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Review of the genus *Petropedetes* Reichenow, 1874 in Central Africa with the description of three new species (Amphibia: Anura: Petropedetidae)

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Abstract

We review and summarize the present knowledge on Central African *Petropedetes*, discuss their taxonomy and describe three new species. We synonymise one name: *P. newtonii* is a junior synonym of *P. johnstoni*. Frogs from the African mainland, namely Cameroon and eastern Nigeria, assigned to "*P. newtonii*" in more recent literature, were misidentified. They are herein described anew as *Petropedetes vulpiae* **sp. nov.** Two further new taxa are morphologically similar to other described species. *Petropedetes euskircheni* **sp. nov.** is morphologically close to *P. parkeri* but differs foremost in the smaller size of the femoral glands in adult males. *P. juliawurstnerae* **sp. nov.** is morphologically similar to *P. perreti* and *P. cameronensis*. It can be distinguished from *P. perreti* by its less developed webbing and from *P. cameronensis* by the size of its tympanum and the occurrence of a tympanic papilla in males. A key to adult males of the currently known Central African *Petropedetes* species is given and an outlook on potential further new taxa is provided.

Key words: *Petropedetes euskircheni* **sp. nov.**, *Petropedetes juliawurstnerae* **sp. nov.**, *Petropedetes vulpiae* **sp. nov.,** Cameroon, Equatorial Guinea, Gabon, Nigeria

Introduction

The African genus *Petropedetes* Reichenow, 1874, as currently defined, comprises ten species of frogs (Scott 2005; Frost 2009). Frogs belonging to the genus are of medium to large size. Most species are stream breeders and inhabit the splash-water zone, where clutches are deposited on moist rock surfaces. The highest species diversity is found in western Central Africa around the Gulf of Guinea (= Biafra Bay). Six species are known from Gabon to Nigeria (Perret 1966, 1984; Amiet 1986), while one species is known from the Upper Guinea forests of West Africa (Boulenger 1905; Rödel *et al.* 2004a) and three more from mountainous East Africa (e.g. Nieden 1911; Channing *et al.* 2002).

Until the work of Frost *et al.* (2006), who placed the genera *Petropedetes, Arthroleptides, Conraua* and *Indirana* in an own family Petropedetidae, *Petropedetes* has been regarded as basel member of the Ranoidea and within a subfamily Petropedetinae of the cosmopolitan family Ranidae (Noble 1931; van der Meijden *et al.* 2005; Bossuyt *et al*. 2006).

East African species were formerly assigned into their own genus *Arthroleptides.* Nieden (1911) describes the East African *Arthroleptides* with *A. martiensseni* being the type species, on characters partly very similar to *Petropedetes* Reichenow, 1874. Among other characters *Arthroleptides* shares with *Petropedetes* the shape of toe tips, but differs by the absence of the vomerine teeth (Nieden 1911). Klemens (1998) mentions the similarity of male sexual characteristics of both genera and Scott (2005) finally allocates *Arthroleptides* in the synonymy of *Petropedetes*. According to her (citing Inger 1954), slight morphological differences, such as the presence or absence of vomerine teeth, may vary within genera and do not force a separation into different genera.

The type species of the genus is *P. cameronensis* Reichenow, 1874. Boulenger (1888) subsequently describes *Cornufer johnstoni* and du Bocage (1895a) *Tympanoceros newtonii*. The latter two species were later transferred to the genus *Petropedetes* by Boulenger (1900). In 1905 Boulenger describes *P. palmipes* from Central Africa. Two further Central African *Petropedetes* species have been described by Amiet (1973, 1983); *P. perreti* Amiet, 1973 and *P. parkeri* Amiet, 1983, respectively. *Petropedetes obscurus* described by Ahl (1924) was recognized to be a synonym of *P. cameronensis* by Perret (1984). Boulenger (1905) describes the only West African species: *Petropedetes natator* Boulenger, 1905. Three East African *Petropedetes*, formerly belonging to *Arthroleptides*, have been described by Nieden (1911), Loveridge (1935) and Channing *et al.* (2002) as *Arthroleptides martiensseni* Nieden, 1911 "1910", *Arthroleptides dutoiti* Loveridge, 1935 and *Arthroleptides yakusini* Channing, Moyer & Howell, 2002 respectively. A list of all currently known species with their respective distributions is presented in table 1.

Herein we restrict ourselves to reviewing Central African *Petropedetes*, occurring roughly throughout the Lower Guinean forest belt from east of Cross River in Nigeria to Gabon in the South. We describe new taxa on the bases of morphological characters and summarize all available biological data for all Central African species. Further data concerning the taxonomy of West and East African species and the phylogeny of the whole group will be subject to forthcoming papers of the authors.

TABLE 1. Currently known *Petropedetes* species in alphabetical order with respective distribution.

Species		Distribution
P. cameronensis	Reichenow, 1874	Central Africa
P. dutoiti	Loveridge, 1935	East Africa
P. johnstoni	(Boulenger, 1888 "1887")	Central Africa
P. martiensseni	(Nieden, 1911 "1910")	East Africa
P. natator	Boulenger, 1905	West Africa
P. newtoni	(du Bocage, 1895)	Central Africa
P. palmipes	Boulenger, 1905	Central Africa
P. parkeri	Amiet, 1983	Central Africa
P. perreti	Amiet, 1973	Central Africa
P. yakusini	(Channing, Moyer and Howell, 2002)	East Africa

Material and methods

Frogs were anesthetized with chlorobuthanol or bencocaine and fixed in 4% formalin or 70% ethanol. All were finally stored in 70% ethanol. Measurements follow standard procedures and were taken on preserved material with an electronic dial calliper (± 0.1 mm). All measurements are given in mm. Presentation of species characteristics follows as closely as possible Amiet (1983) to allow for comparison with previous publications. Webbing formulae follow Rödel [2000; example: 2 (1-2) = second toe (webbing reaches tarsal tubercle number 1 at the interior and number 2 on the exterior side of the second toe); tarsal tubercles counted from tip of the toe base]. Measurements are summarized separately for males (Table 2) and females (Table 3). Statistical tests (Kruskal-Wallis, Mann-Whitney-*U*) have been applied to evaluate morphometric data; using PAST (Version 1.82b) (Hammer *et al.* 2001). If measurements (e.g. femur length) differed between body sides, mean values were used. Drawings were prepared based on photos of relevant body parts. Nomenclature of tadpole morphology follows McDiarmid & Altig (1999). Staging of tadpoles is according to Gosner (1960). The labial-tooth-formulae follow Dubois (1995). A comparison of uncorrected p-distances of 611 bp of the 16S rRNA gene has been calculated using PAUP* 4b10 (Swofford 2002) for the Central African radiation only. These taxa can be easily differenciated from the West- or East African species by morphological characters (see Results). For details on material and methods of the molecular comparison see Schmitz *et al.* (2005); Genbank accession numbers are GU256015 – GU256044. Geographic positions were taken from The Global Gazetteer (http://www.fallingrain.com/world) or collected with hand-hold GPS receivers (see Appendix).

Specimens investigated originate from or have been deposited in: The Natural History Museum, London (BM); Institut Royal des Sciences Naturelles de Belgique, Bruxelles (IRSNB-KBIN); Muséum d'histoire naturelle, Genève (MHNG); Museo Civico di Storia Naturale di "Giacomo Doria", Genova (MSNG); Port Elizabeth Museum, Port Elizabeth (PEM); Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK); Zoologisches Institut und Museum, Greifswald (ZIMG); Museum für Naturkunde, Berlin (ZMB); and Zoologische Staatssammlung, München (ZSM).

Results

The genus *Petropedetes* was characterized by Reichenow (1874) as follows: tongue elongated and cordiform (heart shaped), free behind, notched; vomerine teeth behind the choanae, not touching their posterior border, closer to each other than to the choanae; fingers free; toe discs flat but distinct; toes with a short webbing; tympanum distinct. According to Perret (1966) further osteological characters are: clavicles robust and

straight; omosternum hardly bifurcated; terminal phalanges T-shaped. Reichenow's (1874) genus description is based on the type species *Petropedetes cameronensis* and three characters 1) presence of vomerine teeth, 2) toes with short webbing and 3) distinct tympanum, do not apply to all *Petropedetes* species (see below). The remaining characters apply to all of the following Central African species and are hence not repeated in their diagnoses.

The West African *Petropedetes natator* shares with the other members of the genus the shape of the toe and finger tips and the presence of femoral glands in males. However, it differs from the Central African species by some morphological features, such as external vocal sacs, mandibular fangs, a ridge on the tongue, and the morphology of the rheophilous tadpole (Lamotte *et al.* 1959; Perret 1984; Amiet 1989). From some Central African species *P. natator* differs likewise by the absence of a tympanic papilla in breeding males. The three East African species *P. dutoiti*, *P. martiensseni* and *P. yakusini* share with Central African *Petropedetes* species the shape of the fingers and toe tips, the presence of a tympanic papilla and femoral glands (in male *P. dutoiti*; Klemens 1998; Channing *et al*. 2002). *P. yakusini* males share further secondary sexual characters with some Central African species (see below): brachial hypertrophy and spines on the gular region (Channing *et al*. 2002). However, all East African species can be distinguished from Central African *Petropedetes* by the absence of vomerine teeth in the former (Nieden 1911; Loveridge 1935; Channing *et al*. 2002).

The following species diagnosis, exclusively comprise the respective species specific character combinations, being of diagnostic value within the Central African *Petropedetes*.

For a better comparability of the crucial morphological characters within the genus, we herein first treat the rudimentary-webbed species and continue with species with well developed webbing. Finally, we provide a determination key to all currently known Central African *Petropedetes* species.

A list of synonyms and chresonyms, following Frost (2009), is provided for all species, additionally assignments before the official naming and problematic assignments are listed in Appendix I.

***Petropedetes johnstoni* (Boulenger, 1888 "1887")**
Figs. 1a, 2a, 3a, 4, 5, 7g

Cornufer johnstoni Boulenger, 1888 "1887", Proc. Zool. Soc. London 1887: 564
Tympanoceros newtonii du Bocage, 1895, J. Sci. Math. Phys. Nat. Lisboa, Ser.2, 3: 270
Petropedetes johnstoni – Boulenger, 1900. Proc. Zool. Soc. London, 1900: 439

Material examined. BM 1947.2.7.44 (holotype, described as *Cornufer johnstoni*), subadult male, Cameroon ("Cameroons"), Rio del Rey, coll. H.H. Johnston; MSNG 29890 (5 males, 2 females), Equatorial Guinea, Bioko, Musola, app. 500-800 m a.s.l., I-III.1902, coll. L. Fea; MSNG 50032 (female and tadpole), app. 500-700 m a.s.l., other data as MSNG 29890; ZFMK 87709 (male), Cameroon, Campo region, Nkoelon, app. 125 m a.s.l., 30.X.2007, coll. J.A.M. Wurstner & M.F. Barej; ZFMK 87710 (female), 26.X.2007, other data as for ZFMK 87709.

Diagnosis. A medium sized *Petropedetes*; slender body shape; tympanum round, distinctly smaller than eye diameter (smallest distinct tympanum in the genus); characters of breeding males: tympanic papilla present (papilla slim, compared to other larger *Petropedetes*), papilla close to the upper border of tympanum; forearm hypertrophy weakly developed; carpal spike present; spinosities on upper arm, throat and breast; few minuscule spines on supratympanal gland; femoral glands brightly orange, prominent and very large; webbing rudimentary.

Description. Medium sized *Petropedetes* with slender body shape; both sexes almost equally large (SUL in males: 28.5–45.6 mm, females: 28.1–47.8 mm); mean head width in males about 41% of SUL, in females about 38%; snout rounded to slightly pointed in lateral view; *canthus rostralis* sharp; loreal region concave; eye diameter about 1.5 times eye-narial distance; nose closer to snout-tip than to eye; distinct round tympanum smaller than eye in both sexes (tympanum / eye in males: 0.49–0.63; in females: 0.45–0.48; Fig.

FIGURE 1. Life coloration of rudimentary-webbed Central African *Petropedetes*. a) *Petropedetes johnstoni* (male and female: Nkoelon, Cameroon), b) *P. vulpiae* **sp. nov.** (male and female: Nyasoso, Mt. Kupe, Cameroon), c) *P. parkeri* (male Nguti, Cameroon; female: Amebishu, Cameroon) d) *P. euskircheni* **sp. nov.** (male: Nyasoso, Mt. Kupe, Cameroon; female: Nguengue, Mt. Nlonako, Cameroon).

1a); tympanic papilla of breeding males close to upper border of tympanum, comparatively slim; supratympanic fold distinct; fingers slender with T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; palmar tubercle and thenar tubercle present; manual webbing absent; forearm hypertrophy weakly developed; carpal spikes present in males; spinosities on upper arm, throat and breast; few minuscule spines on supratympanal gland; back skin granular, beset with small warts; fewer larger warts arranged in more or less longitudinal rows; flanks with few large warts; ventral skin smooth; mean femur length in males 53% of SUL, in females about 51%, mean tibia length in both sexes 61% of SUL; mean foot length in males 79% of SUL, in females 78%; pedal subarticular tubercles single; hind limbs slender; femoral glands very large in males, larger and more prominent in males than in females (femoral gland / femur length in males: 0.28–0.46, in females: 0.25–0.27; Fig. 2a); relative length of toes: IV > III > V > II > I; webbing rudimentary: 1 (1) 2 (1-1) 3 (2-2) 4 (3-3) 5 (2).

According to Amiet (1973) the tympanic papilla is shorter than the tympanum diameter and thickened at its tip. This character is hard to verify in preserved specimens, as the papilla is then often shrunken (M.F. Barej *pers. obs.*). Amiet (1983) remarked that skin on throat and basis of the arms is smooth, showing no trace of spinosities. This observation is not consistent with the MSNG material. The most detailed description referring to "*P. johnstoni*" has been published by Parker (1936). However, this was based on specimens which have later been recognized as a new species, *P. parkeri* (Amiet 1983).

Coloration. Dorsum brownish with small dark spots, marking larger warts; colour on flanks as on back, often with larger spots than on back (Fig. 1a); iris speckled with gold and silver; throat marbled blackish; belly whitish with minuscule dark speckles (recognizable only under the microscope); upper and lower legs dorsally with large almost bar like dark spots; femoral glands brightly orange in males. Coloration in preservation: as in life, but colours pale. Boulenger (1888) mentioned a dark inter-orbital bar. In the material examined this bar was often incomplete.

Tadpole description. The MSNG collection comprises one tadpole (MSNG 50032) collected by L. Fea in March 1902 at Musola (500–700 m) on Bioko. The tadpole (Gosner stage 41) has already fully developed hind limbs with rudimentary webbing. The vent tube is regressed. It had a body length of 11.3 mm (total length 26.3 mm) and long hind legs (18.6 mm), its femoral glands were already 1.8 mm long. As from Bioko, no other *Petropedetes* species with rudimentary webbing is known (*P. cameronensis* possesses half-webbed feet) we believe that it is safe to assume that the tadpole is a *P. johnstoni*. Its body is broad and slightly flattened; flanks not parallel but slightly convex; nostrils closer to eye than to snout tip; tail axis long and very muscular; no tail fins visible; end of tail shrunken, in life probably pointed; keratodont formula: 3+3//1+1:2; the upper three rows interrupted by the upper jaw sheath (Fig. 3a). The body shape and tooth formula corresponds to the most advanced *P. palmipes* tadpoles (Lamotte *et al*. 1959) and data on *P. cameronensis* (Schiøtz 1966).

Natural history. *P. johnstoni* inhabits lowland forest and in contrast to other species occurs in areas without flowing water (Amiet 1983; own data). According to Gartshore (1986) this species inhabits littoral forests. In contrast, Fea (in du Bocage 1903) finds the species at a river with rapids, overgrown by vegetation. The call is very characteristic and can be heard from far (du Bocage 1903). Amiet (1989, 1991) finds an egg clutch on a large leaf in the forest, some centimetres above the ground. A male was sitting close to the clutch during daytime. Because of the absence of an open water source he assumed that the tadpoles of *P. johnstoni* are terrestrial (Amiet 1989, 1991). Lawson (1993) reports *Petropedetes* clutches in the centre of leaf whorls, deposited at least 75 m away from the next water source. Tadpoles started to hatch after about two weeks. Lawson (1993) assigns these clutches to what he termed "*P. newtonii"* (described as a new species below). However, according to Amiet's (1989, 1991) and our own observations this behaviour much better fits to the sympatric *P. johnstoni*.

Distribution. An exact type locality of *P. johnstoni* has not been given by Boulenger (1888). However, due to the title of the publication it has always been regarded as "Rio del Rey, Cameroon". Amiet (1983) points out that this region corresponds to a creek of the river Ndian in western Cameroon, close to the Nigerian border. *P. johnstoni* is a typical lowland species and is known from Victoria (= Limbe) and Bibundi (Werner 1898; Andersson 1907; Amiet 1983) in western Cameroon and further localities in the lowland of the

Biafra Bay down to southern Cameroon (Amiet 1983). *P. johnstoni* has also been reported from Bioko (du Bocage 1895a, 1895b, 1903; Boulenger 1906; Mertens 1965; Weinberg 2008; Fig. 4). J.P. Vande weghe photographed a *Petropedetes* with a tympanum smaller than the eye and a tympanic papilla in Langoué Bai, eastern Gabon (Fig. 7g). This would be the first record of the species in Gabon. As no voucher is available this record still needs to be confirmed and the taxonomic status of the population requires further study.

Genetics. A genetic comparison of a fragment of the mitochondrial 16S rRNA gene (611 bp, including gaps) using a calculation of the uncorrected p-distances gave the following results for *Petropedetes johnstoni*: interspecific comparison between *P. johnstoni* and all other Central African *Petropedetes* taxa ranged between 3.85%-9.03%, while the intraspecific variation within *P. johnstoni* was much lower at 0.17% (N= 2) (Table 4).

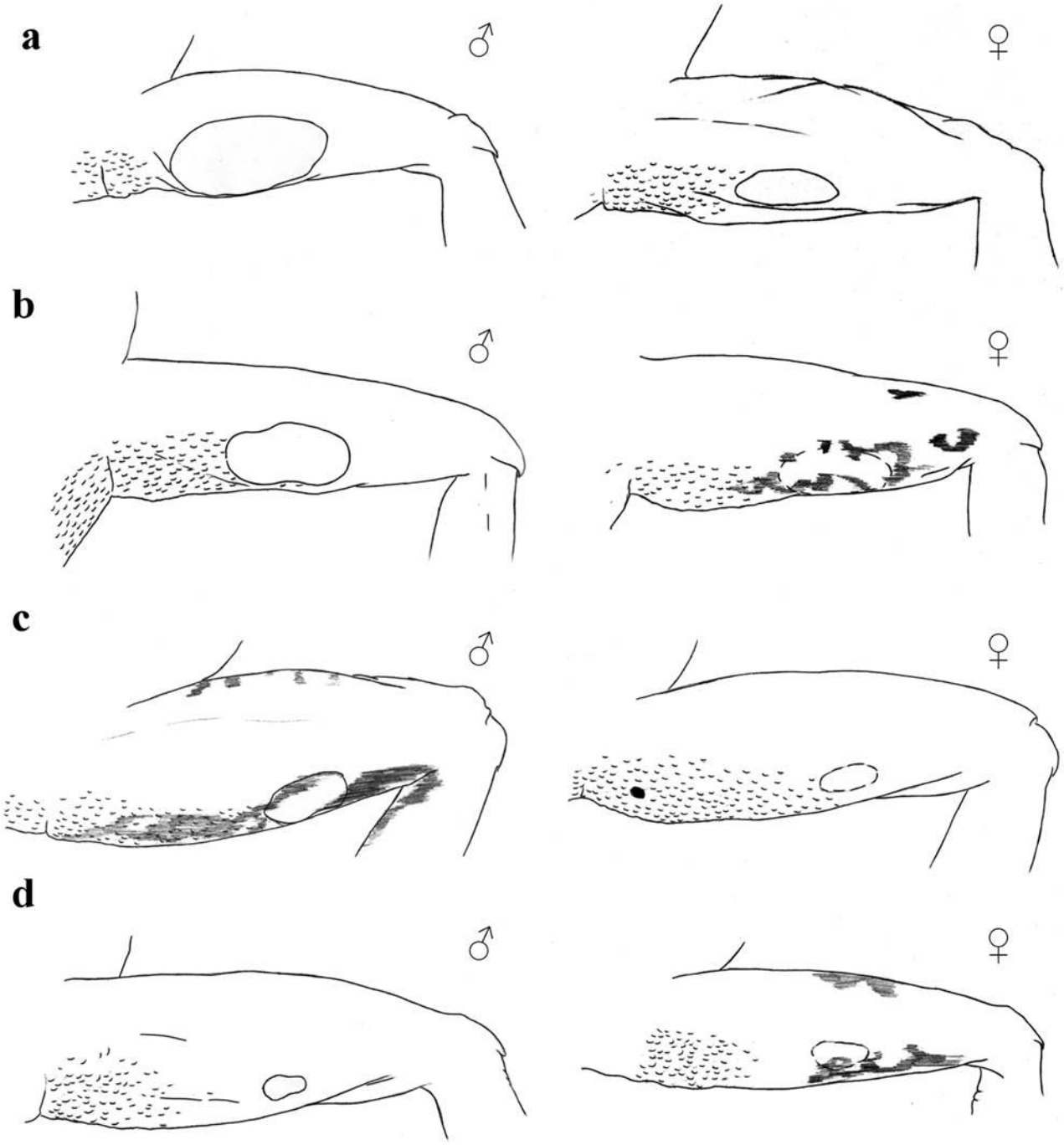

FIGURE 2. Relation of femoral gland to femur and shape of femoral gland in Central African *Petropedetes* with rudimentary webbing. a) *Petropedetes johnstoni* (male and female: MSNG 29890), b) *P. vulpiae* **sp. nov.** (male: ZFMK 81623; female: ZFMK 81554), c) *P. parkeri* (male: PEM A 9125; female: PEM A 9127), d) *P. euskircheni* **sp. nov.** (male: ZFMK 75582; female: MHNG 2713.11).

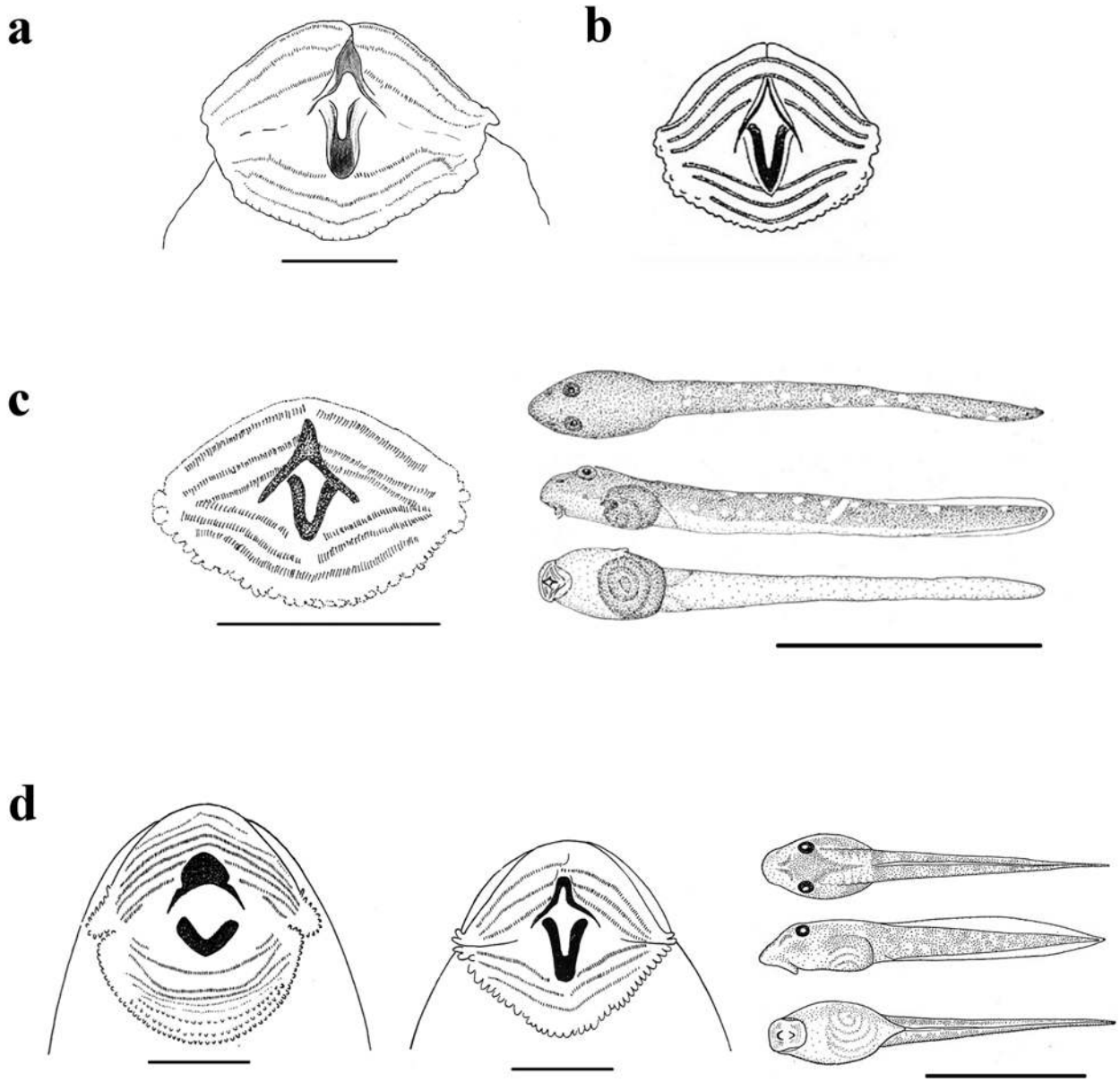

FIGURE 3. Tadpole morphology (scale bar mouth 1mm; scale bar habitus 10 mm): a) *P. johnstoni* (MSNG 50032; Gosner stage: 41; total length: 26.3 mm); b) *P. cameronensis* (modified after Boulenger 1906; tadpole with fully developed hind limbs; no scale bar); c) *P. perreti* (ZMB 73738; Gosner stage: 28; total length: 24.4 mm); d) *P. palmipes* (modified after Lamotte *et al*. 1959); change of denticulation: left: early tadpole stage; centre: tadpole with posterior extremities of 10 mm; tadpole habitus (total length: 22 mm).

Systematic remarks. Boulenger (1888) states that the holotype of *Cornufer* (*Petropedetes*) *johnstoni* is a female specimen. However, according to Parker (1936) the determination of the sex of the holotype's sex is wrong and it indeed is a subadult male of a size, where it is not distinguishable from subadult females. Parker's correction has been later adopted by Amiet (1983). The holotype, showing the size, the large femoral glands and the lateral aspect of the head is shown in Fig. 5.

By the end of the 19th century *Tympanoceros newtonii* has been described by du Bocage (1895a) from the Island Fernando Po (= Bioko). The type of *Tympanoceros newtonii* deposited in the Musée Bocage in Lisbon, is lost (Perret 1976). In contrast to the type of *Cornufer johnstoni*, the holotype of *Tympanoceros newtonii* must have been a male in breeding condition. The description of a second specimen form Bioko has been supplemented by an illustration of a male with well developed papilla (du Bocage 1895b). Both descriptions

agree, among other characters, in rudimentary webbing, occurrence of a conical papilla on the tongue, and black bars on the limbs; but differ in the tympanum size. While the tympanum of *C. johnstoni* is given as half the diameter of the eye, it has been stated as equal to three-quarters of the eye for *T. newtonii*. However, this difference might be due to different methods of measuring the eye diameter. Another difference between the two descriptions concerns the tibiotarsal articulation. It is said to just reach the snout in the description of *C. johnstoni* (Boulenger 1888), while it is given to exceed the snout by four to five millimetres in *T. newtonii* (du Bocage 1895a). Although this difference appears crucial, the examination of this character state in seven specimens of *P.* "*newtonii*" from Bioko revealed very variable results, ranging from articulation reaching the snout-tip to exceeding the snout-tip by some millimetres. Werner (1898) reports *P. johnstoni* from Victoria, Cameroon. These frogs possess a small tympanum and their tibiotarsal articulations extend beyond the snout.

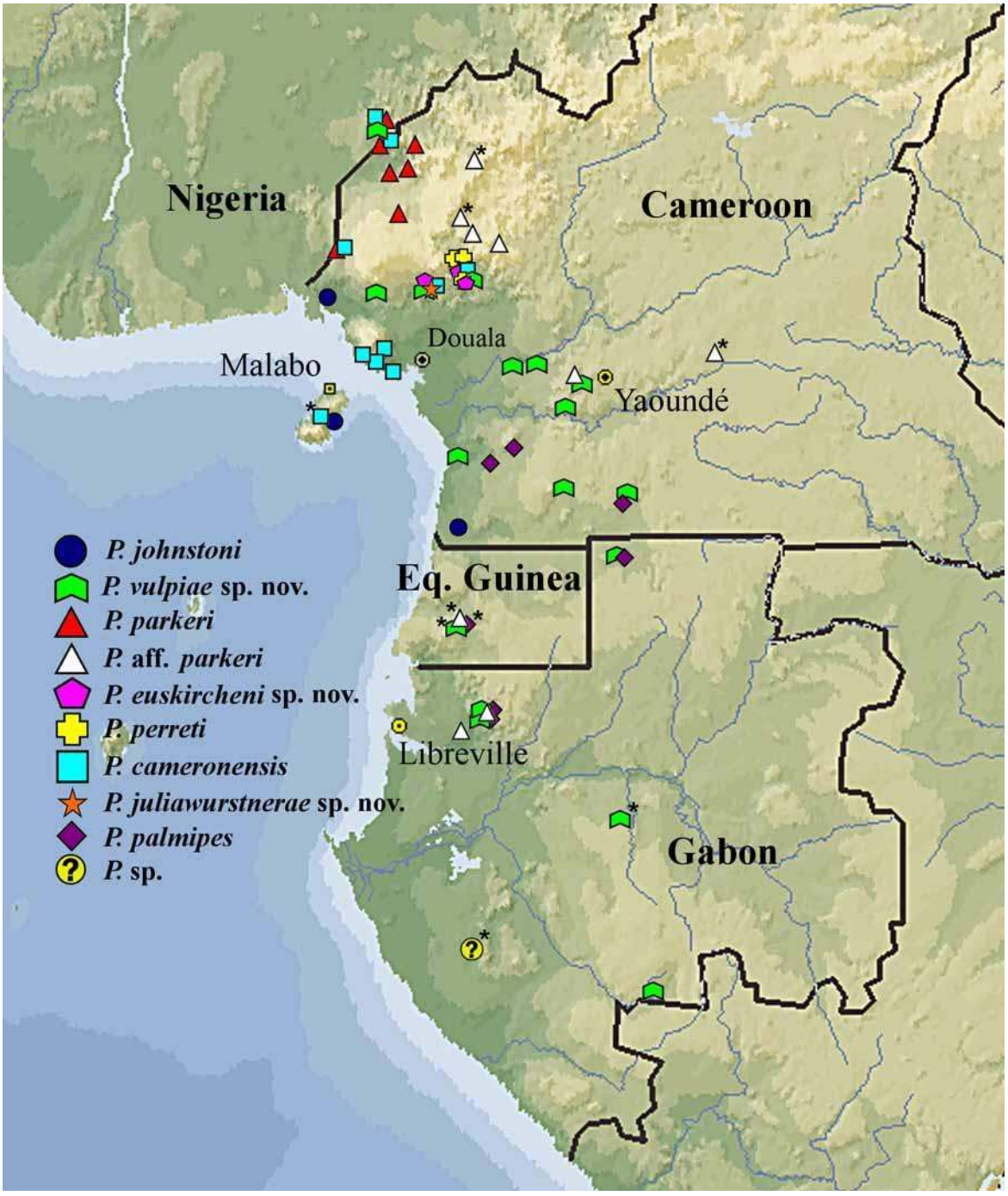

FIGURE 4. Distribution of known *Petropedetes* species; compare with text. Specimens from localities marked with an asterisk (*) were not available and are added from literature.

TABLE 2. Summary of morphological measures (mm) of adult male *Petropedetes*. Given are minimum (min), maximum (max), mean and median values including standard deviation (s.dev) and standard error (s.error). SUL = snout-urostyle-length, HW = head width, FM = femur length, GL = femoral gland length, GW = femoral gland width, TI = tibia, FL = foot length including longest toe, TD horizontal tympanum diameter, O = orbita, EN = distance eye naris, NS = distance naris snout-tip and relations: TI/SUL = tibia to snout-urostyle-length, FM/TI = femur length to tibia, GL/FM = femoral gland length to femur length, GL/GW = femoral gland length to width, TD/O = tympanum diameter to orbita, O/EN = orbita diameter to distance eye-naris, FM/SUL = femur length to snout-urostyle-length, HW/SUL = head width to snout-urostyle-length, FL/SUL = foot length to snout-urostyle-length.

	SUL	HW	FM	GL	GW	TI	FL	TD	O	EN	ES	NS	FM/SUL	TI/SUL	FL/SUL	FM/TI	GL/FM	GL/GW	TD/O	HW/SUL
P. johnstoni																				
N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
min	28.5	12.6	15.7	4.4	2.3	17.9	22.9	2.8	4.7	3.2	5.0	1.7	0.50	0.58	0.77	0.85	0.28	1.79	0.49	0.39
max	45.6	18.5	24.5	11.1	5.4	28.4	37.7	3.4	6.7	4.5	7.2	2.7	0.55	0.63	0.84	0.89	0.46	2.22	0.63	0.44
mean	39.8	16.2	21.2	8.5	4.4	24.4	31.5	3.2	5.9	4.1	6.4	2.3	0.53	0.61	0.79	0.87	0.39	1.94	0.55	0.41
s. error	2.60	0.94	1.34	0.89	0.43	1.64	2.12	0.08	0.29	0.18	0.33	0.16	0.01	0.01	0.01	0.01	0.02	0.06	0.02	0.01
s. dev.	6.88	2.47	3.55	2.34	1.14	4.34	5.60	0.21	0.77	0.48	0.87	0.42	0.02	0.02	0.02	0.01	0.06	0.16	0.04	0.02
median	43.30	17.60	23.10	8.70	4.80	27.20	34.00	3.30	6.20	4.20	6.90	2.40	0.54	0.61	0.79	0.87	0.41	1.90	0.53	0.40
***P. vulpiae* sp. nov.**																				
N	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
min	33.4	14.2	18.1	3.5	1.7	20.6	25.0	4.7	5.1	3.1	4.9	1.6	0.47	0.56	0.67	0.82	0.16	1.32	0.86	0.36
max	43.4	17.4	22.9	7.7	4.8	26.2	33.4	6.5	6.7	4.5	6.7	2.9	0.57	0.65	0.83	0.92	0.40	3.06	1.13	0.53
mean	38.7	15.9	20.5	6.1	3.3	23.4	29.3	5.7	5.8	3.6	5.8	2.3	0.53	0.61	0.76	0.87	0.30	1.90	0.99	0.41
s. error	0.41	0.17	0.23	0.16	0.10	0.27	0.38	0.07	0.06	0.06	0.08	0.05	0.00	0.00	0.01	0.00	0.01	0.05	0.01	0.01
s. dev.	2.48	1.00	1.38	0.97	0.61	1.62	2.25	0.44	0.34	0.36	0.46	0.32	0.02	0.02	0.04	0.02	0.05	0.29	0.07	0.03
median	38.90	16.00	20.60	6.20	3.30	23.40	29.65	5.75	5.80	3.50	5.90	2.30	0.53	0.60	0.76	0.88	0.30	1.88	1.00	0.42
P. parkeri																				
N	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
min	38.0	15.8	19.4	3.9	1.8	21.2	29.2	3.7	5.1	3.6	5.8	2.2	0.47	0.49	0.69	0.86	0.18	1.77	0.73	0.40
max	74.3	34.4	37.4	7.8	3.7	41.4	54.9	11.0	7.9	8.5	13.5	5.1	0.55	0.59	0.78	0.97	0.27	2.46	1.39	0.47
mean	53.8	23.6	27.1	5.9	3.0	29.8	39.6	7.2	6.8	5.4	8.6	3.2	0.50	0.55	0.74	0.91	0.22	2.02	1.05	0.44
s. error	2.76	1.47	1.34	0.34	0.18	1.48	1.96	0.56	0.25	0.38	0.61	0.24	0.01	0.01	0.01	0.01	0.01	0.07	0.05	0.01
s. dev.	9.14	4.86	4.43	1.13	0.58	4.92	6.49	1.84	0.83	1.28	2.02	0.81	0.02	0.04	0.03	0.03	0.03	0.23	0.17	0.02
median	54.00	23.70	27.40	6.00	3.20	29.70	38.70	7.30	7.00	5.20	7.90	3.00	0.51	0.56	0.74	0.91	0.22	1.91	1.03	0.43
***P. euskircheni* sp. nov.**																				
N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
min	44.3	17.9	23.3	3.6	2.1	25.6	34.0	6.3	5.9	3.9	6.4	2.5	0.48	0.57	0.75	0.81	0.12	1.45	0.97	0.39
max	62.0	24.7	31.7	5.8	3.8	37.3	52.1	9.3	8.5	5.4	9.5	4.2	0.56	0.66	0.85	0.91	0.21	2.04	1.19	0.41
mean	54.0	21.6	27.8	4.4	2.6	32.5	43.3	7.8	7.1	4.8	8.2	3.5	0.51	0.60	0.80	0.86	0.16	1.71	1.10	0.40
s. error	2.45	1.01	1.03	0.29	0.22	1.50	2.17	0.42	0.32	0.22	0.41	0.22	0.01	0.01	0.02	0.01	0.01	0.09	0.03	0.00
s. dev.	6.47	2.68	2.73	0.76	0.58	3.98	5.73	1.10	0.85	0.59	1.10	0.57	0.03	0.04	0.04	0.03	0.03	0.23	0.08	0.01
median	54.90	22.20	27.70	4.20	2.50	33.10	44.20	7.60	7.00	4.80	8.60	3.70	0.51	0.60	0.79	0.85	0.16	1.65	1.09	0.40

TABLE 2. (continued)

	SUL	HW	FM	GL	GW	TI	FL	TD	O	EN	ES	NS	FM/SUL	TI/SUL	FL/SUL	FM/TI	GL/FM	GL/GW	TD/O	HW/SUL
P. perreti																				
N	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
min	29.4	11.8	16.8	4.0	1.5	17.2	22.5	3.7	4.3	2.2	4.2	1.8	0.50	0.52	0.63	0.82	0.24	1.84	0.77	0.37
max	42.6	17.8	22.9	8.7	3.9	25.6	32.4	6.1	6.3	3.8	6.1	2.9	0.57	0.68	0.83	0.97	0.41	2.75	1.06	0.43
mean	39.4	15.7	20.7	7.1	3.2	22.7	29.4	5.4	5.8	3.3	5.6	2.3	0.53	0.58	0.75	0.91	0.34	2.26	0.93	0.40
s. error	0.98	0.44	0.42	0.31	0.17	0.55	0.70	0.18	0.15	0.11	0.15	0.10	0.01	0.01	0.01	0.01	0.01	0.08	0.02	0.01
s. dev.	3.54	1.58	1.53	1.12	0.63	1.98	2.51	0.65	0.54	0.41	0.53	0.35	0.02	0.04	0.05	0.04	0.04	0.27	0.09	0.02
median	40.30	16.30	21.10	7.10	3.20	22.90	30.20	5.60	6.00	3.40	5.80	2.40	0.52	0.57	0.74	0.91	0.35	2.19	0.95	0.40
P. cameronensis																				
N	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
min	26.8	9.9	12.1	4.5	2.0	15.4	20.4	1.3	4.1	2.2	3.6	1.4	0.40	0.51	0.69	0.78	0.30	1.96	0.31	0.35
max	34.8	13.3	19.6	8.8	4.5	22.2	28.4	2.1	5.7	3.7	5.3	2.5	0.57	0.65	0.86	0.91	0.50	2.53	0.42	0.39
mean	31.5	11.8	16.1	6.3	2.9	18.9	24.1	1.8	5.0	2.9	4.7	1.9	0.51	0.60	0.76	0.85	0.39	2.22	0.36	0.37
s. error	0.65	0.26	0.50	0.29	0.16	0.48	0.58	0.06	0.13	0.08	0.12	0.08	0.01	0.01	0.01	0.01	0.02	0.04	0.01	0.00
s. dev.	2.60	1.03	2.00	1.17	0.64	1.92	2.31	0.24	0.53	0.32	0.48	0.33	0.04	0.04	0.04	0.04	0.07	0.15	0.04	0.01
median	31.45	11.65	15.80	6.10	2.80	18.90	23.85	1.80	4.95	2.90	4.85	1.80	0.52	0.61	0.77	0.86	0.37	2.19	0.35	0.38
***P. juliawurstnerae* sp. nov.**																				
N	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
min	29.5	11.7	16.2	5.9	1.3	17.7	22.5	2.8	4.2	2.5	4.2	1.5	0.51	0.57	0.73	0.87	0.36	2.88	0.66	0.38
max	38.9	14.9	20.7	9.2	3.2	22.3	29.4	4.9	6.1	3.3	5.5	2.6	0.58	0.62	0.79	0.95	0.51	4.71	0.85	0.43
mean	33.2	13.3	18.0	7.6	2.3	19.9	25.4	4.0	5.2	2.9	4.9	2.0	0.54	0.60	0.76	0.90	0.42	3.41	0.76	0.40
s. error	0.79	0.29	0.38	0.31	0.15	0.39	0.63	0.17	0.15	0.09	0.12	0.10	0.01	0.00	0.00	0.01	0.01	0.14	0.02	0.00
s. dev.	2.72	1.00	1.31	1.06	0.53	1.35	2.19	0.60	0.50	0.31	0.43	0.34	0.02	0.02	0.02	0.02	0.05	0.50	0.06	0.02
median	32.85	13.15	17.80	7.40	2.35	19.70	24.55	3.90	5.10	2.90	4.85	2.05	0.55	0.60	0.76	0.91	0.41	3.39	0.77	0.40
P. palmipes																				
N	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
min	40.3	15.2	21.0	6.9	3.0	23.2	30.5	1.1	6.0	3.6	6.1	2.2	0.46	0.54	0.66	0.81	0.26	1.66	0.18	0.38
max	57.8	30.0	29.7	10.0	5.3	31.2	40.5	1.9	8.2	5.0	8.3	3.7	0.59	0.63	0.80	0.98	0.38	2.68	0.23	0.62
mean	48.4	19.6	25.5	8.1	3.8	27.9	35.4	1.5	7.4	4.4	7.3	2.9	0.53	0.58	0.73	0.91	0.32	2.21	0.20	0.41
s. error	1.26	1.02	0.74	0.26	0.24	0.67	0.86	0.07	0.20	0.10	0.19	0.11	0.01	0.01	0.01	0.01	0.01	0.09	0.01	0.02
s. dev.	4.55	3.68	2.66	0.93	0.86	2.42	3.10	0.24	0.71	0.37	0.69	0.40	0.04	0.03	0.04	0.05	0.04	0.31	0.02	0.06
median	48.80	19.30	26.10	7.90	3.30	27.70	35.40	1.60	7.40	4.40	7.30	2.90	0.53	0.58	0.73	0.93	0.30	2.22	0.20	0.39

In 1900 Boulenger synonymised *Tympanoceros* and *Cornufer* with *Petropedetes* and provided the first key to the three species, known at that time. This key was based on the development of webbing and tympanum size. According to Boulenger (1900) the tympanum reaches half the size of the eye in *P. johnstoni* and more than half the eye diameter in *P. newtonii*. The differentiation of the species in Boulenger's (1900) key was based on specimens collected by Mr. Bates on the Benito River (= River Mbini or Woleu River, today Equatorial Guinea) and not from Fernando Po. In this paper Boulenger (1900) describes the tympanum as being even larger than the eye. Subsequently this statement has been adopted by later authors. Amiet (1983) gives a relation of tympanum to eye size of 100.00–120.00% typical for "*P. newtonii"* and 58.18–75.00% in *P. johnstoni*. A second diagnostic character presented by Boulenger (1900) is the development of a tympanic papilla in males of "*P. newtonii*"; a character obviously unknown at that time in *P. johnstoni*; e.g. Werner (1898) likewise describes males of that species without tympanic papillae. The occurrence of males' secondary sexual characters like tympanic papillae and the bony carpal spikes in *P. johnstoni* was first reported by Andersson (1907). Unfortunately Andersson's (1907) specimens from Bibundi on the foot of Mt. Cameroon, were destroyed during World War II (F. Geller-Grimm, Museum of Wiesbaden, *pers. comm.*).

Another character believed to distinguish "*P. newtonii*" and *P. johnstoni* was the position of the tympanic papilla (Amiet 1983). According to Amiet the papilla is positioned close to the upper tympanic border in *P. parkeri* and *P. johnstoni,* but is positioned more centrally in "*P. newtonii*" (Amiet 1983). However, the papilla of the holotype from Bioko has been described as being close to the upper tympanic border and likewise illustrated for a second specimen of *T. newtonii* (du Bocage 1895a, 1895b). du Bocage's (1895b) drawing is thus more similar to *P. johnstoni* than to "*P. newtonii*" as defined by Amiet (1983). It is hence plausible to assume that the morphological similarities between *C. johnstoni* and *T. newtonii* have been simply overseen due to the fact that Boulenger's (1888) holotype of *C. johnstoni* does not possess the characteristic seasonal traits of breeding males and consequently never has been associated with du Bocage' (1895a) holotype of *T. newtonii*. Furthermore Boulenger's (1900) wrong assignment of specimens from the Benito River (Equatorial Guinea) to *P. newtonii* from Bioko led to the fact that a wrong diagnostic character for *P. newtonii* (tympanum larger than the eye) has been adopted in subsequent literature. As *P. johnstoni* from Bioko and the mainland are morphologically indistinguishable, we herein place *P. newtonii* into the synonymy with the older name *P. johnstoni*: *Tympanoceros newtonii* du Bocage, 1895 = *Petropedetes johnstoni* (Boulenger, 1888 "1887") **new synonym**. Hence, *P. "newtonii"* (sensu Amiet 1983) on the mainland of western Central Africa requires a new scientific name (see below).

Bioko is located only 32 km from mainland Africa and is separated by shallow water (<60 m). This island has probably been connected to the mainland during the last ice age (Jones 1994; Rohling *et al.* 1998). The fauna of Bioko is of continental origin, comprising various faunal elements, like chameleons, lacertids and anurans, being present on the mainland and Bioko, but not occurring on other islands of the Cameroon volcanic line (Jones 1994; Jesus *et al*. 2005; Weinberg 2008). In contrast, the islands São Tomé and Príncipe in the Gulf of Guinea are seperated by a depth of more than 1800 m and are inhabited by their own endemic fauna with a deviating origin (Loumont 1992; Drewes & Stoelting 2004; Measey *et al.* 2007). Hence, the occurrence of the same *Petropedetes* species on Bioko and the mainland seems possible. However, we cannot exclude the possibility that molecular investigations comparing *P. johnstoni* from Bioko with those from the mainland may reveal differences on the species level. For example Bioko is inhabited by its own subspecies of the Cameroon toad (*Amietophrynus camerunensis poensis*), with longer extremities, toes and fingers (Perret 1966). On the other hand specimens of *Hyperolius ocellatus* from Bioko and adjacent mainland are currently regarded as belonging to one subspecies, different to those from south of the Sanaga River (Perret 1975). If future investigations would reveal that specimens from Bioko do belong to a separate evolutionary lineage, the name *P. newtonii* would be available for the island populations.

As herein defined, *P. johnstoni* is easily differentiated from other Central African congeners by its rudimentary webbing. *P. palmipes* and *P. perreti* are both fully webbed, *P. cameronensis* and *P. juliawurstnerae* **sp. nov.** are half-webbed. The presence of a distinct tympanum and a tympanal papilla distinguishes *P. johnstoni* from *P. cameronensis* and *P. palmipes*, which lack these characters. The small but distinct tympanum and the large femoral glands differentiate *P. johnstoni* from *P. euskircheni* **sp. nov.**, *P.*

parkeri and *P. vulpiae* **sp. nov.**, species with reduced webbing. Furthermore *P. johnstoni* seems to be strictly restricted to lowland localities in coastal areas, whereas other species live in more mountainous areas and further away from the coast.

Etymology. This species has been named by Boulenger (1888) to honour Mr. Henry Hamilton Johnston, who collected the type specimen.

***Petropedetes vulpiae* sp. nov.**
Figs. 1b, 2b, 4, 6a, 7b, 7c, 7d, 7e

Holotype. ZFMK 81623 (adult male), Cameroon, Mt. Nlonako, Ekomtolo, 4°51'N, 9°54'E, app. 450 m a.s.l., 12.-16.V.2003, coll. M. Plath.

Paratypes. IRSNB-KBIN 1987 (male) Cameroon, foot of Rumpi Hills, Big Massaka, 4°41'44N, 09°17'31.4E, app. 315 m a.s.l., 8.VII.2009, coll. A. Schmitz & M.F. Barej; MHNG 2713.1-2713.3 (3 males), same data as IRSNB-KBIN 1987; MHNG 2713.6 (female), Cameroon, Mt. Nlonako, Ekomtolo, 4°49'49N, 09°54'43E, app. 450 m a.s.l., 7.II.2003, coll. M. Plath; ZFMK 75588 (male), Cameroon, Mt. Kupe, Nyasoso, 4°49'42N, 9°40'55E, app. 920 m a.s.l., 12.II.2000, coll. H.-W. Herrmann & A. Schmitz; ZFMK 81167 (male), Cameroon, Mt. Nlonako, Ekomtolo, 4°49'49N, 09°54'43E, app. 450 m a.s.l., 17.VIII.2000, coll. M. Solbach; ZFMK 81553 (male), Cameroon, Mt. Nlonako, Ekomtolo, 4°49'49N, 09°54'43E, app. 450 m a.s.l., 13.I.2001, coll. M. Plath; ZFMK 81554 (female), Cameroon, Mt. Nlonako, Ekomtolo, 4°49'49N, 09°54'43E, app. 450 m a.s.l., no date, coll. M. Plath; ZFMK 81711 (male), Cameroon, Mt. Nloanko, Ekomtolo, 4°49'49N, 09°54'43E, app. 450 m a.s.l., 14.V.2003, coll. M. Plath; ZFMK 88863 (male) same data as IRSNB-KBIN 1987; ZMB 73690 (female), Cameroon, Mt. Nlonako, Ekomtolo, 4°49'49N, 09°54'43E, app. 450 m a.s.l., 31.III/4.IV.2001, coll. H.-W. Herrmann *et al.*; ZMB 73691-92 (2 males), same data as IRSNB-KBIN 1987.

Additional material examined. IRSNB-KBIN 13.841 (male), Gabon, Estuaire Province, Kango Department, 15 north of Alen-Nkoma, right of route L107, 2004, coll. O.S.G. Pauwels; IRSNB-KBIN 13.845 (female), 13.846 (male), Gabon, La Ngounié Province, Itsila, July 2004, coll. O.S.G. Pauwels; IRSNB-KBIN 14.932-933 (2 males) 14.934 (female), Gabon, Province de l'Estuaire, Kinguélé, app. 80 m a.s.l., IV.2001, coll. O.S.G. Pauwels; IRSNB-KBIN 14.935 (male), Gabon, Province du Woleu-Ntem, Song, app. 360 m a.s.l., 25.VI.2001, coll. O.S.G. Pauwels; MHNG 684.7 (2 males), Cameroon, Efulen, Kribi, no date, coll. Rosenberg; MHNG 917.70-71 (2 females), Cameroon, Ebolowa, Nkoétyé, 1.I.1955, coll. J.-L. Perret; MHNG 1033.67 (male), Cameroon, Makai, river Ngopi, 1960, coll. J.-L. Perret; MHNG 1521.80 (male), 1521.82 (male), 1521.84 (female), Cameroon, Sakbayémé, 23.X.1972, coll. J.-L. Perret; MHNG 1521.87 (male), 1521.88-90 (3 females), Cameroon, Kala, X.1972, coll. J.-L. Perret; MHNG 1521.92-93 (2 females), Cameroon, Ebolowa, Njazeng, 22.IV.1972, coll. J.-L. Perret; MHNG 1521.94 (male), Cameroon, Ototomo, 30.XII.1968, coll. J.-L. Amiet; MHNG 1521.95 (male), Cameroon, Maholé, Mungo, 28.III.1973, coll. J.-L. Perret; MHNG 2713.4 (female), Cameroon, Mt. Kupe, Nyasoso app. 950 m a.s.l., 5.VII.2009, coll. A Schmitz & M.F. Barej; ZFMK 19582 (male), 19585 (male), 19587 (male), Cameroon, Fako, Mt. Kupe, 5.-6.XII.1976, coll. U. Joger & J. Joger; ZFMK 69202 (male), 69209 (female), Cameroon, Mt. Nlonako, above Nguengue, app. 1100–1200 m a.s.l., 23.XI – 6.XII.1998, coll. ALSCO-Expedition; ZFMK 88860 (male), data as MHNG 2713.4; ZFMK 88861, ZFMK 88862 (2 males), 6.VII.2009, other data as MHNG 2713.4; ZMB 73726 (male), Nigeria, Mbe Mts., X.2005, coll. A. Onadeko; ZMB 73893 (male), Gabon, Province du Woleu-Ntem, Tchimbélé, app. 469 m a.s.l., 10.IV.2001, coll. O.S.G. Pauwels; ZMB 73894 (female) same data as IRSNB-KBIN 14.935.

Diagnosis. Medium sized *Petropedetes*; compact body shape; tympanum usually flattened on the upper and lower border; tympanum larger than diameter of eye in males (Fig. 1b), smaller in females; characters of breeding males: tympanic papilla present (broad, fleshy), papilla closer to the centre than the upper border; forearm hypertrophy well developed; carpal spike present; spinosities on throat, forearms and on almost every wart on flanks and dorsum, even around the tympanum (Fig. 6a); femoral glands large, very prominent; webbing rudimentary.

FIGURE 5. Holotype of *P. johnstoni* (BM 1947.2.7.44; scale bar: 1cm). Left: ventral side showing large femoral glands (marked by arrow), right: lateral view of head showing small tympanum without papilla (photos: C. McCarthy & B. Clarke).

Description of the holotype. The holotype is an adult male in breeding condition, robust body shape; 40.4 mm SUL; snout very short, rounded in lateral view; head width 17.4 mm; eye diameter 6.7 mm; interorbital distance 3.9 mm; naris closer to snout (2.2 mm) than to eye (4.5 mm); skin on throat with spinosities (Fig. 6a); femur length 31.4 mm; tibia length 25.7 mm; foot (incl. longest toe) 31.4 mm; femoral glands large (length x width: 6.2 x 3.3 mm / 6.4 x 3.4 mm); relation femur length and femoral gland length 0.28; spinosity well developed on upper forearms and flanks; webbing rudimentary; coloration of preserved specimen: dorsum pale with dark spots (approx. 2–2.5 mm diameter); hind limbs marbled in dark and bright colours, but with distinct cross bars; throat dark; ventrum whitish with minuscule black speckles; femoral glands almost without darker pigments.

Variation. Medium sized *Petropedetes* with compact body; females slightly larger than males (SUL in males: 33.4–43.4 mm, females: 21.9–46.5 mm); mean head width in males 41% of SUL, in females 39%; snout in lateral view generally rounded; *canthus rostralis* sharp; loreal region concave; eye diameter about 1.6 times eye-narial distance; nose closer to snout tip than to eye; tympanum distinct, larger than the eye in males, smaller in females (tympanum / eye in males: 0.86–1.13, in females: 0.48–0.68); tympanum usually flattened on upper and lower border; tympanic papilla closer to centre than to upper border; tympanic papilla broad and fleshy; tympanum surrounded by minuscule white warts; supratympanic fold distinct; fingers slender, with T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; manual webbing absent; palmar tubercle and thenar tubercle present; forearm hypertrophy well developed in males; carpal spikes present in males; spinosities on throat, forearms, as well as on almost every wart on flanks and dorsum; dorsal tegument predominantly uniform with small regularly scattered warts, a few larger, partly linearly arranged warts present; granules on flanks larger than on dorsum; structure of ventral skin smooth;

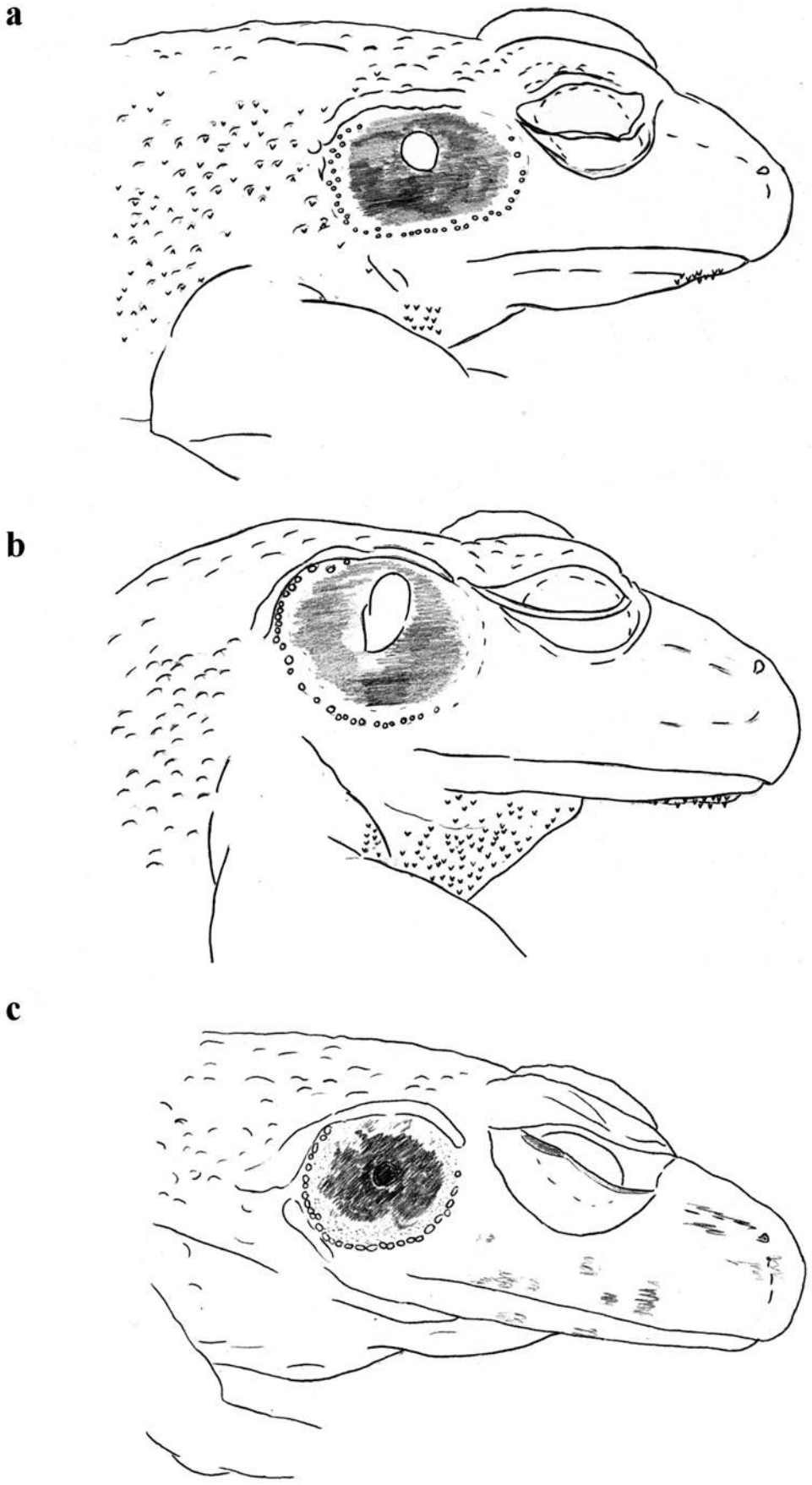

FIGURE 6. Portraits of holotypes showing spinosity: a) *Petropedetes vulpiae* **sp. nov.** (ZFMK 81623), b) *P. euskircheni* **sp. nov.** (ZFMK 75582), c) *P. juliawurstnerae* **sp. nov.** (ZFMK 67360).

mean femur length in males 53% of SUL, in females about 51%; mean tibia length in both sexes 60% of SUL; mean foot length in both sexes 76% of SUL; upper hind limbs of moderate width, lower hind limbs slender; femoral glands more prominent in males, in females sometimes even indistinct, gland values of the two sexes overlap, can therefore be misleading without the relation of tympanum to eye diameter (femoral gland /femur length in males: 0.16–0.40, in females: 0.21–0.29); relative length of toes: IV > III > V > II > I; webbing rudimentary: 1 (1), 2 (1-1), 3 (2-2), 4 (3-3), 5 (2).

Coloration. In life dorsum marbled in brown, green and whitish; larger warts on dorsum are usually dark coloured; iris whitish-golden; hind limbs with large dark spots, similar to transverse bars, large transverse bars are divided by thin light lines, large bars and thin light thin lines may continue on the lower leg (Fig. 1b); throat in most specimens dark, otherwise whitish with dark pigments; belly usually whitish; femoral glands yellowish or orange. Coloration in preservation as in life, but pale; dorsum generally brown; belly whitish with minuscule black speckles (recognizable only under microscope).

Natural history. *Petropedetes vulpiae* **sp. nov.** is part of the Central African forest fauna (Amiet 2006). Frétey & Blanc (2001) find the species close to a stream in forests and gallery forests. *P. vulpiae* **sp. nov.** is, just like *P.* aff. *parkeri* (see below), predominantly active at dawn and only becomes active during day when the climate is very humid (Amiet 1989). Gabonese specimens were collected during midday, but also at night in small streams in primary forest. Specimens from Itsila (Gabon) were caught on mossy rocks in the middle of a cascade at the border between Gabon and the Republic of the Congo (Fig. 7b). Specimens from Alen-Nkoma (Gabon) avoided jumping in fast running water while escaping, those who fell in the water were quickly exhausted (O.S.G. Pauwels, *pers. obs.*). *P. vulpiae* **sp. nov.** and *P.* aff. *parkeri* occur in sympatry and may share a similar biology. However, Amiet (1983) believes that *P. vulpiae* **sp. nov.** may occur on less steep surfaces than *P.* aff. *parkeri*. Perret & Mertens (1957) find specimens in a cave with a small current, where they hid in small holes between rocks. The authors assumed the species to be very common in its biotopes. The clutch of some ten eggs is deposited on moist surfaces on rocks (Amiet 1983, 1989). Males seem to guard the eggs at night (Amiet 1991). Lawson's (1993) clutch observations seem to be based on *P. johnstoni* (see above). The call of *P. vulpiae* **sp. nov.** has been described as a gentle "douc-douc", which is emitted by the males from hiding places within rock cavities (Amiet 1973). The species shows a vocal annual activity cycle *type II sensu* Amiet (2006); a continuous cycle with one less intensive period at the end of the big rainy season and beginning of the following dry season. Mertens (1968) reports on mites in the vent region of several specimens in this species and Vaucher & Durette-Desset (1980) describe a member of the parasitic Spiruroidea from a specimen collected from Kala.

Distribution. *Petropedetes vulpiae* **sp. nov.** occurs from eastern Nigeria to southern Gabon (Fig. 4). The species is known from lowland localities, but also reaches altitudes above 1000 m (e.g. Mertens 1965; Plath *et al.* 2004). Lawson (1993) mentions a specimen from 1769 m from a locality in the Rumpi Hills, but remarked that it has been assigned to this species with reservation. The species is known from localities in Cameroon (Boulenger 1906; Mertens 1965, 1968), Equatorial Guinea (Perret 1984; de la Riva 1994; Lasso *et al*. 2002), and Gabon (Frétey & Blanc 2001; Burger *et al*. 2006a, 2006b; Pauwels & Rödel 2007). It is also present in northern Republic of Congo, as specimens have been found on both sides of a cascade of the border between Gabon and the Republic of Congo (O.S.G. Pauwels, *pers. obs*.).

Genetics. The genetic comparison for the uncorrected p-distances of the mitochondrial 16S rRNA-fragment (Table 4) gave the following results for *Petropedetes vulpiae* **sp. nov.**: interspecific comparison between *P. vulpiae* **sp. nov.** and all other Central African *Petropedetes* taxa ranged between 3.68%-9.53%, while the intraspecific variation within *P. vulpiae* was much lower at 0.00%-0.20% (N= 6). Specimens of *P. vulpiae* **sp. nov.** from Big Massaka perfectly correspond gentically to the holotype from Ekomtolo (Table 4) and are therefore included in the type material.

Systematic remarks. This species has long been considered to be *P. newtonii.* The taxonomic confusion concerning *P. johnstoni* and *P. newtonii* has been elucidated above, outlining that the "real" *P. newtonii* is a synonym of *P. johnstoni*. *Petropedetes vulpiae* **sp. nov.** shares the rudimentary development of its webbing with *P. parkeri, P. johnstoni* and *P. euskircheni* **sp. nov.** Hence, the new species is distinct from species with developed webbing (*P. palmipes* and *P. perreti*, both fully webbed; *P. cameronensis* and *P. juliawurstnerae* **sp.**

nov., both half-webbed). The presence of a distinct tympanum and a tympanal papilla separates *P. vulpiae* **sp. nov.** from *P. cameronensis* and *P. palmipes*, who miss these characters.

Petropedetes vulpiae **sp. nov.** can be differentiated from *P. johnstoni*: by a) the size of the tympanum: the tympanum is smaller than the eye diameter in *P. johnstoni*, while it surpasses eye size in *P. vulpiae* **sp. nov.** (tympanum diameter / eye diameter in males: $N_{vulpiae}$= 35, $N_{johnstoni}$= 7, $p< 0.001$); females of both species possess tympana smaller than the eye, but they are still larger in *P. vulpiae* **sp. nov.** (tympanum diameter / eye diameter in females: $N_{vulpiae}$= 16, $N_{johnstoni}$= 4, $p< 0.01$); b) the size of femoral glands: the femoral glands are more developed in male *P. johnstoni* than in *P. vulpiae* **sp. nov.** (femoral gland length / femur length in males: $N_{vulpiae}$= 35, $N_{johnstoni}$= 7, $p< 0.05$); there is no significant difference in gland size in females of both species (p= 0.27).

Petropedetes vulpiae **sp. nov.** differs from *P. parkeri* and *P. euskircheni* **sp. nov.** by: a) the body size, *P. vulpiae* **sp. nov.** being smaller than *P. parkeri* (SUL in males: $N_{vulpiae}$= 35, $N_{parkeri}$= 11, $p< 0.001$; in females: $N_{vulpiae}$= 16, $N_{parkeri}$= 7, $p< 0.01$) and *P. euskircheni* **sp. nov.** (see below in the species description of *P. euskircheni* **sp. nov.)**; b) femoral gland size, the femoral gland is larger in males and females of *P. vulpiae* **sp. nov.** than in *P. parkeri* (femoral gland length / femur length in male: $N_{vulpiae}$= 35, $N_{parkeri}$= 11, $p< 0.001$; in females: $N_{vulpiae}$= 16, $N_{parkeri}$= 7, $p< 0.001$) and *P. euskircheni* **sp. nov.** (see below); the femoral glands of male *P. parkeri* can reach almost the size of females in *P. vulpiae* **sp. nov.**; in this case the femoral glands in male *P. parkeri* are more prominent and the tympanum is bigger than in female *P. vulpiae* **sp. nov.**); c) the tibia / SUL ratio is higher in both sexes of *P. vulpiae* **sp. nov.** (in males: $N_{vulpiae}$= 35, $N_{parkeri}$= 11, $p< 0.001$; in females: $N_{vulpiae}$= 16, $N_{parkeri}$= 7, $p< 0.01$); d) the shape of the tympanum, males of *P. parkeri* have a rounder tympanum than *P. vulpiae* **sp. nov.**, it can be flattened in *P. euskircheni* **sp. nov.**, but less than in *P. vulpiae* **sp. nov**. (Fig. 6a).

Amiet (1987) mentions small morphological differences between *P. vulpiae* **sp. nov.** populations in Cameroon. Even more striking are differences in the size of the femoral gland between populations from northern Gabon and specimens from the type locality (own data). Unfortunately, we could not compare these populations genetically. Specimens from localities inbetween the type locality and Gabon exhibited intermediate stages in gland size. At the moment we regard all these populations as conspecific, however, their status should be reinvestigated when tissue of specimens from southern Cameroon and Gabon become available.

Etymology. The specific epithet *vulpiae* is the genitive of the latinised matronym of Dr. Christine Fuchs (in latin: Vulpes), Institut für Mikroskopische Anatomie und Neurobiologie der Universitätsmedizin der Johannes Gutenberg-Universität Mainz (Germany), to whom we dedicate this new species, in recognition of her important contributions on globin research in African clawed frogs and her full and continuing support of A.S.

***Petropedetes parkeri* Amiet, 1983**
Figs. 1c, 2c, 4, 7a, 7b, 7f

Material examined. BM 1936.3.4.124 (holotype) adult male, Cameroon, Mamfe region, Atolo, Assumbo, 12.IV.1933, coll. I. Sanderson; BM 1936.3.4.123 (male), Cameroon, Mamfe; BM 1936.3.4.127 (female), 1936.3.4.136 (male), Cameroon, Bachor II; 1936.3.4.128 (female), 1936.3.4.131 (male), Cameroon, Bashau, 1932-1933, coll. I. Sanderson; MHNG 961.66 (male, formerly BM 1936.3.4.133), Cameroon, Mamfe Division, Bashau, 10.III.1933, coll. I. Sanderson; PEM A 9123-9124 (2 males), A 9126 (male), A 9127 (female), Cameroon, Nguti, 15.VII.1996, coll. L. Minter; PEM A 9125 (male), A 9128 (male), 5. & 9.VII.1996, other data as A 9123; ZFMK 61337-338 (2 females), 61342 (male), Cameroon, Ekundu-Kundu, 3-27.II.1989, coll. M.T. O'Shea; ZFMK 87702 (female), Cameroon, Mamfe region, near Amebishu, app. 720 m a.s.l., 14.IX.2007, coll. J.A.M. Wurstner & M.F. Barej; ZMB 73739 (female), Nigeria, Okwangwo, app. 900 m a.s.l., 15.IV.2004, coll. M. Gartshore.

Problematic material (see systematic remarks). IRSNB-KBIN 13.842 (female), Gabon, Estuaire Province, Kango Department, 15 north of Alen-Nkoma, right of route L107, 2004, coll. O.S.G. Pauwels; IRSNB-KBIN 14.941 (female), Gabon, Province du Woleu-Ntem, Tchimbélé, app. 469 m a.s.l., 20.VI.2001, coll. O.S.G. Pauwels; MHNG 1521.60 (male), 1521.61 (female), 1521.64-65 (2 females), Cameroon, Bafoussam, Bangwa, 7.IV.1973, coll. J.-L. Perret; MHNG 1521.70-71 (2 males), Cameroon, Yaoundé, Mt. Kala, X.1972, coll. J.-L. Perret; MHNG 1521.78 (male), Cameroon, Dschang, Falaise de Mbos, 25.XI.1972, coll. J.-L. Perret; ZFMK 73209 (female), 73210 (male), Gabon, Barrage de Tchimbélé, coll. V. Gossmann & S. Lötters; ZMB 73892 (female), same data as IRSNB-KBIN 14.941.

Diagnosis. Large sized *Petropedetes*; robust body shape; tympanum round, larger than eye diameter in males, smaller in females; characters of breeding males: tympanic papilla present (broad and fleshy); papilla close to the upper border of the tympanum; forearm hypertrophy strongly developed in males; carpal spike present; tegumental spinosities well developed on throat, forearms, scattered on flanks and dorsum; femoral glands small, coloured similar to limb, shifted slightly to the posterior side of the leg; webbing rudimentary.

Description. Large sized *Petropedetes* with robust body; males distinctly larger than females (SUL in males: 38.0–74.3 mm, in females: 34.1–61.3 mm); mean head width in males about 44% of SUL, in females about 42%; snout in lateral view short, rounded; *canthus rostralis* slightly rounded but distinct; loreal region concave; eye diameter about 1.3 times eye-narial distance; nose closer to snout-tip than to eye; distinct tympanum, usually larger than eye in males, always smaller in females (tympanum / eye in males: 0.73-1.39, in females: 0.60–0.89; the lowest value of 0.73 in males measured in the smallest specimen, second smallest value: 0.92; tympanic papilla closer to upper border than centre of tympanum; papilla broad and fleshy with oval basis; supratympanic fold distinct; fingers slender, with typically T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; palmar tubercle and thenar tubercle present, palmar tubercle sometimes indistinct; forearm hypertrophy strongly developed in males; carpal spike present in males; tegumental spinosities well developed on throat, forearms, scattered on flanks and dorsum in males; dorsal tegument with smaller warts than flanks; few larger, elongated warts on dorsum; ventral skin smooth; femora long, mean femur length in males 50% of SUL, in females 51%; mean foot length in both sexes 74% of SUL; upper hind limbs of moderate width, lower hind limbs slender; femoral glands small in both sexes, slightly bigger in males (femoral gland / femur in males: 0.18–0.27, in females: 0.16–0.22); relative length of toes: IV > III > V > II > I; webbing rudimentary: 1 (1) 2 (1-1) or 2 (1.25-1) 3 (2-2) 4 (3-3) 5 (2).

Coloration. Dorsum and flanks olive or brownish and dark marbled with diffuse brown-olive spots (Fig. 1c); throat dirty whitish; belly whitish, slightly translucent; throat can be darker than belly; femora and lower legs with large darker spots, darker spots divided by thin bright coloured transversal bars; ventral surfaces of limbs of the same coloration as belly, pale greenish; iris golden with white-green shades; femoral glands coloured as hind limbs, pale orange or greenish. Coloration in preservation: similar as in life; dorsum uniform brown; belly whitish, with minuscule speckles (less dense than in former species, only recognizable under microscope); throat dirty whitish or pale brown.

Natural history. After the first work on the ecology of the species by Sanderson (1936, referred to as *P. johnstoni*), additional data have been gathered by Amiet. However, some observations by Amiet (e.g. 1975, 1983, 1986) are based on populations of "*P. parkeri*" from Mt. Kala, the Bamiléké Plateau and the region of Nkongsamba. The taxonomic status of these populations at present is not clear (see below). Sanderson (1936) calls this species arboreal, because he found them on lower, broadened leafs, in shade. The breeding season is said to take place in the rainy season (Parker 1936; referred to as *P. johnstoni*). The species has been found on wet, mossy rocks in the forest; the large rocks were crossed by runlets (Fig. 7a). According to Sanderson (1936) the adults aggregate in the breeding season on humid rocky surfaces in rough areas with torrent water, while they live in the forest on leaves outside the breeding season.

The advertisement call of *P. parkeri* has been published by Narins *et al*. (2001). Narins *et al*. (2001) describe a part of the courtship behaviour, including the female striking the male's head with her foreleg during amplexus. These authors speculate that this behaviour is connected with secretion of glands in the male tympanal papilla. The small eggs are deposited at the beginning of the rainy season on surfaces of stones within the splash zone. Metamorphosis in *P. parkeri* is finished before the end of the rains or at the beginning of the dry season (Parker 1936).

FIGURE 7. Habitat pictures and specimens of uncertain determination: a) *Petropedetes parkeri,* Mamfe region, Cameroon; b) *P. vulpiae* **sp. nov.** biotope, waterfall at Itsila, Gabon – Republic of Congo border; c) *P. vulpiae* **sp. nov.**, cascade 15 km north of Alen-Nkoma, right of Route L. 107, Kango Department, Estuaire Province, Gabon (photo: J.P. Vande weghe); d) type locality of *P. juliawurstnerae* **sp. nov.** and *P. euskircheni* **sp. nov.**, habitat of *P. vulpiae* **sp. nov.**, Nyasoso, Mt. Kupe, Cameroon; e) *P. vulpiae* **sp. nov.**, cascade at Big Massaka, Cameroon; f) *P.* aff. *parkeri*, Barrage de Tchimbélé, Gabon (ZFMK 73132; photo: V. Gossmann); g) *P.* cf. *johnstoni* near Langoué Bai, Gabon (no voucher; photo: J.P. Vande weghe):

TABLE 3. Summary of morphological measures (mm) of adult female *Petropedetes*. Given are minimum, maximum, mean and median values including standard deviation and standard error. For abbreviations see Table 2.

	SUL	HW	FM	GL	GW	TI	FL	TD	O	EN	ES	NS	FM/SUL	TI/SUL	FL/SUL	FM/TI	GL/FM	GL/GW	TD/O	HW/SUL
P. johnstoni																				
N	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
min	28.1	10.8	13.6	3.7	1.8	18.2	24.1	2.0	4.1	2.2	4.4	2.1	0.48	0.57	0.69	0.74	0.25	2.03	0.45	0.37
max	47.8	18.1	24.7	6.2	2.6	28.7	37.8	3.0	6.4	4.8	7.1	2.6	0.52	0.65	0.86	0.89	0.27	2.61	0.48	0.38
mean	40.0	15.0	20.4	5.2	2.3	24.0	31.2	2.6	5.6	3.8	6.1	2.3	0.51	0.61	0.78	0.84	0.26	2.30	0.47	0.38
s. error	4.53	1.63	2.61	0.58	0.17	2.50	3.48	0.23	0.52	0.58	0.61	0.11	0.01	0.02	0.03	0.03	0.00	0.13	0.01	0.00
s. dev.	9.05	3.26	5.22	1.15	0.33	5.00	6.95	0.45	1.04	1.16	1.21	0.22	0.02	0.03	0.07	0.07	0.01	0.26	0.01	0.01
median	42.00	15.60	21.70	5.45	2.30	24.55	31.35	2.75	5.85	4.10	6.35	2.25	0.52	0.60	0.79	0.87	0.26	2.27	0.48	0.38
P. vulpiae **sp. nov.**																				
N	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
min	21.9	8.3	11.0	2.3	1.1	13.0	16.5	1.9	3.9	2.0	3.1	1.1	0.49	0.57	0.71	0.80	0.21	2.06	0.48	0.37
max	46.5	19.3	24.5	6.4	2.9	29.7	37.3	4.4	6.9	4.1	7.0	3.0	0.55	0.65	0.82	0.91	0.29	3.18	0.68	0.42
mean	41.6	16.2	21.3	5.3	2.2	25.1	31.6	3.6	6.0	3.6	5.9	2.3	0.51	0.60	0.76	0.85	0.25	2.46	0.61	0.39
s. error	1.53	0.66	0.77	0.25	0.11	0.92	1.13	0.15	0.20	0.14	0.24	0.13	0.00	0.01	0.01	0.01	0.01	0.08	0.01	0.00
s. dev.	6.11	2.64	3.08	0.99	0.44	3.66	4.52	0.61	0.80	0.54	0.96	0.52	0.02	0.03	0.03	0.03	0.02	0.32	0.05	0.02
median	43.30	16.40	22.25	5.55	2.25	25.75	32.80	3.75	5.95	3.75	5.95	2.30	0.51	0.59	0.76	0.85	0.25	2.42	0.62	0.38
P. parkeri																				
N	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
min	34.1	13.9	18.2	3.7	1.3	20.8	27.1	2.9	4.8	3.8	5.9	2.1	0.46	0.53	0.70	0.87	0.16	2.06	0.60	0.41
max	61.3	25.2	31.9	6.0	2.8	33.5	45.3	6.5	7.8	6.0	9.6	3.6	0.53	0.61	0.79	0.97	0.22	2.99	0.89	0.43
mean	51.8	21.5	26.5	4.9	2.1	28.6	38.4	4.9	6.6	5.2	8.0	2.8	0.51	0.56	0.74	0.92	0.19	2.38	0.73	0.42
s. error	3.29	1.38	1.76	0.32	0.18	1.56	2.24	0.41	0.37	0.33	0.47	0.20	0.01	0.01	0.01	0.02	0.01	0.14	0.04	0.00
s. dev.	8.71	3.65	4.66	0.85	0.49	4.12	5.92	1.09	0.97	0.88	1.25	0.52	0.03	0.03	0.03	0.05	0.02	0.36	0.09	0.01
median	53.30	21.70	27.00	5.00	2.10	29.20	39.50	5.00	6.80	5.40	8.10	2.90	0.52	0.55	0.74	0.93	0.19	2.33	0.73	0.41
P. euskircheni **sp. nov.**																				
N	17	17	17	16	16	17	17	17	17	17	17	17	17	17	17	17	16	16	17	17
min	38.6	14.4	20.3	2.6	1.2	23.3	31.7	2.7	5.4	2.9	5.8	2.2	0.50	0.58	0.75	0.83	0.10	1.49	0.49	0.37
max	57.3	22.1	30.7	4.0	2.5	34.9	47.3	5.2	7.8	6.0	9.0	4.2	0.57	0.66	0.89	0.90	0.16	2.54	0.85	0.42
mean	47.5	18.6	25.3	3.3	1.8	29.4	39.1	4.2	6.5	4.2	7.2	3.0	0.53	0.62	0.82	0.86	0.13	1.85	0.64	0.39
s. error	1.50	0.64	0.85	0.09	0.09	0.87	1.17	0.20	0.16	0.20	0.25	0.11	0.01	0.01	0.01	0.01	0.00	0.07	0.02	0.00
s. dev.	6.19	2.65	3.49	0.39	0.39	3.58	4.84	0.82	0.66	0.81	1.03	0.47	0.02	0.02	0.04	0.02	0.01	0.28	0.10	0.01
median	45.50	18.20	24.20	3.20	1.75	28.80	38.20	4.30	6.50	4.10	7.00	3.00	0.53	0.62	0.83	0.85	0.13	1.78	0.66	0.39

TABLE 3. (continued)

	SUL	HW	FM	GL	GW	TI	FL	TD	O	EN	ES	NS	FM/SUL	TI/SUL	FL/SUL	FM/TI	GL/FM	GL/GW	TD/O	HW/SUL
P. perreti																				
N	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
min	32.2	13.0	17.6	4.0	1.7	19.0	24.0	2.6	4.6	3.1	4.6	1.5	0.48	0.50	0.67	0.84	0.18	1.78	0.47	0.35
max	48.5	18.4	23.9	6.4	2.6	26.7	34.7	4.2	6.8	4.0	6.8	3.0	0.55	0.61	0.77	0.96	0.28	3.22	0.71	0.40
mean	43.3	16.4	22.0	5.2	2.1	24.4	31.5	3.4	6.0	3.6	6.1	2.5	0.51	0.56	0.73	0.90	0.24	2.49	0.57	0.38
s. error	0.96	0.37	0.44	0.18	0.06	0.54	0.65	0.12	0.14	0.08	0.14	0.10	0.01	0.01	0.01	0.01	0.01	0.11	0.02	0.00
s. dev.	3.74	1.42	1.70	0.69	0.24	2.11	2.54	0.46	0.53	0.30	0.54	0.37	0.02	0.03	0.03	0.03	0.03	0.42	0.07	0.01
median	44.30	16.60	22.30	5.30	2.20	24.40	31.90	3.40	6.00	3.70	6.20	2.60	0.51	0.57	0.74	0.90	0.24	2.47	0.56	0.38
P. cameronensis																				
N	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
min	34.2	12.6	17.2	4.3	1.7	21.6	27.5	1.7	4.8	2.8	4.8	1.7	0.46	0.53	0.69	0.75	0.22	1.74	0.28	0.35
max	49.0	19.0	25.9	7.1	2.7	30.7	37.3	2.6	6.8	4.7	7.8	3.3	0.57	0.66	0.84	0.95	0.31	3.16	0.48	0.43
mean	40.1	15.1	20.8	5.3	2.2	24.1	30.5	2.2	5.7	3.5	5.9	2.4	0.52	0.60	0.76	0.86	0.25	2.43	0.38	0.38
s. error	0.93	0.45	0.52	0.18	0.06	0.56	0.61	0.07	0.14	0.13	0.20	0.11	0.01	0.01	0.01	0.01	0.01	0.10	0.01	0.00
s. dev.	3.85	1.85	2.16	0.76	0.24	2.31	2.50	0.28	0.59	0.54	0.82	0.45	0.03	0.04	0.05	0.05	0.03	0.40	0.05	0.02
median	39.80	14.70	20.20	5.20	2.20	23.20	30.40	2.10	5.70	3.40	5.80	2.40	0.51	0.62	0.76	0.87	0.25	2.37	0.39	0.37
P. juliawurstnerae **sp. nov.**																				
N	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
min	39.1	15.0	19.8	6.6	1.5	21.8	29.0	2.9	5.3	3.0	5.9	2.6	0.50	0.54	0.70	0.87	0.32	3.36	0.47	0.37
max	42.6	16.6	22.1	8.7	2.2	25.0	33.2	3.6	6.7	3.8	6.6	3.0	0.53	0.60	0.80	0.93	0.41	4.87	0.60	0.41
mean	40.9	15.8	21.1	7.4	1.9	23.3	30.6	3.2	5.9	3.4	6.2	2.8	0.52	0.57	0.75	0.91	0.35	3.93	0.54	0.39
s. error	0.32	0.16	0.21	0.20	0.08	0.31	0.40	0.07	0.17	0.08	0.07	0.04	0.00	0.01	0.01	0.01	0.01	0.18	0.01	0.00
s. dev.	1.01	0.49	0.66	0.65	0.25	0.97	1.27	0.22	0.53	0.26	0.22	0.12	0.01	0.02	0.03	0.02	0.03	0.57	0.04	0.01
median	40.80	15.75	21.25	7.30	2.00	23.45	30.30	3.20	5.75	3.35	6.20	2.80	0.52	0.57	0.75	0.91	0.35	3.72	0.53	0.39
P. palmipes																				
N	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
min	37.5	13.5	19.6	4.6	2.5	21.6	27.2	1.3	6.2	3.0	5.2	2.2	0.46	0.52	0.65	0.89	0.22	1.80	0.20	0.35
max	54.7	21.2	25.9	7.8	3.5	28.4	37.2	1.7	7.8	4.5	7.5	3.0	0.55	0.60	0.77	0.93	0.31	2.76	0.25	0.39
mean	44.2	16.3	22.6	6.1	2.7	25.1	31.9	1.5	6.7	3.9	6.5	2.6	0.51	0.57	0.72	0.90	0.27	2.24	0.22	0.37
s. error	2.3	0.9	0.9	0.4	0.1	1.0	1.5	0.1	0.2	0.2	0.3	0.1	0.01	0.01	0.01	0.00	0.01	0.10	0.01	0.00
s. dev.	6.48	2.55	2.58	1.05	0.37	2.94	4.17	0.19	0.61	0.53	0.78	0.29	0.03	0.03	0.04	0.01	0.03	0.28	0.02	0.01
median	43.90	16.00	22.05	5.90	2.55	24.70	31.05	1.55	6.50	4.00	6.65	2.60	0.52	0.57	0.73	0.90	0.28	2.23	0.22	0.37

Petropedetes parkeri shows, in contrast to other members of the genus, a reversed sexual size dimorphism (Amiet 1983). The state that males grow larger than females is rare and occurs only in about 10% of amphibians (Shine 1979). Most often this is connected to some kind of territoriality or male parental care. However, Sanderson (1936) notes the laceration of non-breeding males in the gular region and assumed relics of the previous breeding seasons. This could be regarded as an outcome of territorial behaviour. Further respective data are however lacking. This species appears to live in forests. Some specimens of *P.* aff. *parkeri* from Gabon (see below, Fig. 7f) have been collected during the day in a gallery forest. *P.* aff. *parkeri* is called "barking frog" by locals in western Gabon (V. Gossmann *pers. comm.*).

Distribution. We can only assign populations from western Cameroon and eastern Nigeria to *P. parkeri* with certainty (Fig. 4). At these locations species inhabit altitudes below 1000 m.

Genetics. The genetic comparison for the uncorrected p-distances of the mitochondrial 16S rRNA-fragment (Table 4) gave the following results for *Petropedetes parkeri*: interspecific comparison between *P. parkeri* and all other Central African *Petropedetes* taxa ranged between 5.94%-12.39%, while the intraspecific variation within *P. parkeri* was much lower at 0.00%-0.22% (N= 4).

Systematic remarks. *Petropedetes parkeri* has long been confused with "*P. newtonii*" (described herein as *P. vulpiae* **sp. nov.**) and *P. johnstoni* (Gartshore 1994). Amiet (1983) first recognizes that the description of the species' habitat by Parker (1936) and Sanderson (1936) do not fit the circumstances of the description by Boulenger (1900). He subsequently described this species using distinct morphological characters. *P. parkeri* and *P. euskircheni* **sp. nov.** are the two largest members of the genus. The fleshy papilla in both species has an oval basis, while it is rounder in the remaining species. *P. parkeri* is only rudimentary-webbed and therefore easily distinguishable from more fully webbed species (*P. palmipes* and *P. perreti*, both fully webbed; *P. cameronensis* and *P. juliawurstnerae* **sp. nov.**, both half-webbed). Moreover, the presence of a distinct tympanum and a tympanal papilla seperates *P. parkeri* from *P. cameronensis* and *P. palmipes*, which lack these characters. The size of the femoral gland distinguishes *P. parkeri* from *P. vulpiae* **sp. nov.** and *P. johnstoni*, which possess much larger ones. Due to a similar appearance, *P. parkeri* has been confused with a cryptic species in the past. Distinguishing characters between *P. parkeri* and *P. euskircheni* **sp. nov.** are presented in the description of the new species (see below).

As holotype, Amiet (1983) has chosen a *P. parkeri* from Atolo, Mamfe region. The paratypes were from localities in the Mamfe region, but also from the "Falaise de Mbos" and Bangwa. He further investigated material from Kala, Léna (Yaoundé region). He regards the species as vocally and morphologically homogenous throughout its discontinuous range, although he mentioned small deviations in the lengths of the femora between western and eastern populations (Mt. Kala, Yaoundé region; Amiet 1983). The type locality at Atolo is located at app. 425 m a.s.l. The overall altitudinal distribution ranges between 400 and 2300 feet (approximately 120-700 m; Parker 1936; Sanderson 1936). Own and unpublished findings confirm sites below 1000 m. The sites are a hill close to Mukwecha (720 m), Okwangwo (900 m) and material collected by Les Minter from Nkwende Hills near Nguti (400 m). Amiet (1978, 1983) instead lists altitudes between 750–1400 m from Mbakang and Foto-Ndonchwet and doubts localities in very low altitudes from Sanderson (1936) and Parker (1936). The altitudinal range of *P. parkeri* may overlap with the altitudinal range of *P. euskircheni* **sp. nov.** (type locality at about 900 m; see below). Without genetic comparisons, so far the *P. parkeri*-like populations in Central Cameroon region around Yaoundé and the northern populations of the Manengouba Mountains cannot be assigned with certainty, neither to *P. parkeri* nor to *P. euskircheni* **sp. nov.**

Due to the finding of *P. euskircheni* **sp. nov.** not all populations can be irrespectively assigned to a particular taxon. We therefore assign unsure localities within Cameroon (e.g. Mt. Kala), but also specimens from Gabon (e.g. Frétey & Blanc 2001; Lötters *et al*. 2001) and Equatorial Guinea (de la Riva 1994; Lasso *et al*. 2002) to *P.* aff. *parkeri* (Fig. 4).

Etymology. The species has been named by Amiet (1983) in honour of Mr. Hampton Wildman Parker, former curator of the Natural History Museum, who conducted a meticulous morphological study on specimens from the Sanderson collection.

TABLE 4. Uncorrected p-distances between Central African *Petropedetes* based on 611 bp of the 16S rRNA gene.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	*P. cameronensis* GU256018 (ZMB 73728, Mbe Mts./Nigeria)	-																
2	*P. cameronensis* GU256017 (ZMB 73729, Rhoko Forest/Nigeria)	0.0000	-															
3	*P. cameronensis* GU256016 (ZFMK 81154, Mt.Nlonako)	0.0050	0.0050	-														
4	*P. cameronensis* GU256015 (ZFMK 81615, Mt.Nlonako)	0.0034	0.0034	0.0017	-													
5	*P. euskircheni* **sp. nov.** GU256027 (MHNG 2713.7, Mt.Kupe)	0.0648	0.0648	0.0666	0.0648	-												
6	*P. euskircheni* **sp. nov.** GU256025 (MHNG 2713.8, Mt.Kupe)	0.0605	0.0605	0.0622	0.0605	0.0035	-											
7	*P. euskircheni* **sp. nov.** GU256026 (ZFMK 88864, Mt.Kupe)	0.0620	0.0620	0.0638	0.0620	0.0035	0.0000	-										
8	*P. euskircheni* **sp. nov.** GU256019 (ZFMK 75582, Mt.Kupe)	0.0596	0.0596	0.0596	0.0596	0.0039	0.0000	0.0000	-									
9	*P. euskircheni* **sp. nov.** GU256021 (ZFMK 75586, Mt.Kupe)	0.0622	0.0622	0.0639	0.0622	0.0000	0.0033	0.0034	0.0039	-								
10	*P. euskircheni* **sp. nov.** GU256020 (ZFMK 75539, Mt.Nlonako)	0.0842	0.0842	0.0820	0.0819	0.0312	0.0314	0.0312	0.0312	0.0313	-							
11	*P. euskircheni* **sp. nov.** GU256024 (ZFMK 78365, Mt.Nlonako)	0.0689	0.0689	0.0706	0.0689	0.0314	0.0301	0.0309	0.0286	0.0301	0.0000	-						
12	*P. euskircheni* **sp. nov.** GU256022 (ZFMK 81103, Mt.Nlonako)	0.0689	0.0689	0.0706	0.0689	0.0314	0.0301	0.0309	0.0286	0.0301	0.0000	0.0000	-					
13	*P. euskircheni* **sp. nov.** GU256023 (ZFMK 81168, Mt.Nlonako)	0.0689	0.0689	0.0706	0.0689	0.0314	0.0301	0.0309	0.0286	0.0301	0.0000	0.0000	0.0000	-				
14	*P. johnstoni* GU256029 (ZFMK 87709, Campo)	0.0722	0.0722	0.0739	0.0722	0.0627	0.0635	0.0652	0.0656	0.0602	0.0794	0.0702	0.0702	0.0702	-			
15	*P. johnstoni* GU256028 (ZFMK 87710, Campo)	0.0706	0.0706	0.0723	0.0706	0.0610	0.0619	0.0635	0.0637	0.0585	0.0768	0.0686	0.0686	0.0686	0.0017	-		
16	*P. juliawurstnerae* **sp. nov.** GU256032 (ZMB 73694, Mt.Kupe)	0.0873	0.0873	0.0856	0.0873	0.0765	0.0736	0.0753	0.0706	0.0736	0.0997	0.0886	0.0886	0.0886	0.0903	0.0886	-	
17	*P. juliawurstnerae* **sp. nov.** GU256031 (ZFMK 67360, Mt.Kupe)	0.0925	0.0925	0.0925	0.0925	0.0736	0.0718	0.0718	0.0720	0.0719	0.1068	0.0944	0.0944	0.0944	0.0854	0.0831	0.0000	-

TABLE 4. (continued)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18	*P. juliawurstnerae* **sp. nov.** GU256030 (ZFMK 75590, Mt.Kupe)	0.0877	0.0877	0.0860	0.0877	0.0765	0.0739	0.0754	0.0706	0.0739	0.0998	0.0890	0.0890	0.0890	0.0906	0.0889	0.0034	0.0045
19	*P. palmipes* DQ283074 (Genbank, near Bipindi)	0.0908	0.0908	0.0925	0.0908	0.0820	0.0801	0.0785	0.0779	0.0836	0.0844	0.0854	0.0854	0.0854	0.0923	0.0905	0.1026	0.0989
20	*P. parkeri* GU256033 (ZFMK 87702, Mamfe)	0.0740	0.0740	0.0757	0.0740	0.0645	0.0635	0.0652	0.0613	0.0619	0.0846	0.0769	0.0769	0.0769	0.0669	0.0652	0.1003	0.0942
21	*P. parkeri* GU256034 (ZMB 73739, Okwangwo/Nigeria)	0.0757	0.0757	0.0773	0.0757	0.0628	0.0619	0.0634	0.0594	0.0602	0.0822	0.0753	0.0753	0.0753	0.0652	0.0635	0.0987	0.0920
22	*P. parkeri* DQ022363 (Genbank, Nguti)	0.0778	0.0778	0.0798	0.0778	0.0659	0.0678	0.0677	0.0645	0.0660	0.0843	0.0809	0.0809	0.0809	0.0702	0.0683	0.1056	0.1003
23	*P. parkeri* AF124132 (Genbank, Nguti)	0.0898	0.0898	0.0899	0.0877	0.0737	0.0762	0.0760	0.0724	0.0737	0.0854	0.0869	0.0869	0.0869	0.0738	0.0714	0.1172	0.1148
24	*P. perreti* GU256037 (ZMB 73734, near Nkongsamba)	0.0889	0.0889	0.0872	0.0889	0.0835	0.0803	0.0821	0.0782	0.0803	0.1016	0.0870	0.0870	0.0870	0.0920	0.0903	0.0284	0.0359
25	*P. perreti* GU256036 (ZMB 73737, Esipa Village)	0.0889	0.0889	0.0872	0.0889	0.0835	0.0803	0.0821	0.0782	0.0803	0.1016	0.0870	0.0870	0.0870	0.0920	0.0903	0.0284	0.0359
26	*P. perreti* GU256038 (ZMB 73731, Mt. Manengouba)	0.0889	0.0889	0.0872	0.0889	0.0835	0.0803	0.0821	0.0782	0.0803	0.1016	0.0870	0.0870	0.0870	0.0920	0.0903	0.0284	0.0359
27	*P. perreti* GU256035 (ZFMK 75524, Mt.Nlonako)	0.0889	0.0889	0.0872	0.0889	0.0835	0.0803	0.0821	0.0782	0.0803	0.1016	0.0870	0.0870	0.0870	0.0920	0.0903	0.0284	0.0359
28	*P.* sp. DQ283177 (Genbank, Rabi, Toucan Well Head/Gabon)	0.0783	0.0783	0.0801	0.0783	0.0641	0.0677	0.0677	0.0699	0.0642	0.0824	0.0695	0.0695	0.0695	0.0503	0.0520	0.0988	0.1018
29	*P. vulpiae* **sp. nov.** GU256044 (ZFMK 88859, Mt.Kupe)	0.0648	0.0648	0.0665	0.0648	0.0469	0.0475	0.0479	0.0461	0.0458	0.0625	0.0594	0.0594	0.0594	0.0391	0.0374	0.0899	0.0828
30	*P. vulpiae* **sp. nov.** GU256042 (ZFMK 88863, Big Massaka)	0.0638	0.0638	0.0655	0.0638	0.0470	0.0469	0.0480	0.0462	0.0452	0.0626	0.0586	0.0586	0.0586	0.0385	0.0368	0.0886	0.0828
31	*P. vulpiae* **sp. nov.** GU256043 (ZMB 73692, Big Massaka)	0.0638	0.0638	0.0655	0.0638	0.0470	0.0469	0.0480	0.0462	0.0452	0.0626	0.0586	0.0586	0.0586	0.0385	0.0368	0.0886	0.0828
32	*P. vulpiae* **sp. nov.** GU256039 (ZFMK 75588, Mt.Kupe)	0.0673	0.0673	0.0674	0.0673	0.0449	0.0461	0.0459	0.0458	0.0442	0.0623	0.0555	0.0555	0.0555	0.0405	0.0387	0.0823	0.0828
33	*P. vulpiae* **sp. nov.** GU256040 (ZFMK 81167, Mt.Nlonako)	0.0638	0.0638	0.0655	0.0638	0.0470	0.0469	0.0480	0.0462	0.0452	0.0626	0.0586	0.0586	0.0586	0.0385	0.0368	0.0886	0.0828
34	*P. vulpiae* **sp. nov.** GU256041 (ZFMK 81623, Mt.Nlonako)	0.0655	0.0655	0.0672	0.0655	0.0488	0.0486	0.0497	0.0481	0.0469	0.0626	0.0603	0.0603	0.0603	0.0401	0.0385	0.0903	0.0851

TABLE 4. (continued)

		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
18	*P. juliawurstnerae* **sp. nov.** GU256030 (ZFMK 75590, Mt.Kupe)	-																
19	*P. palmipes* DQ283074 (Genbank, near Bipindi)	0.1010	-															
20	*P. parkeri* GU256033 (ZFMK 87702, Mamfe)	0.1007	0.1029	-														
21	*P. parkeri* GU256034 (ZMB 73739, Okwangwo/Nigeria)	0.0990	0.1012	0.0017	-													
22	*P. parkeri* DQ022363 (Genbank, Nguti)	0.1056	0.1065	0.0000	0.0019	-												
23	*P. parkeri* AF124132 (Genbank, Nguti)	0.1173	0.1176	0.0022	0.0000	0.0021	-											
24	*P. perreti* GU256037 (ZMB 73734, near Nkongsamba)	0.0286	0.1079	0.1037	0.1020	0.1094	0.1246	-										
25	*P. perreti* GU256036 (ZMB 73737, Esipa Village)	0.0286	0.1079	0.1037	0.1020	0.1094	0.1246	0.0000	-									
26	*P. perreti* GU256038 (ZMB 73731, Mt. Manengouba)	0.0286	0.1079	0.1037	0.1020	0.1094	0.1246	0.0000	0.0000	-								
27	*P. perreti* GU256035 (ZFMK 75524, Mt.Nlonako)	0.0286	0.1079	0.1037	0.1020	0.1094	0.1246	0.0000	0.0000	0.0000	-							
28	*P.* sp. DQ283177 (Genbank, Rabi, Toucan Well Head/Gabon)	0.0990	0.0981	0.0886	0.0869	0.0893	0.0969	0.0972	0.0972	0.0972	0.0972	-						
29	*P. vulpiae* **sp. nov.** GU256044 (ZFMK 88859, Mt.Kupe)	0.0900	0.0831	0.0596	0.0579	0.0625	0.0717	0.0933	0.0933	0.0933	0.0933	0.0566	-					
30	*P. vulpiae* **sp. nov.** GU256042 (ZFMK 88863, Big Massaka)	0.0890	0.0836	0.0586	0.0569	0.0626	0.0718	0.0920	0.0920	0.0920	0.0920	0.0556	0.0000	-				
31	*P. vulpiae* **sp. nov.** GU256043 (ZMB 73692, Big Massaka)	0.0890	0.0836	0.0586	0.0569	0.0626	0.0718	0.0920	0.0920	0.0920	0.0920	0.0556	0.0000	0.0000	-			
32	*P. vulpiae* **sp. nov.** GU256039 (ZFMK 75588, Mt.Kupe)	0.0823	0.0780	0.0578	0.0559	0.0607	0.0701	0.0860	0.0860	0.0860	0.0860	0.0521	0.0000	0.0000	0.0000	-		
33	*P. vulpiae* **sp. nov.** GU256040 (ZFMK 81167, Mt.Nlonako)	0.0890	0.0836	0.0586	0.0569	0.0626	0.0718	0.0920	0.0920	0.0920	0.0920	0.0556	0.0000	0.0000	0.0000	0.0000	-	
34	*P. vulpiae* **sp. nov.** GU256041 (ZFMK 81623, Mt.Nlonako)	0.0906	0.0854	0.0603	0.0586	0.0646	0.0719	0.0937	0.0937	0.0937	0.0937	0.0573	0.0017	0.0017	0.0017	0.0020	0.0017	-

***Petropedetes euskircheni* sp. nov.**
Figs. 1d, 2d, 4, 6b, 7d

Holotype. ZFMK 75582 (adult male), Cameroon, Mt. Kupe, Nyasoso, 4°49'42N, 9°40'55E, app. 920 m a.s.l., 15.I.2000, coll. H.-W. Herrmann & A. Schmitz.

Paratypes. IRSNB-KBIN 1988 (male), Cameroon, Mt. Kupe, Nyasoso, 4°49'42N, 9°40'55E, app. 925 m a.s.l., 18.XII.1997, coll. O. Euskirchen; MHNG 2713.7 (male), Cameroon, Mt. Kupe, Nyasoso, 4°49'42N, 9°40'55E, app. 950 m a.s.l., 5.VII.2009, coll. A. Schmitz & M.F. Barej; MHNG 2713.11 (female), same data as holotype; ZFMK 67344 (female), same data as IRSNB-KBIN 1988; ZFMK 68152, (male), 68156 (female) Cameroon, Mt. Kupe, NW-slope, app. 910 m a.s.l., 4°49'42N, 9°40'55E, 18.XII.1997–03.I.1998, coll. A. Schmitz; ZMB 73693 (male), same data as ZFMK 68152.

Additional material examined. ZFMK 67347-348 (2 females), Cameroon, Mt. Kupe, Nyasoso, app. 920 m a.s.l., 19.XII.1997, coll. O. Euskirchen; ZFMK 68153-155 (1 male, 2 females), same data as ZFMK 68151; ZFMK 69207-208 (2 females), Cameroon, Mt. Nlonako, above Nguengue, app. 1100–1200 m a.s.l., 23.XI.-6.XII.1998, coll. ALSCO-Expedition; ZFMK 69497 (female), Cameroon, Mt. Nlonako, above Nguengue, app. 1200 m a.s.l., 2.XII.1998, coll. ALSCO-Expedition; ZFMK 75539 (female), Cameroon, Mt. Nlonako, Nguengue, app. 1100 m a.s.l., 18.-21.I.2000, coll. H.-W. Herrmann & A. Schmitz; ZFMK 75583 (subadult male), same data as holotype; ZFMK 78365 (female), Cameroon, Mt. Nlonako, Ekomtolo, 3.IV.2001, coll. H.-W. Herrmann *et al.*; ZFMK 81103 (female), Cameroon, Mt. Nlonako, XI.2000 – I.2001, coll. H.-W. Herrmann & M. Solbach; ZFMK 81168 (female), Cameroon, Mt. Nlonako, Ekomtolo, 24.VIII.2000, coll. M. Solbach.

Diagnosis. Large sized *Petropedetes*; robust body shape; tympanum rounded or slightly flattened on the upper and lower borders, almost equal to or larger than eye in males, always smaller than eye in females; characters of breeding males: tympanic papilla present (broad and fleshy), closer to upper border of tympanum; forearm hypertrophy strongly developed; carpal spike present; tegumental spinosities developed on throat, forearms and hardly on the anterior part of the dorsolateral side (Fig. 6b); femoral glands very small (smallest in Central African *Petropedetes*), usually shifted to the posterior part of the femur, glands can be indistinct in both sexes; webbing rudimentary.

Description of the holotype. The holotype is an adult male in breeding condition with a robust body shape and broad head; 54.9 mm SVL; snout in lateral view short, rounded; head width 22.4 mm; eye diameter 6.9 mm; interorbital distance 5.6 mm; naris closer to snout (3.5 mm) than to eye (5.4 mm); femur length 46.4 mm; tibia length 35.6 mm; foot (incl. longest toe) 46.6 mm; femoral glands small (length x width: 4.8 x 2.8 mm / 4.6 x 2.9 mm, holotype with especially large glands); femoral glands turned slightly to the posterior side of the femur; relation femoral gland length to femur length: 0.16; spinosities well developed on throat, upper lips and breast, upper forearms and flanks (Fig. 6b); dorsal skin texture heterogeneous with small warts and few larger, longitudinal warts; venter smooth; flanks with rough warts; webbing rudimentary; coloration of preserved specimen: dorsum pale, marbled with dark spots; hind limbs with transversal white lines, these continuing on lower legs; throat dark; venter whitish; femoral glands with few darker markings.

Variation. Large sized *Petropedetes* with robust body, second largest species of the genus; males larger than females (SUL in males: 44.3–62.0 mm, in females: 38.6–57.3 mm); mean head width in males 40% of SUL, in females 39%; snout in lateral view generally rounded, obtuse; *canthus rostralis* distinct but slightly rounded; loreal region concave; eye diameter about 1.5 times distance eye-nose; nose closer to snout tip than to eye; distinct tympanum, usually flattened on upper and lower border of tympanum (tympanum / eye in males: 0.97–1.19, in females: 0.49–0.85); tympanum surrounded by minuscule white warts; tympanic papilla close to upper border of tympanum; papilla broad and fleshy with oval basis; supratympanic fold distinct; fingers slender, with typically T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; manual webbing absent; palmar tubercle and thenar tubercle present; forearm hypertrophy strongly developed in males; carpal spike present in males, spinosities developed on throat, upper lips and forearms, few spinosities on dorsolateral parts of flanks; skin structure heterogeneous, larger warts on flanks; larger longitudinal warts present on dorsum, in some specimens arranged in lines; ventral skin smooth;

mean femur length in males 51% of SUL, in females about 53%; mean tibia length in males 60% of SUL, in females about 62%; mean foot length in males 80% of SUL, in females 82%; upper hind limbs moderate-slender; lower hind limbs slim femoral glands very small (smallest in genus), of similar size in both sexes (femoral gland / femur in males: 0.12–0.21, in females: 0.10–0.16); relative length of toes: IV > III > V > II > I; webbing rudimentary: 1 (1) 2 (1-1) 3 (2-2) 4 (3-3) 5 (2).

Coloration. Dorsum dull, most often brown-black or almost uniformly marbled brown-olive (Fig. 1d); thin white band between eyes, partly proceeded posteriorly by broader dark band; femora with dark spots, divided by thin pale lines; lines continuing on lower legs; venter whitish; femoral glands are coloured pale orange or brown, as hind legs; coloration in preservation: dorsum uniform, mainly blackish-grey; belly whitish with minuscule spots (less dense than in other species), throat dark or whitish with darker pigments in males, of same colour as belly or slightly darker pigmented in females.

Natural history. Specimens with unambiguous determination have been found in high numbers at a watercatchment at Mt. Kupe about 910 m altitude (Euskirchen *et al*. 1999, Fig. 7d). Adults and juveniles occurred in syntopy with *P. vulpiae* **sp. nov.** and *P. juliawurstnerae* **sp. nov.** Specimens of *P. euskircheni* **sp. nov.** were found at night on slippery, steep stones close to rapids or in the riverine vegetation on leaves in a height of 20–180 cm. Disturbed frogs flee into water.

Distribution. Currently, this species is only known with certainty from Mt. Kupe and Mt. Nlonako (Fig. 4). Specimens from the two localities differ slightly genetically, but form one clade compared to the remaining members of the genus (see below). Morphologically they are indistinguishable. The two populations are consequently regarded as conspecific herein. The type locality of the species is on Mt. Kupe.

Genetics. Morphologically, *P. euskircheni* **sp. nov.** resembles *P. parkeri*. To confirm the proposed species status a genetic comparison of the two species with uncorrected p-distances of the mitochondrial 16S rRNA gene (611 bp, including gaps) has been calculated. The differences for the two species are as follows: interspecific comparison of 16S rRNA ranged between 5.94-8.69% ($N_{euskircheni}$= 9, $N_{parkeri}$= 4); the intraspecific variation was 0.00%-3.14% (N= 9) in *P. euskircheni* **sp. nov.** and 0.00%-0.22% (N= 4) in *P. parkeri*. Thus the interspecific differences between these two taxa are well within the general range of interspecific genetic differences between other species of the genus (Table 4).

The intraspecific variation within the 16S rRNA of *P. euskircheni* **sp. nov.** was higher than in the other taxa. Specimens within the *P. euskircheni* **sp. nov.**-clade formed two locality based (Mt. Kupe and Mt. Nlonako) subclusters (Table 4). Calculated for each locality only, the specimens from each cluster showed the same low within site variability as in other Central African *Petropedetes* species (Mt. Kupe: 0.00%-0.39%; Mt. Nlonako: 0.00%; Table 4). The genetic differences between vouchers from Mt. Kupe and Mt. Nlonako could not be backed up with morphological characters. At present male specimens are only known from Mt. Kupe. As only males in breeding condition allow determination with certainty, we refrain from taxonomically distinguishing specimens from the Mt. Kupe and Mt. Nlonako. To ensure a clear taxonomic status for future work, only specimens from the type locality (Mt. Kupe) have been included in the type material.

Systematic remarks. *Petropedetes euskircheni* **sp. nov.** is rudimentary-webbed and therefore easily distinguishable from species with developed webbing (*P. palmipes* and *P. perreti*, both fully webbed; *P. cameronensis* and *P. juliawurstnerae* **sp. nov.**, both half-webbed). The presence of a distinct tympanum and a tympanal papilla distinguish *P. euskircheni* **sp. nov.** from *P. cameronensis* and *P. palmipes*, which lack these characters. In addition to this character it can be separated by the size of the femoral gland from *P. vulpiae* **sp. nov.** and *P. johnstoni*, which both possess larger femoral glands (in both sexes) (femoral gland length / femur length in males: $N_{euskircheni}$= 7, $N_{vulpiae}$= 35, p< 0.001; $N_{johnstoni}$= 7, p< 0.01 in females: $N_{euskircheni}$= 16, $N_{vulpiae}$= 16, p< 0.001; $N_{johnstoni}$= 4, p< 0.01). Moreover, males of *P. euskircheni* **sp. nov.** grow larger than *P. vulpiae* **sp. nov.** and *P. johnstoni* (SUL: $N_{euskircheni}$= 7, $N_{vulpiae}$= 35, p< 0.001; $N_{johnstoni}$= 7, p< 0.01).

Most likely the new species can be mistaken with *P. parkeri*. Both species are morphologically similar and have small femoral glands. However, the femoral glands are distinctly smaller in *P. euskircheni* **sp. nov.** Main distinguishing characters of *P. euskircheni* **sp. nov.** from *P. parkeri* are: a) the size of femoral gland: femoral glands are small but distinct in males of *P. parkeri*, while they are very small and more shifted to the posterior side of the limb in *P. euskircheni* **sp. nov.** (see Table 1); the femoral gland length / femur length ratio is smaller

in *P. euskircheni* **sp. nov.** than in *P. parkeri* (in males $N_{euskircheni}$= 7, $N_{parkeri}$= 11, $p < 0.01$; in females: $N_{euskircheni}$= 16, $N_{parkeri}$= 7, $p < 0.001$); b) the head width / SUL ratio in *P. euskircheni* **sp. nov.** is significantly broader (in males $N_{euskircheni}$= 7, $N_{parkeri}$= 11, $p < 0.01$; in females: $N_{euskircheni}$= 16, $N_{parkeri}$= 7, $p < 0.001$), although values overlap with *P. parkeri*; moreover the head shape is more flattened in *P. parkeri*, i.e. larger parts of the tympana are visible in dorsal view than in *P. euskircheni* **sp. nov.**; c) the tibia length / SUL ratio in *P. euskircheni* **sp. nov.** is higher in both sexes (in males $N_{euskircheni}$= 7, $N_{parkeri}$= 11, $p < 0.01$; in females: $N_{euskircheni}$= 16, $N_{parkeri}$= 7, $p < 0.001$); d) the foot length / SUL ratio in *P. euskircheni* **sp. nov.** is higher in both sexes (in males $N_{euskircheni}$= 7, $N_{parkeri}$= 11, $p < 0.01$; in females: $N_{euskircheni}$= 16, $N_{parkeri}$= 7, $p < 0.001$); e) the spinosity of the skin seems to be more developed on the dorsum of male *P. euskircheni* **sp. nov.** (as the exact breeding status of most vouchers is unknown, this character has to be used with caution); f) maximum snout-urostyle-length: *P. parkeri* are larger; up to 74 mm, the largest *P. euskircheni* **sp. nov.** male reaches 62 mm; however overall SUL does not differ significantly (p= 0.71) between the species; g) the shape of the tympanum is usually rounder in *P. parkeri* than in *P. euskircheni* **sp. nov.**, where it is slightly flattened or oval in three of four specimens (but less than in *P. vulpiae* **sp. nov.**).

Petropedetes euskircheni **sp. nov.** is most similar to *P. parkeri* and has been mixed up with the latter species (e.g. Euskirchen *et al*. 1999) in the past. The co-occurrence of two similar species makes a clear assignment of different localities to a taxon difficult (see above). Amiet (1983) mentiones *P. parkeri* from localities at higher elevations north of Mt. Kupe and Mt. Nlonako (from Foto Ndonchwet, Mbakang, Bangwa). As the only available male specimen in breeding condition from Bangwa (MHNG 1521.60) possesses large femoral glands, and no molecular comparisons could be applied, we tentatively assign these specimens to *P.* aff. *parkeri* (Fig. 4).

Etymology. The specific epithet *euskircheni* is a patronym. The species is named after Dipl.-Biol. Oliver Euskirchen, who accompanied A. Schmitz during fieldwork in 1997/98.

***Petropedetes perreti* Amiet, 1973**
Figs. 3c, 4, 8a, 9a, 10a, 11a, b

Petropedetes perreti Amiet, 1973, Bull. I.F.A.N. sér. A., 2: 463

Material examined. MHNG 1253.90 (holotype, formerly JLA 71.196) adult male, Cameroon, Mt. Manengouba, Nsoung, 1400-1500 m, 29.III.1971, coll. J.-L. Amiet; MHNG 961.64 (male), Cameroon, Mt. Manengouba, Nsoung, river Medjié, 1957, coll. J.-L. Perret; MHNG 1522.43 (male), Cameroon, Mt. Manengouba, Nsoung, 29.III.1973, coll. J.-L. Perret; SMF 52364 (female), Cameroon, Nkongsamba, 7.II.1955, coll. J.-L. Perret; ZFMK 69212, 69215, 69219, 69221, 69226 (5 males), 69211, 69213-214, 69216-217, 69223 (6 females), 69232 (tadpole), Cameroon, Mt. Nlonako, above Nguengue, app. 1100–1200 m a.s.l., 23.XI – 6.XII.1998, coll. ALSCO-Expedition; ZFMK 75524, 75526-28 (4 females),75530, 75532 (2 males), Cameroon, Mt. Nlonako, Nguengue, app. 1100 m a.s.l., 18.-21.I.2000, coll. H.-W. Herrmann & A. Schmitz; ZMB 73731 (female), Cameroon, Mt. Manengouba, Manengouba II, app. 1156 m a.s.l., 16.XI.2006, coll. N.L: Gonwouo; ZMB 73732 (male), Cameroon, Mt. Manengouba, Manengouba II, app. 1260 m a.s.l., 17.XI.2006, coll. N.L. Gonwouo; ZMB 73733 (female), Cameroon, Mt. Manengouba, Manengouba II, app. 1260 m a.s.l., 17.XI.2006, coll. N.L. Gonwouo; ZMB 73734 (female), Cameroon, near Nkongsamba, Plot East 002, app. 1525 m a.s.l., 08.VIII.2008, coll. M.-O. Rödel & N.L. Gonwouo; ZMB 73735 (male), Cameroon, near Nkongsamba, Plot East 002, app. 1225 m a.s.l., 10.VIII.2008, coll. M.-O. Rödel & N.L. Gonwouo; ZMB 73736 (female), Cameroon, near Nkongsamba, Plot East 002, app. 1225 m a.s.l., 17.VI.2008, coll. M.-O. Rödel & N.L. Gonwouo; ZMB 73737 (male), Cameroon, Esipa Village, 12.III.2006, coll. N.L. Gonwouo; ZMB 73738 (tadpoles), Cameroon, Mount Manengouba, 10.VIII.2008, mountain stream at 1225 m a.s.l., coll. N.L. Gonwouo & M.-O. Rödel.

Diagnosis. Medium sized *Petropedetes* with slender body; tympanum distinct, round, smaller or almost equal to eye diameter in males, distinctly smaller in females; white conical tubercles close to vent; characters

of breeding males: tympanic papilla present (long and slim), situated in the centre of the tympanum (Fig. 8a); forearm hypertrophy very weakly developed; carpal spike present; spinosities on inner side of arms and forearms (none on throat); femoral glands distinct in both sexes; glands of moderate size, elliptic shape; fully webbed (Fig. 10a).

Description. Medium sized *Petropedetes* with slender body; females slightly larger than males (SUL in males: 29.4–42.6 mm, in females 32.2–48.5 mm); mean head width in males about 40% of SUL, in females about 38%; snout rounded in lateral view; *canthus rostralis* distinct but slightly rounded; loreal region concave; eye diameter about 1.7 times distance eye-nose; nose closer to snout tip than to eye; distinct round tympanum; smaller or almost equal to eye in males, smaller in females (tympanum / eye in males: 0.77–1.06, in females: 0.47–0.71); tympanum encircled with minuscule white warts; tympanic papilla positioned in centre of tympanum; supratympanic fold distinct; fingers slender, with typically T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; manual webbing absent; palmar tubercle and thenar tubercle present, palmar tubercle sometimes indistinct; forearm hypertrophy moderate in males; carpal spikes present in males; spinosities in males on inner side of arms and forearms (not on throat); skin texture heterogeneous on dorsum and flanks; ventral skin smooth; mean femur length in males about 53% of SUL, in females about 51%, mean tibia length in males 58% of SUL, in females 56%; mean foot length in males 75% of SUL in females 73%; upper and lower hind limbs moderate; femoral glands distinct, but flat in both sexes; glands larger and slightly more prominent in males (femoral gland / femur length in males: 0.24–0.41, in females: 0.18–0.28; Fig. 9a); relative length of toes: IV > III > V > II > I; fully webbed (Fig. 10a; in few specimens webbing absent on posteriormost three fourth on the fourth toe [4 (0.75-0.75)], but then skin folds runs parallel to the last phalange to the tip of the toe).

Coloration. Dorsum marbled of brownish or greenish with black parts or more or less uniformly dark; dorsum speckled with white minuscule spots (Fig. 8a); iris speckled with gold and green; larger warts on flanks can be coloured brighter than surrounding parts; legs darker than dorsum; belly whitish; throat whitish or marbled with dark; femoral glands with dark marbling; femora above with large dark spots (almost bars), continuing on lower legs; coloration in preservation: dorsum mainly uniform brownish or black with very small white spots; belly yellowish.

Tadpole. The elongated tadpoles have an ovoid, flat, almost pointed body and a very long and muscular tail that exceed the body length by at least three times (Fig. 3c); only last third of tail with very narrow hyaline tail fins, the dorsal ones being a bit longer than the ventral ones; eyes very large and positioned almost dorsally (Fig. 11b); nostrils positioned slightly closer to the eyes than to the snout-tip; mouth positioned anteroventrally; keratodont formulae in stage 28 tadpoles (N= 5; total length appr. 20 mm) is 3+3//2+2:1; the keratodont formula of one tadpole (ZFMK 69232, Gosner stage 41) slightly differed: 3+3 //1+1:2; upper and lower jaw shaped like a narrow V; spiracle small, not visible in dorsal view; overall dorsal coloration consisted of a greenish brown, beset with minute bluish dots; along the vertebral line short reddish stripes discernible; venter almost uniform whitish. Stage 41 larvae (N= 3) had a body length of 12.7 mm (total length 36 mm) and very long hind legs (20.5 mm).

Natural history. *Petropedetes perreti* is a forest species (Herrmann *et al*. 2005), occurring along mountain streams above 1200 m and reaching altitudes over 1700 m. It is hence an element of Amiet's orophil fauna (Amiet 1973). Lamotte *et al*. (1959) report adults adhering with their bellies and limbs to stones in strong currents. This observation has also been made by Amiet (1975), who additionally found specimens on leaves of plants on the river sides. The clutch is deposited on rock surfaces within the splash zone of rapids and waterfalls, where the tadpoles develop (Amiet 1973, 1983, 1989). Males are found at night close to the clutch and appear to defend it (Amiet 1973).

We observed *P. perreti* at various sites on the eastern flanc of Mount Manengouba between 1200 and 1500 m a.s.l. along fast flowing mountain rivers. Some of these sites were already heavily degraded but still possessed at least some forest on the banks. Adults and juveniles could be observed at night sitting on stones amidst the torrent or some meters away from water (1-2 m above water on tree and palm trunks). One male was observed sitting on a clutch of approximately 84 eggs with white embryos. The clutch was deposited between mosses on a rock in the splash zone of a rapid, approximately 50 cm above the water surface. After

being disturbed, the male only moved a few cm from the clutch (Fig. 11a). At another locality we observed tadpoles moving and feeding on wet rocks in the splash zone of a waterfall during daytime (Fig. 11b). When approaching them, they only jumped away a few centimeters until they were again out of reach. Only when intensively disturbed did they jump into water.

Distribution. *Petropedetes perreti* is endemic to Cameroon. The species is found on the southern slopes of the Bamiléké Plateau, Mt. Manengouba and Mt. Nlonako (Fig. 4), areas which are characterized by a very high precipitation through the rainy season (Amiet 1973; Herrmann *et al*. 2005).

Genetics. The genetic comparison for the uncorrected p-distances of the mitochondrial 16S rRNA-fragment (Table 4) gave the following results for *Petropedetes perreti*: interspecific comparison between *P. perreti* and all other Central African *Petropedetes* taxa ranged between 2.84%-10.16%, while there was no intraspecific variation between the included sequences of the *P. perreti* vouchers (0.00%; N= 6). The lowest interspecific difference has been detected between *P. perreti* and *P. juliawurstnerae* **sp. nov.** ranging between 2.84%-3.59%, but species can be clearly differentiated on the morphological basis alone (see species description of *P. juliawurstnerae* **sp. nov.**).

Systematic remarks. *Petropedetes perreti* is one of to the two species of the genus with fully developed webbing. In contrast, *P. euskircheni* **sp. nov.**, *P. johnstoni*, *P. parkeri* and *P. vulpiae* **sp. nov.** show a mere rudiment of web. It can be easily distinguished from *P. palmipes* (fully webbed) and *P. cameronensis* (half-webbed) by its bigger and distinct tympanum and the tympanic papilla in males (see Fig. 8a, 8b, 8d). The most similar species is *P. juliawurstnerae* **sp. nov.** (see respective paragraph for distinguishing characters). Lawson (1993) notes the occurrence of *P. perreti* from the Rumpi Hills in western Cameroon. However, the taxonomic status of these frogs needs confirmation.

Etymology. The species has been named by Amiet (1973) to honour the herpetologist and former curator of herpetology at the Natural History Museum in Geneva Dr. Jean-Luc Perret.

***Petropedetes cameronensis* Reichenow, 1874**

Figs. 3b, 4, 8b, 9b, 10c, 12, 13

Platymantis cameronensis – Peters, 1875, Montasber. Preuss. Akad. Wiss. Berlin, 1875: 211
Hylambates cameronensis – Boulenger, 1882, Cat. Batr. Sal. Coll. Brit. Mus., Ed. 2: 137
Hylambates (*Platymantis*) *cameronensis* – Knauer, 1883, Naturgesch. Lurche: 111
Petropedetes cameronensis – Boulenger, 1900, Proc. Zool. Soc. London, 1900: 439
Petropedetes obscurus Ahl, 1924, Zool. Anz., 58: 81-82

Material examined. ZMB 8222 (holotype) adult female, 1872-1873, Cameroon, Bimbia, coll. A. Reichenow; MHNG 918.52 (male), Cameroon, Buea, Grand Soppo, 26.IX.1938, coll. R. Mertens & J.-L. Perret; MHNG 1522.32-34 (3 males), 1522.35-37 (3 females), Cameroon, Maholé, Mungo, 28.III.1973, coll. J.-L. Perret; MHNG 1521.40 (male), Cameroon, Buea, 29.XI.1972, coll. J.-L. Perret; MSNG 29891 (male), Cameroon, Mt. Cameroon, Buea, app. 800–1200 m a.s.l., VI.-VII.1902, coll. L. Fea; ZFMK 8798-99 (2 females), Cameroon, Viktoria, II.1973, coll. W. Böhme; ZFMK 14980 (female), Cameroon, Fako, Buea, 20.-22.III.1974, coll. W. Böhme & W. Hartung; ZFMK 15427 (male), Cameroon, Batoki, 28.II.1954, coll. M. Eisentraut; ZFMK 61343 (female), Cameroon, Ekundu-Kundu, 21.-27.II.l989, coll. M.T. O'Shea; ZFMK 69233 (female), Cameroon, Mt. Nlonako, above Nguengue, app. 1100–1200 m a.s.l., 23.XI.-6.XII.1998, coll. ALSCO-Expedition; ZFMK 78018 (female), Mt. Nlonako: Ekomtolo, app. 500 m a.s.l., XI.2000, coll. H.-W. Herrmann; ZFMK 78355-356 (2 males), 78360 (female), Cameroon, Mt. Nlonako, Ekomtolo, 1/5.IV.2001, coll. H.-W. Herrmann *et al*.; ZFMK 81153 (male), Cameroon, Mt. Nlonako, Ekomtolo, 27.V.2000, coll. M. Solbach; ZFMK 81154 (male), 18.VIII.2000, other data as ZFMK 81153; ZFMK 81555 (female), 81616-617 (2 males), 81614-615 (2 females), Cameroon, Mt. Nlonako: Ekomtolo, 3-7.II.2003, 4.V.2003, 10-11.XII.2002, coll. M. Plath; ZMB 21759, 55222 (2 males, syntypes of *Petropedetes obscurus* Ahl, 1924), Tscharra, Dana River, coll. Brenner; ZMB 73729-73730 (1 male, 1 female), Nigeria, Rhoko-forest, near Cross River National Park, II.2007, coll. A. Onadeko & M.-O. Rödel; ZMB 73727-72728 (2 females), Nigeria, Mbe Mountains, VI/VII.2005, coll. A. Onadeko.

Problematic material: ZSM 159/1988/1-2 (2 specimens, sex unknown), Cameroon, Victoria, II.1978, coll. F. Sauer.

Diagnosis. Small sized *Petropedetes* with compact body shape; snout short; tympanum very small, rather indistinct; characters of breeding males: tympanic papilla absent; carpal spike absent; forearm hypertrophy not developed; only Central African *Petropedetes* without spinosity; femoral glands oval shaped; toes approximately half-webbed: 1 (0) 2 (0-0) 3 (0-0) 4 (1.5-1.5) or 4 (2-2) 5 (0) or 5 (0.5) (Fig. 10c).

Description. Small sized *Petropedetes* with compact body; females distinctly larger than males (SUL in males: 26.8–34.8 mm, in females: 34.2–49.0 mm); mean head width in males about 37% of SUL, in females about 38%; snout in lateral view rounded to slightly pointed; *canthus rostralis* sharp; loreal region concave; eye diameter about 1.7 times distance eye-nose; nose closer to snout tip than eye; tympanum very small, rather indistinct in both sexes (tympanum / eye in males: 0.31–0.42, in females: 0.28–0.48); no tympanic papilla in breeding males; supratympanic fold distinct; fingers slender, with typically T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; manual webbing absent; palmar tubercle and thenar tubercle present, palmar tubercle sometimes indistinct; dorsal skin structure heterogeneous with larger warts on the flanks; few large and longitudinal warts on back; ventral skin smooth; mean femur length in males 51% of SUL, in females 52%; mean tibia length in both sexes 60% of SUL; mean foot length in both sexes 76% of SUL; upper hind limbs of moderate size; lower hind limbs slender; oval femoral glands larger in males than in females (femoral gland / femur in males: 0.30–0.50, in females: 0.22-0.31, Fig. 9b); no secondary sexual characters other than femoral gland size known; relative length of toes: IV > III > V > II > I; half-webbed species, toe IV with up to two phalanges free of webbing: 4 (1.5-1.5) or 4 (2-2); toe V with up to half phalange free of webbing: 5 (0) or 5 (0.5).

Coloration. Dorsum with pale spots or light brown colours (Fig. 8b); one specimen (ZFMK 78355) with dark brown ground colour and small pale dots of about 1 mm; iris golden; flanks can possess white coloured warts; legs coloured similarly as dorsum, but with larger dark bars; throat whitish or dark marbled; belly yellowish grey; coloration in preservation as in life but pale; belly whitish with minuscule speckles, the latter especially dense in the breast region, almost absent on abdomen (recognizable only with dissecting microscope).

Tadpole. According to Boulenger's (1906) figure of the mouth of an advanced *P. cameronensis* tadpole the labial-tooth-row formula is 2:1+1//1+1:2 (Fig. 3b); mouth bordered by papillae; papillae row with a median gap on lower lip. Schiøtz (1966) presents a tooth formula for a still tailed tadpole with fully developed hind limbs as 3+3//1+1:2. The tail length of this specimen is more than 2.5 as long as the body; tail without traces of ventral fin, only a very narrow dorsal fin (Schiøtz 1966).

The tadpole assignments of both authors appear reliable, as the species is easily recognizable by the extent of the webbing. Boulenger (1906) even lists another species in his work and Schiøtz (1966) additionally describes the call of adult specimens of *P. cameronensis*.

Natural history. *Petropedetes cameronensis* occurs mainly in the lowland, but is also known from localities up to 1400 m, where it was found together with *P. perreti* (Amiet 1973). On Bioko the species is known from mid-altitude, but may also occur in the coastal zone (Boulenger 1906; Mertens 1965). Schiøtz (1963) collects specimens at night on stones in a fast-flowing stream and Amiet (1975) finds the species in rapids and waterfalls. The call of *P. cameronensis* has been described as a whistle (Schiøtz 1966) or a trill that drowns the noise of torrents (Amiet 1989). Eggs of *P. cameronensis* are deposited on tree trunks or leaves close to humid rocks, where the saxicolous (living on rocks) tadpoles develop (Amiet 1989). Herrmann *et al*. (2005) observe males guarding clutches from February to May on Mt. Nlonako. Schiøtz (1966) assumes that the muscular tail without or only narrow fin allows the tadpole to jump on stones.

Distribution. In the original description the type locality is given as Bimbia, Cameroon, which has been specified by Perret (1984) as Bimbia, Victoria (= Limbe); and hence the coastal Cameroonian lowland south of Limbe. Schiøtz (1963) calls the type locality "Bimba, Cameroons", which is probably a misspelling. This mistake has been further developed as "Bima, Cameroons" by Frost (2009). *P. cameronensis* is also known from moderate altitudes (Lawson 1993), even reaching heights above 1100 m on Mt. Nlonako (Herrmann *et al*. 2005). The species is known from areas in eastern Nigeria (Schiøtz 1963; Perret 1984) and western

Cameroon (e.g. Boulenger 1906; Perret 1966; Fig. 4). Amiet (1973) assumes that the Sanaga River may be the species' eastern distributional border. *P. cameronensis* has also been recorded from Bioko (Boulenger 1906; Mertens 1965).

FIGURE 8. Life coloration of Central African *Petropedetes* with developed webbing: a) *Petropedetes perreti* (male: Mt. Manengouba, Cameroon; female: Nguengue, Mt. Nlonako, Cameroon), b) *P. cameronensis* (left: Limbe, Cameroon; right: Rhoko-forest, Nigeria), c) *P. juliawurstnerae* **sp. nov.** (male and female: Nyasoso, Mt. Kupe, Cameroon, d) *P. palmipes* (left male: Monte Alen, Equatorial Guinea; photo: I. de la Riva; right male: Bipindi, Cameroon; photo: H.-W. Herrmann).

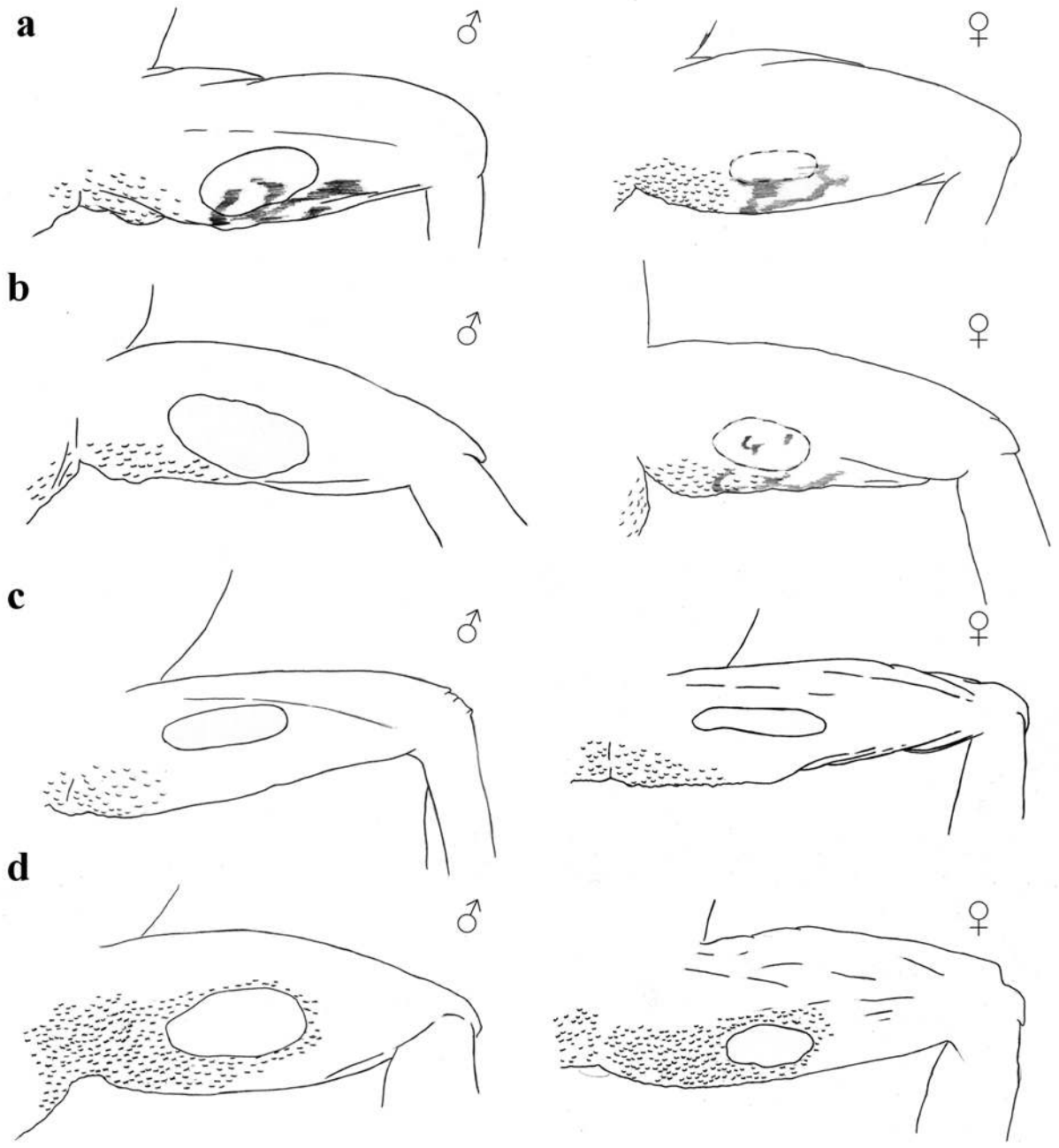

FIGURE 9. Relation of femoral gland to femur and shape of femoral gland in Central African *Petropedetes* with developed webbing: a) *Petropedetes perreti* (male: ZFMK 69215; female: ZFMK 69211), b) *P. cameronensis* (male: ZFMK 81616; female: ZFMK 81555), c) *P. juliawurstnerae* **sp. nov.** (male: ZFMK 67360; female: ZFMK 68134), d) *P. palmipes* (male: MHNG 1033.28; female: MHNG 1033.5).

Genetics. The genetic comparison for the uncorrected p-distances of the mitochondrial 16S rRNA-fragment (Table 4) gave the following results for *Petropedetes cameronensis*: interspecific comparison between *P. cameronensis* and all other Central African *Petropedetes* taxa ranged between 5.96%-9.25%, while the intraspecific variation within *P. cameronensis* was much lower at 0.00%-0.50% (N= 4).

Systematic remarks. Ahl (1924) describes *Petropedetes obscurus* from Tscharra, Dana River and distinguishes this half-webbed species from *P. cameronensis* by the size of its tympanum, which is only one third of the eye diameter in *P. obscurus* and half the diameter in *P. cameronensis*. Perret (1984) who studies the validity of *P. obscurus,* erroneously changes the type locality to Ishiara, Tana River, Kenya. Based on the morphology of the two syntypes (2 males: ZMB 21759, ZMB 55222) he concludes that the diagnostic

characters of Ahl (1924) are not sufficient and consequently placed *P. obscurus* in the synonymy of *P. cameronensis*. Our examination of the type specimen of *P. obscurus* confirmed Perret's (1984) decision. Hence, an affiliation of the two specimens to the East African *Arthroleptides*, as assumed by Klemens (1998), can be rejected. Both specimens clearly possess vomerine teeth, already mentioned in Ahl's description (1924, Fig. 12). The placement of the type locality into East Africa must, however be rejected. As such, the type locality remains mysterious. The only Tscharra that we found (www.fallingrain.com) is in Austria (zoogeographically impossible). There are various settlements called Dana in Nigeria, Cameroon, Chad and Central African Republic, however, all in the dry savanna regions.

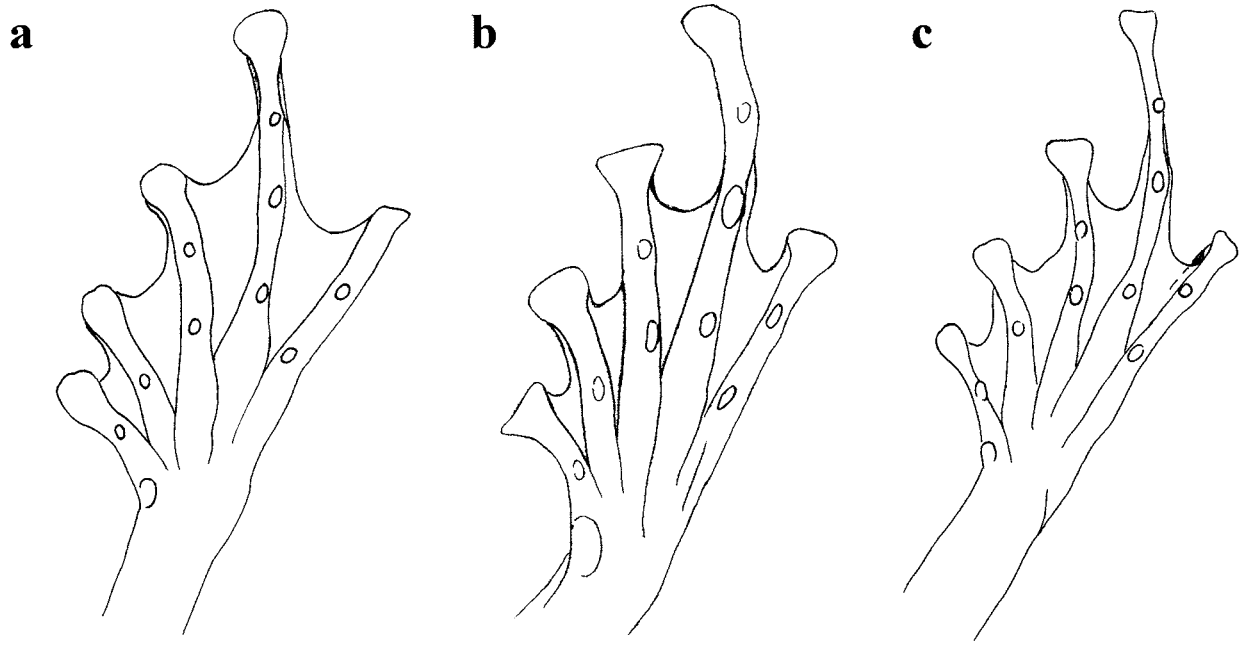

FIGURE 10. Development of webbing of a) *Petropedetes perreti* (ZFMK 69217), b) *P. juliawurstnerae* **sp. nov.** (ZFMK 68170), c) *P. cameronensis* (ZFMK 81555).

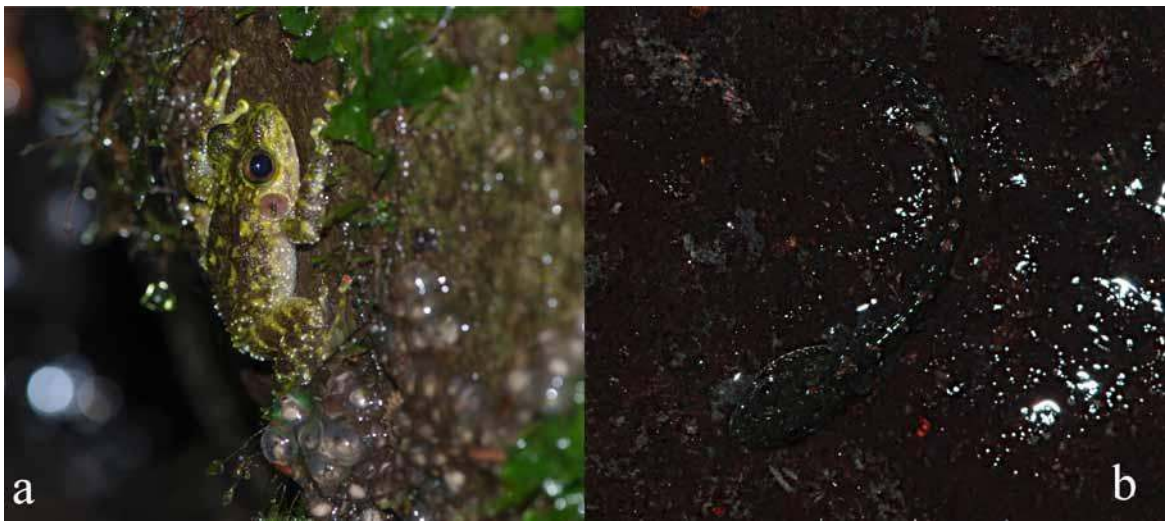

FIGURE 11. *Petropedetes perreti*: a) male guarding clutch and b) a tadpole (ZMB 73738); both from mountain streams at 1200-1500 m a.s.l., Mt. Manengouba, Cameroon.

Herrmann (1989) publishes a list of amphibian types in the Zoological Museum, Greifswald (ZIMG) and lists among others, *Petropedetes cameronensis*. He gives the "type locality" of this frog as Bonjongo. Our examination of this frog (Acc Cat I – 3411) revealed that it differs from the description of Reichenow (1874).

The holotype from ZIMG is bleached out and the femoral glands are hard to identify, but other characters are still recognizable. The tympanum does not possess a papilla, but although being smaller than the diameter of the eye, it is clearly distinct. An even more striking character differentiating this frog from Reichenow's description is the lack of webbing. These characters are already sufficient to show that this frog cannot be an additional *P. cameronensis* type. The ZIMG frog is also much smaller than the frog described and figured in Reichenow (1874). Whereas Reichenow (1874) mentions 120 mm, the ZIMG specimen reaches a length of only 82 mm from the tip of the snout to the tip of the toe (Fig. 13). The ZIMG specimen probably belongs to *P. johnstoni*, which would match with the locality on the foot of Mt. Cameroon. Apparently Herrmann (1989) lists a specimen collected by Buchholz in "Mai 73" (May 1873) from Bonjongo, but misidentifies it. The only identifiable type of *P. cameronensis*, collected by Reichenow (1874) himself is stored in the ZMB.

Petropedetes cameronensis is half-webbed and possesses an indistinct tympanum lacking a tympanic papilla in males. Hence, *P. cameronensis* is easy to distinguish from the rudimentary-webbed species with a tympanic papilla *P. euskircheni* **sp. nov.**, *P. johnstoni*, *P. parkeri* and *P. vulpiae* **sp. nov.** The species could potentially be mistaken with *P. palmipes* due to its indistinct tympanum, but differs from *P. palmipes* by its smaller size, less developed webbing (toes fully webbed in *P. palmipes*) and lacking a carpal spike (Amiet 1973). Although having a similar webbing, *P. cameronensis* can be unambiguously distinguished from *P. juliawurstnerae* **sp. nov.** alike (see the following species description).

FIGURE 12. Vomerines in *P. obscurus* (synonym of *P. cameronensis*) (marked by arrow; ZMB 55222).

***Petropedetes juliawurstnerae* sp. nov.**
Figs. 4, 6c, 7d, 8c, 9c, 10b, 14, 15

Holotype. ZFMK 67360 (adult male), Cameroon, Mt. Kupe: Nyasoso, 4°49'42N, 9°40'55E, app. 920 m a.s.l., 19.XII.1997, coll. O. Euskirchen.

Paratypes. IRSNB-KBIN 1989 (female), IRSNB-KBIN 1990 (male), Cameroon, Mt. Kupe, Nyasoso app. 950 m a.s.l., 4°49'42N, 9°40'55E, 6.VII.2009, coll. A Schmitz & M.F. Barej; MHNG 2713.12 (male), 5.VII.2009, other data as IRSNB-KBIN 1989; MHNG 2713.13 (female), same data as IRSNB-KBIN 1989); ZFMK 67357 (female), 2.I.1998, other data as holotype; ZFMK 67359 (female), 67987-990, 68170 (4 males), Cameroon, Mt. Kupe, NW-slope, app. 910 m a.s.l., 18.XII.1997-3.I.1998, coll. A. Schmitz; ZFMK 68131 (male), 68134-136 (3 females), app. 950 m a.s.l., other data as ZFMK 67987; ZFMK 75590 (female), 75591 (male), Cameroon, Mt. Kupe: Nyasoso, 4°49'42N, 9°40'55E, 15.I.2000, coll. H.-W. Herrmann & A. Schmitz; ZFMK 88866 (female), data as IRSNB-KBIN 1989; ZMB 73694 (male), ZMB (73695) (female), data as IRSNB-KBIN 1989.

FIGURE 13. Various *Petropedetes* specimens; from left to right: holotype of *P. cameronensis* (ZMB 8222); *P. cameronensis* "type" (ACC Cat I – 3411), and types of *P. obscurus* (ZMB 21759, ZMB 55222).

FIGURE 14. Typical dorsal pattern in *Petropedetes juliawurstnerae* **sp. nov.** (ZFMK 68170):

Additional material. ZFMK 67355 (male), Cameroon, Bakossi Mts., Meked, app. 625 m a.s.l., no date, coll. O. Euskirchen.

Diagnosis. Medium sized *Petropedetes*; slender body shape; tympanum round and distinct, smaller than eye diameter; characters of breeding males: tympanic papilla present, situated in the centre of the tympanum;

forearm hypertrophy only weakly developed; carpal spike present; femoral glands long and narrow, not round; a typical dorsal marking of light spots in the form of a flower with five petals recognizable in many specimens (Fig. 14); webbing moderate: 1 (0) 2 (0-0) 3 (1-1) 4 (2-2) 5 (0.5) (Fig. 10b).

FIGURE 15. X-rays of the holotype of *Petropedetes juliawurstnerae* **sp. nov**. (ZFMK 67360) with a developing bony carpal spike, not yet protruding the skin; right hand enlarged (scale 10 mm).

Description of the holotype. The holotype is an adult male with a slender body shape; 32.7 mm SUL; snout in lateral view rounded; head width 13.8 mm; eye diameter 4.8 mm; interorbital distance 3.2 mm; naris closer to snout (1.9 mm) than to eye (3.2 mm); *canthus rostralis* distinct but rounded; loreal region deeply concave; throat without spinosities (Fig. 6c); femur length 18.1 mm; tibia length 19.8 mm; foot (incl. longest toe) 24.4 mm; femoral glands large, long and narrow (length x width: 6.8 x 1.9 mm / 6.6 x 2.0 mm); relation femoral gland length to femur length 0.37; spinosity hardly developed on upper forearms; webbing of feet: 1 (0) 2 (0-0) 3 (1-0.5) 4 (2-2) 5 (0.5); coloration in preservation: overall colour brown-grey; white marking in shape of a 5-petal flower (indistinct); white warts on flanks, hind limbs and abdomen; upper hind limbs with white transversal bars, continuing on lower legs; ventral side whitish and pale, throat of same coloration with minuscule darker pigmented points; ventral surfaces of femora whitish with darker marbling, which covers in parts the femoral glands; lower leg ventrally with little marbling.

Variation. Medium sized *Petropedetes* with slender body; females being slightly larger (SUL in males: 29.5–38.9 mm, in females: 39.1–42.6 mm); mean head width in males 40% of SUL in females 39%; snout in lateral view rounded; *canthus rostralis* distinct but rounded; loreal region deeply concave; eye diameter about 1.8 times eye-narial distance; nose closer to snout tip than eye; distinct round tympanum, smaller than eye in both sexes (tympanum / eye in males: 0.66–0.8%, in females: 0.47–0.60); slender tympanic papilla situated in centre of tympanum (Fig. 8c); supratympanic fold distinct; fingers slender, with typically T-shaped fingertips;

relative length of fingers: III > IV > II > I; manual subarticular tubercles single; manual webbing absent; palmar tubercle and thenar tubercle present, palmar tubercle sometimes indistinct; forearm hypertrophy weakly developed in males; carpal spike present in males (well visible on X-rays; Fig. 15); spinosities in males weakly developed on upper forearms; dorsal skin heterogeneous with larger warts on flanks; dorsum with prolonged warts, less distinctly developed than in other species; ventral skin smooth; mean femur length in males 54% of SUL, in females 52%, mean tibia length in males 60% of SUL, in females 57%; mean foot length in males 76% of SUL, in females 75%; upper hind limbs of moderate size, lower hind limbs slender; femoral glands line-shaped, long and narrow, of almost similar length in both sexes (femoral gland / femur length in males: 0.36–0.51, in females: 0.32–0.41); relative length of toes: IV > III > V > II > I; half-webbed species, different webbing usually 3 (1-1), sometimes 3 (0.5-0) running along the 3rd toe, 4 (1.5-1.5) up to 4 (2-2) and 5 (0) or 5 (0.5); webbing of ZFMK 68170 (paratype) 1 (0) 2 (0-0) 3 (1-0) 4 (2-2) 5 (0).

Females of *P. juliawurstnerae* **sp. nov.** possess long femoral glands, which may make sex determination difficult. Females are best recognizable by their smaller tympana and more slender femoral glands (Fig. 9c).

Coloration. Dorsum brown with large greenish spots on head, or back dark brown without lighter spots, only light warts (Fig. 8c); iris golden; flanks with white warts; legs coloured as dorsum with greenish transversal bars; femoral glands pale orange or brownish; coloration in preservation: dorsum predominantly uniform grey or brown with few light, small spots; typical pattern of pale spots, resembling a flower with five petals, in most specimens recognizable; legs with thin white transverse lines.

Natural history. The species has been found at a water reservoir and close to small, fast flowing creeks at Mt. Kupe. The streambed was stony and the surrounding vegetation was a transition between primary and secondary rainforest. The frogs were sitting on slippery stones, overgrown by algae, or in the riverine vegetation at heights of 10–20 cm. On Mt. Kupe *P. juliawurstnerae* **sp. nov.** occurs in syntopy with *P. euskircheni* **sp. nov.**

Distribution. At present the species is only known from its type locality at Mt. Kupe and Meked on the adjacent Bakossi Mountains (Fig. 4).

Genetics. The genetic comparison for the uncorrected p-distances of the mitochondrial 16S rRNA-fragment (Table 4) gave the following results for *Petropedetes juliawurstnerae* **sp. nov.**: interspecific comparison between *P. juliawurstnerae* **sp. nov.** and all other Central African *Petropedetes* taxa ranged between 2.84%-12.39%, while the intraspecific variation within *P. juliawurstnerae* **sp. nov.** was much lower at 0.00%-0.90% (N= 5). The lowest interspecific difference has been detected between *P. perreti* and *P. juliawurstnerae* **sp. nov.** ranging between 2.84%-3.59%, but species can be clearly differentiated on the morphological basis alone (see below).

Systematic remarks. Mostly closely *P. juliawurstnerae* **sp. nov.** resembles *P. perreti* and *P. cameronensis*. It shares a tympanic papilla in the centre of the tympanum and a similar shape with *P. perreti* (Figs. 8a, 8c), and similar webbing with *P. cameronensis* (Figs. 10b, 10c). From the other species *P. juliawurstnerae* **sp. nov.** is distinctly different by its half-webbed toes; i.e. fully webbed in *P. palmipes* (additionally lacking the tympanal papilla) and rudimentary-webbed in *P. euskircheni* **sp. nov.**, *P. johnstoni*, *P. parkeri*, and *P. vulpiae* **sp. nov.** Breeding males of *P. juliawurstnerae* **sp. nov.** can be distinguished from other species with a tympanic papilla by the position of the papilla. Only *P. juliawurstnerae* **sp. nov.** and *P. perreti* have papillae in the centre of the tympanum. In all other species this papilla is positioned closer to the dorsal edge of the tympanum. The papilla of *P. juliawurstnerae* **sp. nov.** is broad at the end, when not shrivelled after preservation.

From the most similar two species, *P. perreti* and *P. cameronensis, P. juliawurstnerae* **sp. nov.** can be distinguished by the following characters: *P. juliawurstnerae* **sp. nov.** is smaller than *P. perreti* (SUL in males: $N_{juliawurstnerae}$= 12, $N_{perreti}$= 13, p< 0.001; in females: $N_{juliawurstnerae}$= 10, $N_{perreti}$= 15, p< 0.01). The tympanum diameter / eye diameter ratio is smaller in male *P. juliawurstnerae* **sp. nov.** (tympanum diameter / eye diameter in males: $N_{juliawurstnerae}$= 12, $N_{perreti}$= 13, p< 0.001), but does not differ significantly in females (p= 0.23). The webbing is less developed than in *P. perreti* (Figs. 10a, 10b): 1) webbing deeper notched in *P. juliawurstnerae* **sp. nov.**, 2) webbing always less developed on the fourth toe, where it usually leaves 1.5–2 phalanges free in *P. juliawurstnerae* **sp. nov.**; but only 0 or 1 free phalange in *P. perreti.* The femoral gland of

P. juliawurstnerae **sp. nov.** is long and narrow (stripe-like) in males and females. The femoral glands of *P. perreti* are more oval. The gland length / gland width ratio in *P. juliawurstnerae* **sp. nov.** is significantly larger (gland length / gland width in males: $N_{juliawurstnerae}$= 12, $N_{perreti}$= 13, p< 0.001; in females: $N_{juliawurstnerae}$= 10, $N_{perreti}$= 15, p< 0.001).

In contrast, *P. cameronensis* and *P. juliawurstnerae* **sp. nov.** do not differ in their size (males p=0.19; females p=0.29). *Petropedetes juliawurstnerae* **sp. nov.** can be distinguished from *P. cameronensis* by the size of the tympanum which is distinct in *P. juliawurstnerae* **sp. nov.**, but only rudimentary or even indistinctly developed in *P. cameronensis* (tympanum diameter / eye diameter in males: $N_{juliawurstnerae}$= 12, $N_{cameronensis}$= 16, p< 0.001; in females: $N_{juliawurstnerae}$= 10, $N_{cameronensis}$= 17, p< 0.001). *P. cameronensis* males lack the tympanic papillae present in breeding *P. juliawurstnerae* **sp. nov.** males. Especially in females, which do not carry a tympanic papilla, the similar webbing makes it difficult distinguishing the new species from *P. cameronensis*. In this case the shape of the femoral gland is the character best suited for species identification. The femoral glands are oval shaped in *P. cameronensis*; the gland length / gland width ratio in *P. juliawurstnerae* **sp. nov.** is significantly larger (gland length / gland width in males: $N_{juliawurstnerae}$= 12, $N_{cameronensis}$= 16, p< 0.001; in females: $N_{juliawurstnerae}$= 10, $N_{cameronensis}$= 17, p< 0.001).

Spinosities in examined specimens of *P. juliawurstnerae* **sp. nov.** seem not to be fully developed, therefore spines could be developed on the throat and more developed on upper forelimbs as well, as in other species (Fig. 6c).

Etymology. The specific epithet *juliawurstnerae* is a matronym. The name is dedicated to Mrs. Julia Anna Maria Wurstner (Bad Neuenahr-Ahrweiler, Germany), who accompanied the senior author during fieldwork in 2007 and supported his work from the beginning.

Petropedetes palmipes **Boulenger, 1905**

Figs. 3d, 4, 8d, 9d, 16

Petropedetes palmipes Boulenger, 1905, Ann. Mag. Nat. Hist., Ser. 7, 15: 282

Material examined. IRSNB-KBIN 13.840 (male), Gabon, Estuaire Province, Kango Department, 15 km north of Alen-Nkoma, right of route L107, 2004, coll. O.S.G. Pauwels; IRSNB-KBIN 14.936 (female), 14.937-14.939 (3 males), Gabon, Kinguélé, app. 80 m a.s.l., VI.2001, coll. O.S.G. Pauwels; IRSNB-KBIN 14.940 (male), Gabon, Province du Woleu-Ntem, Song, app. 360 m a.s.l., 25.VI.2001, coll. O.S.G. Pauwels; MHNG 961.68 (male), Cameroon, Mbikiliki, 18.I.1956, coll. J.-L. Perret; MHNG 1033.28-31 (4 males), 1033.32-33 (2 females), Cameroon, Mbikiliki, 1959, coll. J.-L. Perret; MHNG 1033.49-50 (2 males), 1033.51-52 (2 females), Cameroon, Bipindi, Abiete, 1969, coll. J.-L. Perret; ZFMK 28942 (female), Cameroon, Kribi, Efulen, 1906, coll. G.L. Rosenberg; ZFMK 73210-211 (2 females), Gabon, 18 km northeast of Barrage de Kinguélé, app. 165 m a.s.l., 25.-27.I.2000, coll. S. Lötters & V. Gossmann; ZMB 73891 Gabon (male), Province du Woleu-Ntem, Tchimbélé, app. 469 m a.s.l., 08.VI.2001, coll. O.S.G. Pauwels.

Diagnosis. Medium to large-sized *Petropedetes*; robust body shape; tympanum indistinct; breeding males without tympanic papilla; moderate forearm hypertrophy; carpal spike present; spinosities developed on whole body; moderate femoral glands prominent; toes fully webbed.

Description. Medium to large-sized *Petropedetes* with robust body; females growing slightly larger than males (SUL in males: 40.3–57.8 mm, in females: 37.5–54.7 mm); mean head width in males about 41% of SUL, in females about 37%; snout more pointed than in other species; *canthus rostralis* distinct but rounded, loreal region concave; eye diameter about 1.7 times eye-narial distance; nose closer to snout tip than eye; tympanum very small and indistinct (tympanum / eye in males: 0.18–0.23, in females: 0.20–0.25); no tympanic papilla; supratympanic fold distinct; fingers slender, with typically T-shaped fingertips; relative length of fingers: III > IV > II > I; manual subarticular tubercles single; manual webbing absent; palmar tubercle and thenar tubercle present, palmar tubercle sometimes indistinct; forearm hypertrophy moderately developed in males; carpal spike present in males; spinosities on whole body; dorsal surfaces with

heterogeneous skin structure, some larger warts on flank and back, otherwise skin texture on flanks and dorsum similar (Fig. 8d); ventral skin more granular than in other species; mean femur length in males 53% of SUL, in females 51%, mean tibia length in males 58% of SUL, in females 57%; mean foot length in males 73% of SUL, in females 72%; upper hind limbs of moderate size, lower hind limbs slender; femoral glands larger in males than in females (femoral gland / femur length in males: 0.26–0.38, in females: 0.22–0.31; Fig. 9d); relative length of toes: IV > III > V > II > I; toes fully webbed, on 4th toe sometimes slightly less developed 4 (0.5-0.5).

FIGURE 16. Clutch and tadpoles of *Petropedetes palmipes*; Monte Alen, Equatorial Guinea (photo: I. de la Riva):

Coloration. Dorsum uniformly dark; green and black with very few minuscule pale spots; throat whitish or dark marbled; upper hind limbs with pale, thin cross bars; coloration in preservation as in life, but pale. According to Lamotte *et al*. (1959) adults are of a glossy black colour in life, and therefore hard to find between stones. Boulenger (1905) describes them as dark olive above, spotted or marbled dark and light. Limbs bear broad dark bands and narrow light cross-bars, the ventral side is dirty whitish (Boulenger 1905).

Tadpole. Lamotte *et al*. (1959) describe the tadpoles of *P. palmipes*. Tadpoles were found in high numbers in small rocky pools at the foot of rapids. The general coloration of the tadpoles is grey on dorsum and flanks, a duller colour around eyes and nostrils; venter translucent, intestinal tract being visible (Fig. 3d); overall body shape flat; large eyes situated in the first third of body; tail almost twice as long as body and tail tip pointed; jaw sheats small, narrow and serrated; keratodont formula in younger stages 4:3+3//1+1:5, in older ones 3+3//1+1:2 (Fig. 3d). More developed tadpoles are darker than younger stages. Tadpoles do not exceed a total length of 35 mm (25 mm being tail; Lamotte *et al.* 1959).

Natural history. Very little data on the biology of this species has been published. Specimens were caught at night in primary forest among stones in a stream. Clutches were found glued to rocks (Fig. 16). Gossmann *et al*. (2002) explains that both eggs and larvae occur on submerged rocks. Lamotte *et al*. (1959) find tadpoles of *P. palmipes* in stagnant parts of rivers beneath small rapids. Schiøtz (1966) describes similarities in the morphology of advanced larval stages of *P. palmipes* and *P. cameronensis*, possessing identical teeth formulae. Schiøtz (1966) interprets the different tadpole mouth development as a change in biology, younger larvae being rheophilous and older ones semiterrestrial, scraping algae off stones. The full webbing of adults

points to a more aquatic life history, at least in post-metamorphs. The call of *P. palmipes* is not known (Amiet 1989).

Distribution. *Petropedetes palmipes* occurs mainly in lowland areas (Fig. 4). It has been found in southern Cameroon (Perret 1966), in Equatorial Guinea (de la Riva 1994; Lasso *et al*. 2002) and Gabon (Lötters *et al*. 2001; Pauwels & Rödel 2007). The *P. palmipes* record from western Cameroon by Perret & Mertens (1957) is based on a *P. perreti* specimen (not known at that time).

Genetics. The genetic comparison for the uncorrected p-distances of the mitochondrial 16S rRNA-fragment (Table 4) gave the following results for the single genetic voucher of *Petropedetes palmipes* which we could use for this gentic comparison: interspecific differences to *P. palmipes* and all other Central African *Petropedetes* taxa ranged between 7.80%-11.76%.

Systematic remarks. *Petropedetes palmipes* is one of two fully webbed Central African *Petropedetes* species; the other one being *P. perreti*. By the amount of webbing it can easily be differentiated from the half-webbed species *P. cameronensis* and *P. juliawurstnerae* **sp. nov.** and the rudimentary-webbed species *P. euskircheni* **sp. nov.**, *P. johnstoni*, *P. parkeri* and *P. vulpiae* **sp. nov.** *P. palmipes* can be easily distinguished from the fully webbed species *P. perreti* by the size of the tympanum, which is very small and rather indistinct in both sexes of *P. palmipes*, while it is large and distinct in *P. perreti* (Figs. 8a, 8d). In addition breeding males of *P. perreti* possess a tympanic papilla, which is lacking in *P. palmipes*.

Key to adult Central African *Petropedetes* species

1 toes fully webbed 2
1' toes half-webbed or rudimentary-webbed 3
2 tympanum distinct; in males ¾ of eye diameter or larger, males with tympanic papillae (Fig. 8a) and carpal spike in breeding season, tympanum in females up to ¾ of eye diameter; femoral glands large (larger in males) ..... *P. perreti*
2' tympanum indistinct in both sexes (Fig. 8d), small; males without tympanic papillae, but with carpal spike in breeding season; femoral glands large to very large (larger in males) ..... *P. palmipes*
3 toes half-webbed 4
3' toes rudimentary-webbed 5
4 tympanum distinct; males with tympanic papillae (Fig. 8c) and carpal spike in breeding season; femoral gland line shaped in both sexes (Fig. 9c) ..... *P. juliawurstnerae* **sp. nov.**
4' tympanum indistinct; males without tympanic papillae or carpal spike (Fig. 8b); femoral gland ovoid (Fig. 9b), larger in males ..... *P. cameronensis*
5 tympanum small but distinct, in males smaller or equal to eye diameter, in females tympanum less than half eye diameter (Fig. 1a); males with tympanic papillae and carpal spike in breeding season; femoral gland large ..... *P. johnstoni*
5' tympanum of moderate size or large and distinct, in males usually bigger than the eye, in females half the eye diameter or larger; males with tympanic papillae and carpal spike in breeding season; femoral gland very small to moderate 6
6 femoral gland of moderate size; tympanum in males usually oval shaped or flattened, males with tympanic papillae closer to the centre than upper border, carpal spike present in breeding season; females larger than males; species of moderate size (males: < 43 mm; females: < 47 mm) ..... *P. vulpiae* **sp. nov.**
6' femoral gland small or very small, shifted to the posterior side of the leg; tympanum in males rounded or flattened; males with tympanic papillae closer to upper border than to centre, carpal spike present in breeding season; large species (males: > 60 mm; females: > 50 mm) 7
7 femoral gland small but distinct (Fig. 2c), in males about 22% of femur length; tympanum in males ¾ of eye diameter or larger than eye, occurs in lower altitudes of south-western Cameroon and eastern Nigeria (Fig. 4) .... *P. parkeri*
7' femoral gland very small (smallest in genus Fig. 2d), in males only about 16% of femur length; tympanum in males as large as eye diameter, occurs in higher altitudes at Mt. Kupe and Mt. Nlonako (Fig. 4) ..... *P. euskircheni* **sp. nov.**

Discussion

Our revision of the Central African *Petropedetes* species revealed three new species described herein. One of them, *P. vulpiae* **sp. nov.**, was formerly known, but wrongly identified (as *P. newtonii*). As already indicated

by the results presented in this paper, the full species diversity in this genus is probably still not fully understood and it is likely that further undescribed species may exist.

The identification of previously overlooked cryptic species questioned the usefulness of some of the diagnostic characters provided in earlier descriptions. Currently only the secondary sexual characters of breeding males allow for an unambiguous determination in terms of morphological traits (Amiet 1973, 1983). Many characters, like the structure (granulation, spinosities) of the skin or the coloration, are not constant and most likely seasonally variable. Hence, identification of many juveniles, females and even immature males is often not not possible (Amiet 1983). A further problem is that some characters become less distinct or even disappear in preserved material. Characteristic morphological structures, allowing for species delimitation in the genus are: amount of webbing and femoral gland size and shape. The amount of webbing is visible in all ages and both sexes. Femoral glands however, are almost always more developed and larger in male specimens (Fig. 2, Fig. 9). These glands can be indistinct or externally not visible at all in females (du Bocage 1903; this paper). In some species the femoral glands are distinctly coloured and the size of the gland is easily discernible. In *P. parkeri* the glands show the same coloration as the shanks and consequently the gland is hardly visible at all in some specimens. Skin spinosities of breeding males may be diagnostic characters as well. However, they seem to vary seasonally and even males with fully developed tympanal papillae (hence, being potentially breeding individuals) of a particular species can exhibit different stages of this character. A further useful diagnostic character of the genus is the position of the tympanic papilla, which during the breeding season occurs in males of some species (*P. euskircheni* **sp. nov.**, *P. vulpiae* **sp. nov.**, *P. johnstoni, P. juliawurstnerae* **sp. nov.**, *P. parkeri, P. perreti;* Amiet 1973, 1983; this paper). Perret (1966) wrongly mentiones presence of papillae in *P. cameronenis*. However, this has already been clarified by Amiet (1973); although overlooked by Narins *et al*. (2001), who were the first to examine the function of this unique structure. Duellmann & Trueb (1994) believe that the papillae reduce the absorption of vibrations. Narins *et al*. (2001) discover that this fleshy protuberance contains a high number of exocrine glands and hypothesize a relation to special amplexus behaviour. However, they also suppose a function in the emission of the advertisement call.

Our current knowledge on the distribution of the different species is far from being complete. *P. euskircheni* **sp. nov.** is a cryptic species, morphologically similar to *P. parkeri. P. parkeri*-like specimens from the Yaoundé region in central Cameroon may belong to one of these two or to another similar looking species. Small morphological differences between populations of *P. parkeri* from western Cameroon and the Yaoundé region have already been presented by Amiet (1983). Based on his records of the species at higher elevations, Amiet (1983) doubts the lowland records of Sanderson (1936). Gartshore (1986) thinks that localities in the lowlands are probable; but states that the species was always at least recorded close to mountains. However, it is likewise possible that records from differing altitudes may actually comprise various cryptic species. Good examples of Cameroonian frog genera exhibiting altitudinal endemism are *Astylosternus, Cardioglossa, Leptodactylodon* and *Phrynobatrachus* (Amiet 1972, 1977, 1980; Blackburn 2008; Zimkus 2009). Future research should pay attention to *Petropedetes* aff. *parkeri* from Gabon and Equatorial Guinea. The Sanaga River is known as a geographic barrier for amphibians (Amiet 1987) and mammals (Quérouil *et al*. 2003; Telfer *et al*. 2003), restricting geneflow or having already resulted in sibling species occurring on one or other side of the river (Amiet 1987).

At present the only species with a larger distribution is *P. vulpiae* **sp. nov.** However, the taxonomic status of various populations, others than those of the type locality, needs to be verified by means of genetic, acoustic and morphological investigations. Amiet (1987) mentions, referring to them as *P. newtonii,* that it is impossible to provide morphological differences between eastern and western populations of this continuously distributed species. In contrast to this statement, Amiet (1987) reports differences within the structure of the mating call between populations. Such differences may be taken as a hint on distinct species, even if these are morphologically very similar (Heyer *et al*. 1996; Channing *et al*. 2005).

In addition to the species described herein, the existence of at least one more undescribed species from Gabon can be assumed. Currently it is only known to us by its DNA sequence (GenBank No. DQ283177; 16S rRNA, specimen RABI 033). It has been falsly included as *P. newtonii* in the Frost *et al*. (2006) tree.

Unfortunately no vouchers were available to us. Genetically this species is related to *P. johnstoni* and *P. vulpiae* **sp. nov.** (Table 4). It might thus be a species, morphologically similar to one of them.

Burger *et al*. (2004) reports on a *Petropedetes* sp. from a forest stream at 350-660 m a.s.l. on Monts Doudou and states that these frogs differ from *P. vulpiae* **sp. nov.** (referred to as *P. newtonii*) and the other two species from Gabon (*P. palmipes* and *P.* aff. *parkeri*), however, without providing distinctive characters. The figured frog (fig. 14 in Burger *et al*. 2004) shows no webbing and a tympanum smaller than the eye. The tympanum lacks a papilla. Hence, it might be a female, a subadult male or a male without typical breeding characters. Overall this frog resembles *P. johnstoni* in its coloration and habitus, being in accordance with the upper altitudinal range of this lowland species. At present *P. johnstoni* is not known from Gabon. However, the status of these frogs requires further morphological and genetic investigation.

Further *Petropedetes* populations with uncertain taxonomic status exist. Joger (1982) reports on *Petropedetes* sp. from northern Cameroon north of Ngaoundéré. Unfortunately he collected only a female and some juveniles (ZFMK 19591-592, ZFMK 19654-657). These specimens are characterized by a webbing in-between rudimentary and half-webbed [webbing formula: 1 (1) 2 (1-0.75) 3 (2-1.5) 4 (2.5-2.5) 5 (1)]. Additional populations of *P. cameronensis* and *P. johnstoni* should be checked as well. Both species have been described from the mainland. *P. newtonii,* the synonym of *P. johnstoni,* however, was based on material from Bioko. It thus should be tested whether populations from Bioko and the mainland may represent separate taxa. In general it is not unlikely that further cryptic species with a very restricted distribution exist. This especially concerns montane taxa (for recent examples compare e.g. Rödel *et al.* 2004b; Blackburn 2008). One example for such a taxon is *P. juliawurstnerae* **sp. nov.**, currently known only from a small area at Mt. Kupe and the Bakossi Mountains. *P. euskircheni* **sp. nov.** has a similar distribution, however, also including Mt. Nlonako. Dowsett-Lemaire & Dowsett (1999) report on "*P. parkeri*" from Mt. Kupe and Bakossi Mts. Hence, it cannot be ruled out, that *P. euskircheni* **sp. nov.** occurs on the nearby mountain range.

Unfortunately ecological data of Central African *Petropedetes* species are still scarce. Due to the partly complex situation of use and misuse of names, including the existence of previously undescribed species, the affiliation of available data to a particular species name is often difficult. The best studied species is probably *P. parkeri*, which has been investigated by Sanderson (1936) and Parker (1936) for a period of more than one breeding season. Both authors referred to it as *P. johnstoni.* They provided morphological characters of both sexes in different stages of maturity. A short description of the courtship behaviour of *P. parkeri* has been published by Narins *et al*. (2001) and a more detailed study on the mating and courtship behaviour is in preparation (L. Minter *pers. comm*.). Data on *P. parkeri* collected by Amiet & Perret (1969, referred to as *P. newtonii*) and Amiet (1975, 1983, 1986, 1989) will be only assignable to a particular name, when populations of these localities are taxonomically verified by genetics. As far as biological data of Central African *Petropedetes* are known, it seems that the following characters occur in all species: the amplexus is initiated outside of water. Male secondary sexual characters such as the brachial hypertrophy, development of minuscule spines in the pectoral and gular region, as well as on flanks and dorsum and a bony carpal spike and / or tympanic papillae may help ensuring a better grip during the amplexus and/or to prevent slipping down on the steep and slippery structures where clutches are deposited (Amiet 1989). Males of different species are known to stay close to the clutch during night, a male *P. perreti* has been even found on the clutch (M.-O. Rödel *pers. obs*.). A male of *P. johnstoni* has been likewise found near a clutch during the day, but it is uncertain as to whether it guarded the clutch or not (Amiet 1989, 1991; Herrmann *et al*. 2005). This species seems to be exceptional in some respects. Eggs have been found on a leaf in the forest, hence *P. johnstoni* might, in contrast to other known congeners, have a reproduction mode independent of the splash water zone (Amiet 1983, 1989). Tadpoles figured by Lawson (1993) probably belong to this species. However, Amiet's (1989, 1991) interpretation of a semiterrestrial tadpole has not yet been verified and needs further investigations.

Petropedetes tadpoles exhibit a characteristic morphology, adapted to their life on moistened rock surfaces. Their habitus is pear-shaped, the big eyes are situated dorsally, and the tail is long and very muscular, but lacks or only has very narrow fins (Lamotte *et al*. 1959; Schiøtz 1966; Amiet & Perret 1969; Amiet 1983, 1989; this paper). *Petropedetes* tadpoles mostly live on rocks within the spray zone of rapids and waterfalls

where they feed on algae. As a result of the lacking or narrow fin, *Petropedetes* tadpoles are bad swimmers (Amiet & Perret 1969). However, narrow tail fins are also usual adaptations of torrenticol tadpoles. When disturbed *Petropedetes* tadpoles prefer flipping away on the rock surfaces, using curved feather-like movements of their tails. Only under severe danger do they jump into water (Amiet 1983, 1989; this paper). In contrast, the West African *P. natator* tadpoles possess dorsal and ventral tail fins and sucker like mouth parts. They attach themselves to rocks most often directly within the strongest current of rapids and waterfalls (Lamotte & Zuber-Vogeli 1954; M.-O. Rödel *unpubl. data*). The known Central African *Petropedetes* tadpoles have been reported to have a very early development of the posterior extremities, a further hint on a more terrestrial life as extremities hinder good swimming performance (Wassersug & von Seckendorf-Hoff 1985).

At the moment *Petropedetes perreti* and *P. palmipes* are regarded as Endangered, *P. cameronensis*, *P. johnstoni* and *P. vulpiae* **sp. nov.** (referred to as *P. newtonii*) as Near Threatened and only *P. parkeri* as Least Concern (IUCN 2008). The population trend is stated as decreasing for all species except that of *P. johnstoni*, where data are not sufficient. The status of *P. parkeri* should be revised, given that we herein described *P. euskircheni* **sp. nov.** as a distinct species and further populations from Gabon and Equatorial Guinea are of uncertain taxonomic status. The uncertain distributions and the lack of biological knowledge of most species shows a need for future research, including the collection of up to date data on the conservation status of all species.

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Appendix I. Assignments before official naming and problematic assignments of Central African *Petropedetes* (order following present work)

Petropedetes johnstoni (Boulenger, 1888 "1887")
Problematic assignments:
Perret (1966): corresponds probably to *P. parkeri*, due to the locality Mamfe
Amiet (1973): corresponds to *P. parkeri* and *P.* aff. *parkeri*
Durette-Desset & Vaucher (1979): corresponds probably to *P.* aff. *parkeri*
Herrmann *et al*. (2005): altitude not suitable with species ecology

***Petropedetes vulpiae* Barej, Rödel, Gonwouo, Pauwels, Böhme and Schmitz, 2010**
Assignments before official naming of species:
in general referred to as *P. newtoni* concerning specimens on the mainland.
Amiet & Perret (1969): *P. newtoni* corresponds to *P.* aff. *parkeri* (locality close to Yaoundé) (see Amiet 1973, 1983)

Petropedetes parkeri Amiet, 1983
Assignments before official naming of species:
Parker (1936): referred to as *P. johnstoni*
Sanderson (1936): referred to as *P. johnstoni*
Perret (1966): referred to as *P. johnstoni*
Amiet (1973): referred to as *P. johnstoni*

***Petropedetes euskircheni* Barej, Rödel, Gonwouo, Pauwels, Böhme and Schmitz, 2010**
Assignments before official naming of species:
Euskirchen *et al*. (1999): referred to as *P. parkeri*
Herrmann *et al*. (2000): referred to as *P. parkeri*
Plath *et al*. (2004): referred to as *P. parkeri*
Herrmann *et al*. (2005): referred to as *P. parkeri*

Petropedetes perreti Amiet, 1973
Assignments before official naming of species, problematic assignment:
Perret & Mertens (1957): as *P. palmipes*
Lawson (1993): *P. perreti* from Rumpi Hills, locality unsure

Appendix II. Gazeteer

Abiete (2°55’00N, 10°30’00E), Amebishu (5°53.866’N, 09°33.495’E), Atolo (6°10’60N, 09°28’00E), Bashau (5°43’00N, 09°25’00E), Batoki (4°02’30N, 09°06’21E), Big Massaka (4°41’44N, 09°17’31.4E), Bimbia (3°57’16N, 09°14’42E), Bipindi (3°04’60N, 10°25’00E), Buea (4°39’34N, 09°14’12E), Ebolowa (2°53’60N, 11°09’00E), Efulen (2°46’60N, 10°31’60E), Ekomtolo (4°49’49N, 09°54’43E), Ekundu-Kundu (5°09’00N, 08°52’60E), Esipa Village (4°02’N, 09°90’E), Grand Soppo (4°09’17N, 09°14’34E), Kala (3°51’00N, 11°22’00E), Kinguélé (0°27’N, 10°16’E), Mahole (4°49’28N, 09°36’32E), Makai (3°55’60N, 10°54’00E), Mamfe (5°46’00N, 09°16’60E), Manengouba II (4°58.18’N, 09°52.24’E), Mbe Mts. (6°15’268N, 09°04’685E), Mbikiliki (3°10’60N, 10°33’00E), Mts Doudou Reserve (2°13.63’S, 10°23.67’E), Musola (3°25’60N, 08°36’00E), Mt. Kupe (4°48’N, 09°42’E), Mt. Manengouba (4°58.786'N, 09°53.695’E), Nguéngué (4°55’02”N, 09°59’21”E), Nguti (5°19.9’N, 09°24.8’E), Nkoelon (2°23.830’N, 10°02.790’E), Nkoétyé (2°52’00N, 11°19’00E), Nkongsamba (4°57’12N, 09°55’57E), Nsoung (4°59’12N, 09°49’04E), Nyasoso (4°49’42N, 9°40’55E), Okwangwo (6°26’754N, 9°18’304), Ototomo (3°38’60N, 11°19’00E), Plot East 002 (4°58.787’N, 09°53.722’E), Rio del Rey (4°43’60N, 8°39’00E), Rhoko Forest (5°41.014N, 8°16.502E), Sakbayémé (4°01’60N, 10°34’00E), Song (0°38’N, 10°16’E), Tchimbélé (0°37’N, 10°24’E), Victoria (= Limbe) (4°00’46N, 9°13’13E).