fertilization duct, Ln–Lateral notches, S–Spermatheca

has a wide base and a narrow apex, curved at the apex (Fig. 2B). Conductor resembles a thumb that is bent backward. Embolus originating centrally with basal embolic outgrowth, with a slight curve for the base and basal membrane (Fig. 2A).

Female. Total length 12.5. Carapace 4.2 long, 3.9 wide. Abdomen 8.3 long, 5.5 wide. Habitus as in Fig. 3D, E. Carapace light brown, with four pairs of lateral bands. Eye sizes and interdistances: AME 0.28, ALE 0.3, PME 0.2, PLE 0.24, AME–AME 0.13, AME–ALE 0.1, PME–PME 0.25, PME–PLE 0.3. Cephalic region, chelicerae, labium and endites red-brown. Coxa and femur of all legs brown suffused with black, the rest of the segments brown. Leg measurements: I 15.12 (3.90, 5.81, 3.51, 1.90), II 14.71 (4.20, 5.10, 3.50, 1.91), III 13.12 (3.80, 4.51, 3.21, 1.60) IV 16.11 (4.81, 5.50, 4.50, 1.30). Abdomen rounded with three chevron marks dorsally, red-brown with black and white spots. Horizontal bands cream-white anteriorly and black posteriorly. Ventre with horizontal black lines outlined with cream-white. Distal segment of the posterior spinnerets same size as the proximal segment.

Epigyne as in Fig. 3A, B. Teeth wide posteriorly and narrow distally, slightly longer than the lateral notches, central origin (Fig. 3A). Spermathecae lobes and copulatory ducts rounded, anterior lobe slightly darker than the middle and posterior lobe (Fig. 3B). Copulatory ducts sclerotised and of basal origin. Epigyne and vulva delimiting edges concave.

Distribution. Central and East Africa (Fig. 7).

***Mistaria zorica* (Strand, 1913), comb. n.**
Fig. 4

Synonym: *Agelena zorica* Strand, 1913 see Strand (1913: 411, ♀), Denis (1950: 499, fig. 9, ♀) and Roewer (1955: 40, fig. 13, ♀)

Type material examined. Lectotype, ♀, Kenya, Nairobi, 1944, Meneghetti (NMLS).

Diagnosis. This species is almost the same size as *M. nyeupenyeusi* G.M. Kioko & S. Li, sp. n., but it can be separated by the ovoid shape of the anterior spermatheca lobe compared to the triangular shape in the latter species (Figs 4B, 6B). Epigyne delimiting edge is concave in *M. zorica* compared to square in *M. nyeupenyeusi* G.M. Kioko & S. Li, sp. n. (Figs 4A, 6A). The general colour pattern of the two species can also be used to distinguish them: *M. zorica* is cream-yellow and *M. nyeupenyeusi* G.M. Kioko & S. Li, sp. n. is black and white.

Redescription. Female. Total length 5.4. Carapace 2.0 long, 1.8 wide. Abdomen 3.4 long, 2.4 wide. Habitus as in Fig. 4C, D. Carapace with a distinct pattern of four pairs of lateral bands. Yellow palp with a transverse brown band present on the patellar. Eye sizes and interdistances: AME 0.13, ALE 0.16, PME 0.13, PLE 0.14, AME–AME 0.09, AME–ALE 0.06, PME–PME 0.16, PME–PLE 0.11. Chelicerae and labium red-brown, endites yellow. Sternum brown suffused with black. Legs yellow with an indistinct horizontal black line on the coxa ventrally (Fig. 4D). Leg measurements: III

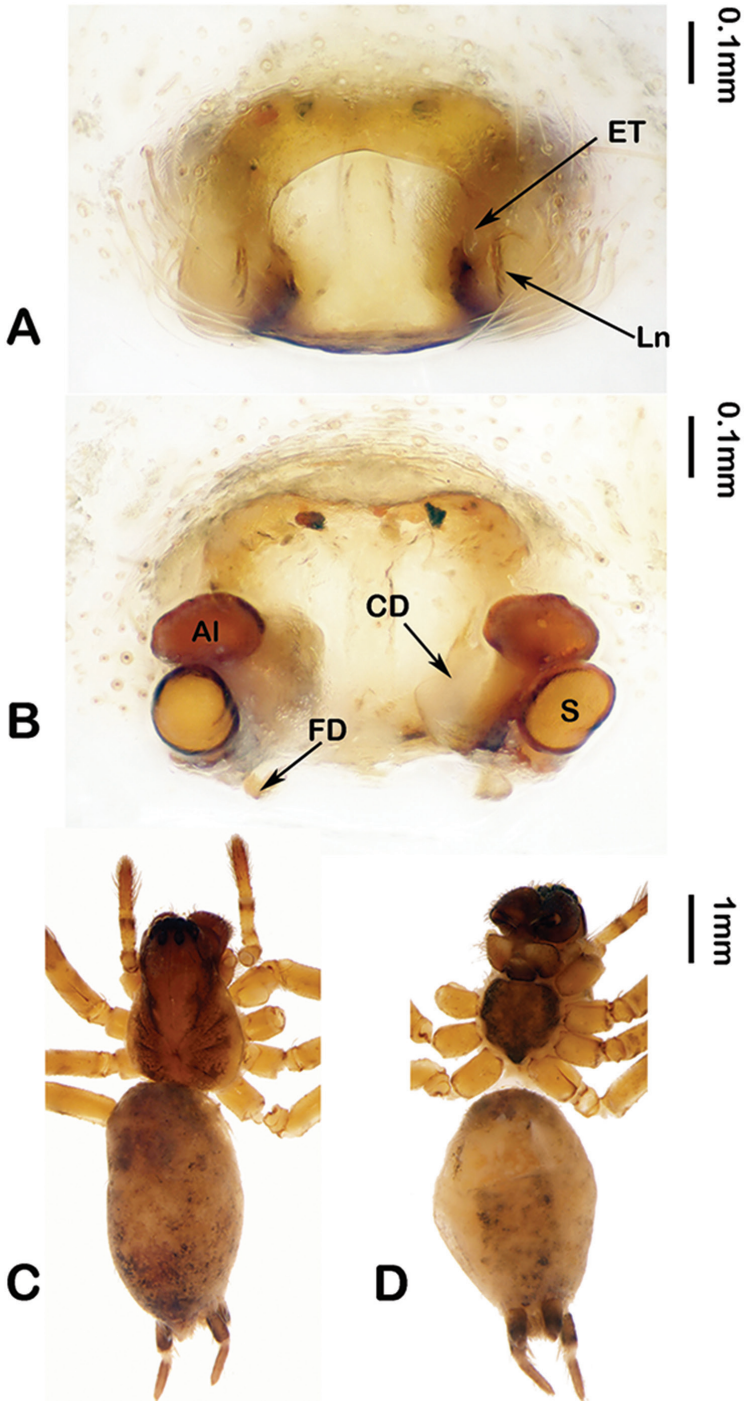

Figure 4. *Mistaria zorica,* female lectotype. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Female habitus, dorsal view **D** Female habitus, ventral view. Scale bars: equal for **C, D**; Al–Anterior lobe, CD–Copulatory duct, ET–Epigynal teeth, FD–Fertilization duct, Ln–Lateral notches, S–Spermatheca

6.70 (2.10, 2.10, 1.50, 1.00), IV 8.02 (2.11, 2.51, 2.10, 1.30). Legs I and II missing. Abdomen long, ovoid, cream-yellow with no discernable pattern, almost plain. Long posterior spinnerets, three times longer than the anterior spinerets, with the proximal segment, black-brown and the distal segment brown (Fig. 4C).

Epigyne as in Fig. 4A, B. Cream-yellow. Epigyne teeth short and blunt, central origin. Anterior vulva delimiting edge curverd inwards at the middle (Fig. 4A). Copulatory ducts lightly sclerotised, widely separated, vertical length the same as the three retrolateral lobes of spermatheca and position basal (Fig. 4B). Spermathecae longitudinally cover 2/3 length of the pit (Fig. 4B).

Male unknown.

Distribution. Central and East Africa (Fig. 7).

***Mistaria nyeupenyeusi* G.M. Kioko & S. Li, sp. n.**
http://zoobank.org/65299CC2-CFF3-4219-8FBA-EE1DC5F206A1
Figs 5, 6

Type material. Holotype ♂, Kenya, Nyeri County, Naro Moru Town, Mount Kenya National Reserve Naro Moru gate, Met station, S00°10.230', E037°12.143', about 3000 m a.s.l., 24 July 2017, Q. Zhao & G. Kioko (NMK). Paratypes, 7 ♀, same data as holotype (IZCAS).

Etymology. Specific name comprises the two Swahili words 'nyeupe' and 'nyeusi' which mean white and black, respectively. It is descriptive of the general colour pattern of the species; noun in apposition.

Diagnosis. Males of *M. nyeupenyeusi* G.M. Kioko & S. Li, sp. n. can be separated from those of *M. leucopyga* by having a blunt and thick embolus compared to sharp tipped and thin embolus in the former species (Fig. 5D). Another distinguishing character is the presence of a basal embolic outgrowth in *M. leucopyga* that is absent in this species (Fig. 5E). Females can be distinguished by the shape of the epigyne delimiting edge which is square-shaped compared to concave in *M. leucopyga* (Fig. 5A). The species can be separated from *M. zorica* by the shape of the anterior lobe of the vulva which is triangular compared to ovoid in the latter species and also by the position and sclerotisation of the copulatory ducts which are 2/3 the length of the pit and lightly sclerotised in *M. zorica* compared to occupying the entire pit and heavily sclerotised in *M. nyeupenyeusi* (Figs 4B, 6B).

Description. Male. Total length 5.06. Carapace 2.25 long, 1.9 wide. Abdomen 2.81 long, 1.6 wide. Habitus as in Fig. 6C. Carapace rounded. V-shaped pattern on the carapace formed by the first two lateral lines from the cephalic region and the fovea. Eye sizes and interdistances: AME 0.13, ALE 0.14, PME 0.11, PLE 0.14, AME–AME 0.06, AME–ALE 0.06, PME–PME 0.09, PME–PLE 0.11. Chelicerae red-brown. Labium and endites brown suffused with black and creamy apically. Sternum black with a cream line in the middle, width 1/3 wide size of sternum. Legs cream-white with black rings on all femora. Leg measurements: I 8.80 (2.50, 3.10, 1.90, 1.30), II 8.21 (2.40, 2.40, 2.00,

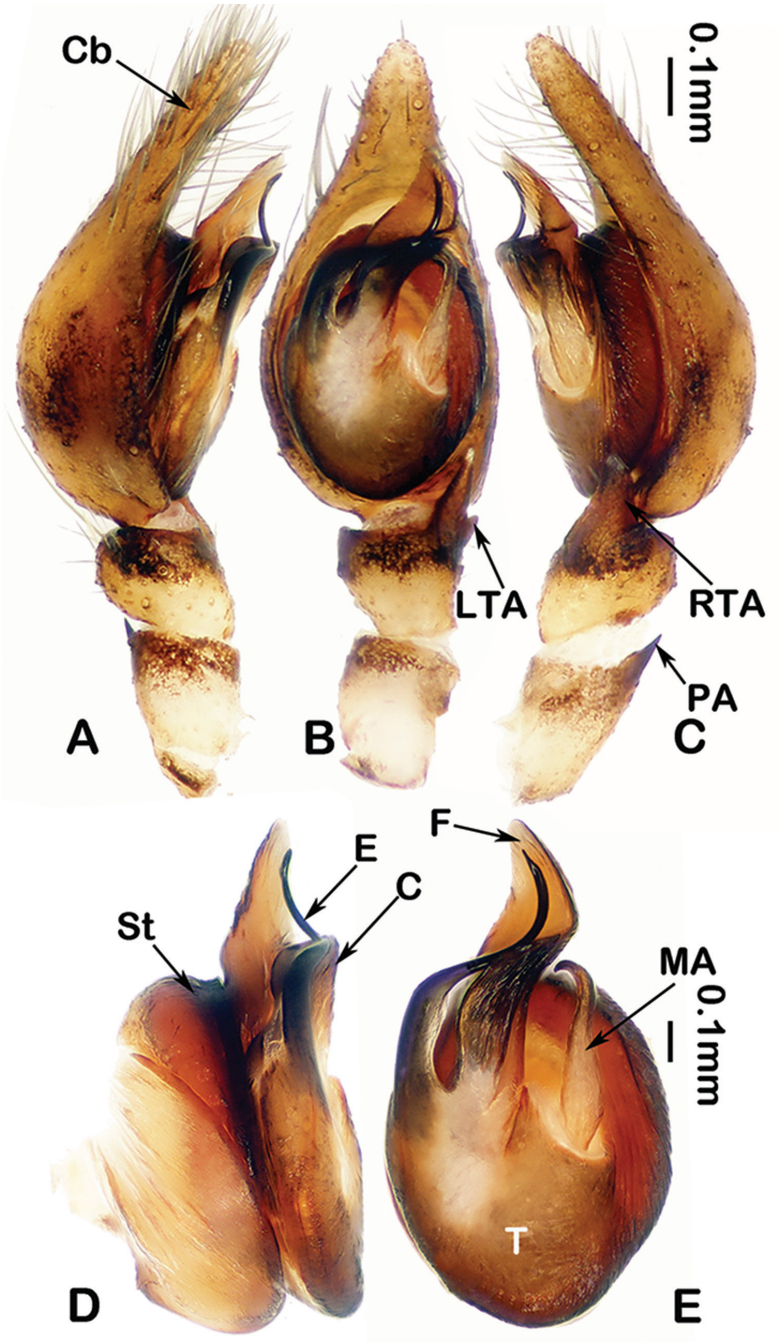

Figure 5. Left palp of *Mistaria nyeupenyeusi* G.M. Kioko & S. Li, sp. n., male holotype. **A** Prolateral view **B** Ventral view **C** Retrolateral view **D** Palpal bulb prolateral view **E** Palpal bulb ventral view. Scale bar: equal for **A, B, C**, Also scale bar equal for **D, E**; C–Conductor, Cb–cymbium, CF–Cymbium furrow, E–Embolus, F–Fulcrum, LTA–Prolateral tibial apophysis, MA–Median apophysis, PA–Patellar apophysis, RTA–Retrolateral tibial apophysis, ST–Sub tegulum, T–Tegulum

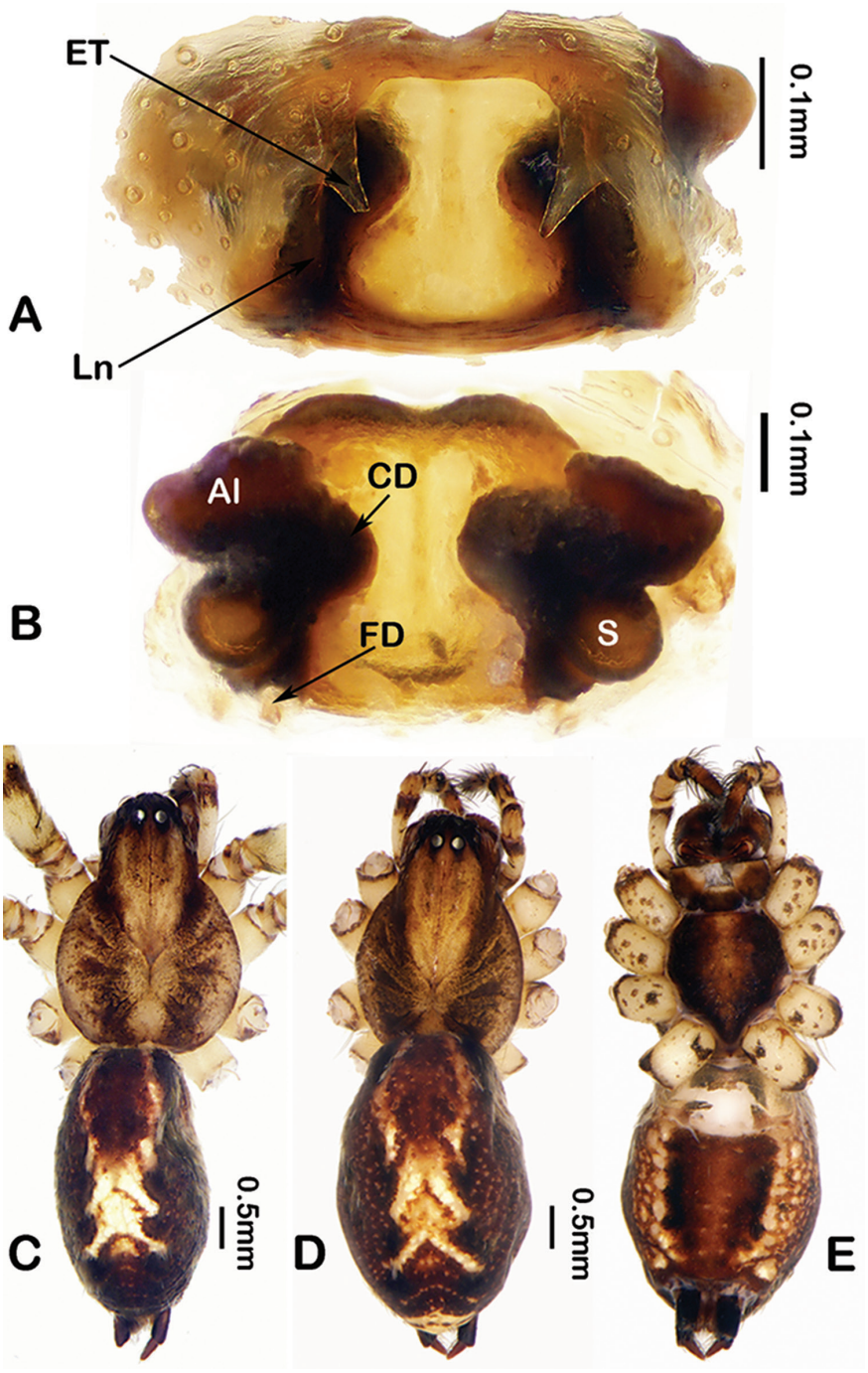

Figure 6. *Mistaria nyeupenyeusi* G.M. Kioko & S. Li, sp. n., female paratype (**A, B, D, E**) and male holotype (**C**). **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view. Scale bar: equal for **D, E**; Al–Anterior lobe, CD–Copulatory duct, ET–Epigynal teeth, FD–Fertilization duct, Ln–Lateral notches, S–Spermatheca

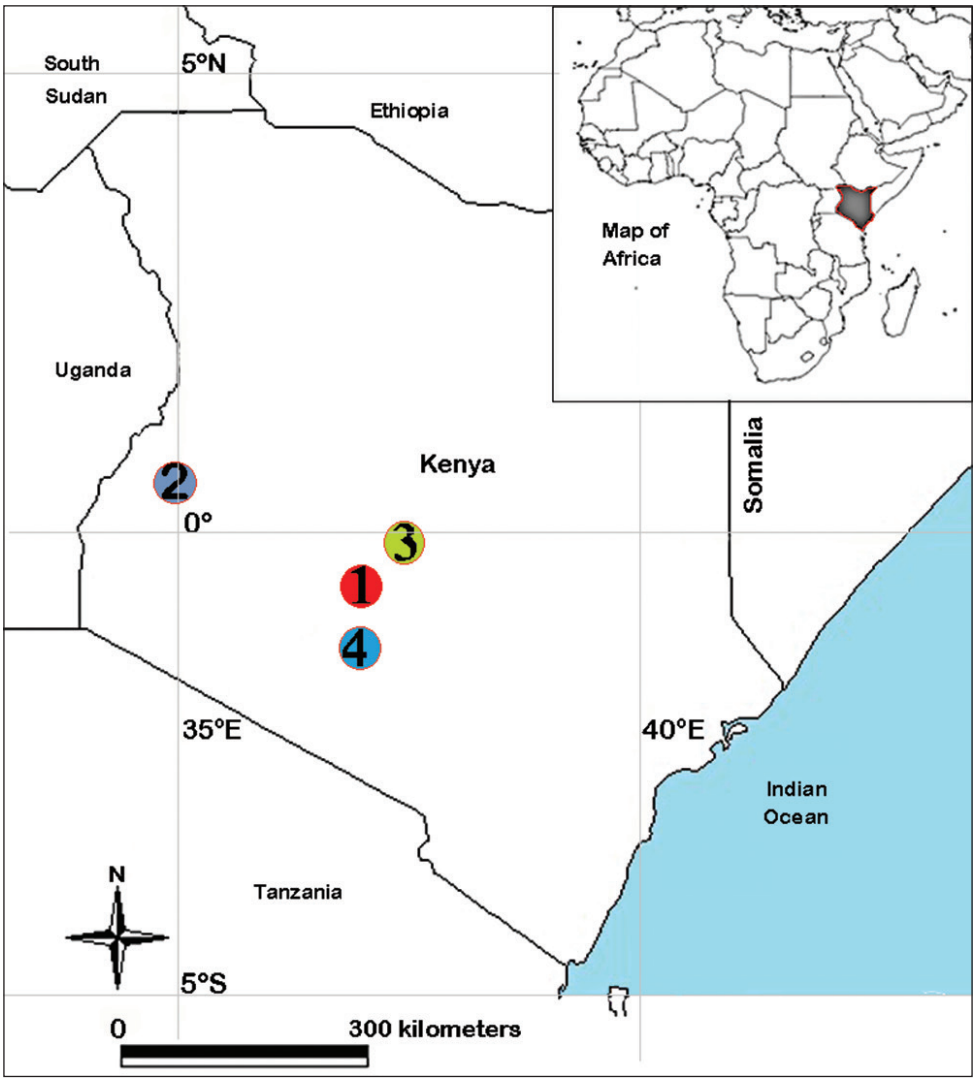

Figure 7. Known distribution of four *Mistaria* species from Kenya. **1** *M. fagei* **2** *M. nairobii* **3** *M. nyeu-penyeusi* G.M. Kioko & S. Li, sp. n. **4** *M. zorica.*

1.41), III 7.81 (1.90, 2.70, 1.91, 1.30), IV 7.81 (2.20, 2.40, 2.00, 1.21). Abdomen with a cream-coloured, ribbon-like chevron marking dorsally and one dotted cream chevron below it. Ventre of abdomen black-brown with cream-coloured horizontal stripes laterally.

Palp as in Fig. 5A–E. Cymbium small and rounded, 0.95 long. Cymbium tip 1/4 the size of the cymbium length. Sub-tegulum raised at point of attachment to the fulcrum. Patellar apophysis short, about 1/4 length of the patellar. Tibia 1/3 length of patellar (Fig. 5C). Median apophysis with a wide base and narrow apex, curved apically. Embolus thick, no embolic outgrowth at the base (Fig. 5E).

Female. Total length 4.97. Carapace 2.0 long, 1.9 wide. Abdomen 2.97 long, 2.4 wide. Habitus as in Fig. 6D and E. U-shape pattern on carapace formed from two lateral lines on cephalic region and the first pair of lateral bands. Carapace cream-coloured suffused with black and covered with white setae. Eye sizes and interdistances: AME 0.12, ALE 0.16, PME 0.14, PLE 0.13, AME–AME 0.06, AME–ALE 0.06, PME–PME 0.12, PME–PLE 0.09. Chelicerae, labium and endites brown-black. Sternum black with a white-brown median stripe. Cream-white legs with black bands at the joints. Leg measurements: I 10.30 (3.30, 3.00, 2.70, 1.30), II 7.00 (2.20, 2.20, 1.60, 1.00), III 6.50 (2.00, 1.90, 1.70, 0.90), IV 9.40 (2.50, 3.10, 2.50, 1.30). Abdomen brown-black with cream-coloured spots, pattern of the chevron markings ribbon-like with the lower chevron mark wider. Proximal segment of posterior spinnerets black, distal segment brown.

Epigyne as in Fig. 6A, B. Epigyne teeth anterior origin, wide posteriorly and narrow distally, lateral notches reduced to almost absent (Fig. 6A). Square shaped sclerotised delimiting edge, heavily sclerotised copulatory ducts, first lobe of spermatheca triangular (Fig. 6A, B). Copulatory ducts positioned anteriorly (Fig. 6B). Spermatheca lobe size is reduced posterioly i.e. anterior lobe largest and posterior lobe smallest (Fig. 6B).

Distribution. Known only from the type locality (Fig. 7).

Discussion

Mistaria fagei comb. n., *M. nairobii* comb. n. and *M. zorica* comb. n. were amongst the species of *Agelena* listed as requiring further attention by Lehtinen (1967). Our study shows that they morphologically resemble *Mistaria leucopyga* rather than the type species of *Agelena* i.e. *A. labyrinthica,* in having males with fulcrum on the palp, a spine like embolus and similar in shape and position conductor and females with three retrolateral spermathecal lobes and presence of epigynal teeth. Further studies on the rest Ethiopian species of *Agelena* and *Mistaria* listed by Lehtinen (1967) based on the material studied by Roewer (1955) and newly collected material, will be published in another paper.

Acknowledgements

The manuscript benefited greatly from comments by Yasen Mutafchiev (Sofia, Bulgaria), Ansie Dippenaar-Schoeman (Pretoria, South Africa), Jie Liu (Wuhan, China) and Zhisheng Zhang (Chongqing, China). Francesco Ballarin (Verona, Italy), Yuri M. Marusik (Magadan, Russia) kindly checked an early version of the manuscript. Sarah Whitman (NMLS) assisted in acquiring the types. David N. Jansen helped with the translation of Caporiacco (1949) from Latin and Italian. Grammar of the final draft was kindly checked by Sarah Crews. The field work was kindly supported by the Kenya Wildlife Service (KWS), the Kenya Forest Service (KFS), the National Environment

Management Authority (NEMA) and the National Commission for Science, Technology and Innovation (NACOSTI). The study was financially supported by the National Natural Science Foundation of China to Shuqiang Li (NSFC-31530067, 31471960).

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